Steve
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The Classic Collection
TRANSCRIBED

Aeroallergen
PhotoLibrary™

Welcome

The Aeroallergen PhotoLibrary is a wonderful resource for all those wishing to better understand the world of allergy. This informative project contains everything one needs to become proficient in identifying aeroallergens within the northern hemisphere.

Many years of active research were required to accumulate the knowledge contained within. Aerobiology is an emerging science, and we truly hope that our PhotoLibrary will assist clinicians and university investigators in their educational efforts.

In 1999, Steve Kagen visited Walter Lewis in St. Louis and suggested the idea of immortalizing a small portion of Lewis' botanical knowledge in a digital format by placing some of his plant and pollen photos on a CD. Several years later, and with thousands of hours of effort, the project grew to include every aspect of multimedia, audio files, an Internet home for the PhotoLibrary, interactive quizes, and Estelle Levetin's mold spore expertise as well. There is today no better resource of aeroallergen information available.

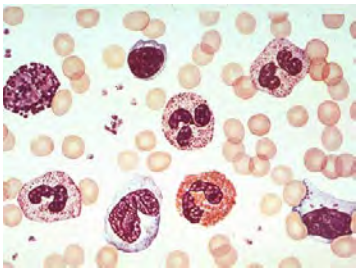
We truly hope that you will benefit from our Aeroallergen PhotoLibrary of North America.

Steve Kagen, M.D.

Walter H. Lewis, PhD

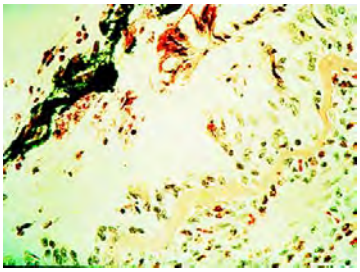
Estelle Levetin, PhD

Chapters



INTRODUCTION TO CELLS

In the next several slides under Cells, these are not allergens but these are the results of interactions with allergens happening within the human body. You will find a microscopic view of a lung biopsy of a patient who died from a fatal asthma attack. We are also going to show you what the IgE antibody really looks like and other antibodies and importantly you will get to see a mast cell. Also we will show you where eosinophils are found within the human body. Enjoy this section on cells here in the Aeroallergen PhotoLibrary of North American.



001 MIC LUNG BIOPSY IN FATAL ASTHMA

This is a light microscope view of a patient's lung after a fatal attack of asthma. I can't point it out to you, but I'll describe it for you. There are too many cells in this slide; it's congested. There is inflammation. Too many cells accumulating, producing too much mucus and plugging the airway. This inflammation did not occur overnight. This patient was under treated for a number of months, and this inflammation, this swelling, produced spasm of the airways - closing the airways making it difficult to breathe. She had been sleeping with her bronchodilator rescue medication in her hand, waking up, taking a puff, hopefully feeling better, and she never made it to the Emergency Room. Any patient who uses albuterol type medications in the evening hours is out of control and needs inhaled or systemic steroids to control this inflammatory reaction you see here in the lung.

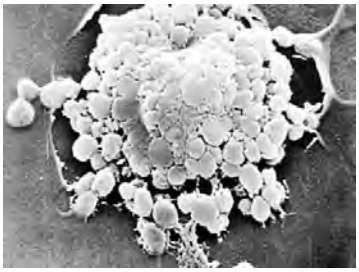
002 IgE - IMMUNOGLOBULIN E

This is a slide that shows you a computer generated model of IgE, the allergy antibody. IgE was the 5th antibody, discovered by Dr. Ishizaka and Dr. Ishizaka in 1966. This antibody acts like a fuse on an allergy bomb, interacting with antigen on the top 'dog eared' panels, on the top right and left, and then causing activation of a mast cell with subsequent release of cellular chemicals that produce immediate symptoms of allergy.

003 IgG SUBCLASSES

Here is a view of the four IgG subclasses. On the top right is IgG subclass 4. This antibody looks a lot like IgE, and in some patients there have been reports that IgG subclass 4 may induce allergic symptoms. On the far left is IgG subclass 1, the long necked IgG subclass 2 is second in line from the left, and IgG subclass 3 is the smaller one, third from the left. Fifteen percent of the "normal" population has a deficiency of IgG subclass 4. This does not mean that they have a disease, only that they are deficient in making "normal amounts" of that IgG subclass.

004 EM HUMAN MAST CELL

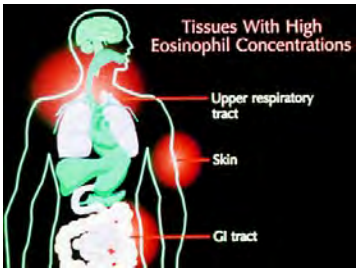


This is an EM view of a human mast cell showing the circular granules that are preformed as they are being released from this cell. Each one of these granules contains different chemicals like histamine and leukotrienes, all of which can cause immediate symptoms of itching, swelling, coughing, sneezing and burning. If you have this cell, or this allergy bomb, releasing its contents in the skin, it produces itching and hives. If it is happening in the lung, we call it asthma. If this allergic reactivity occurs in the nose, it is called hay fever or allergic rhinitis. And remember on the outside of this cell there is an IgE antibody just waiting to react. Now, for some people, the mast cells actually do not have IgE antibody causing the problem, but the mast cell itself is sensitive; so some patients even without allergy antibody mechanisms can have release of chemicals like histamine to cause symptoms. These patients are hypersensitive. They become sick easily.

005 EM MAJOR BASIC PROTEIN

This is an electron microscope view of major basic protein taken by Dr. Gerald Gleich at the Mayo Clinic. Major basic protein lives up to its name and is very basic. It is very negatively charged. It is one of the most negatively charged proteins that have ever been discovered in science. Being that it is very negatively charged, it can rip up membranes and it can destroy cells. Therefore, it is a very useful protein to have to fight off infections like parasites. This protein, major basic protein, when insufflated or puffed into the lungs of guinea pigs can reproduce the fatal pathology we see of fatal asthma attacks. So major basic protein is a very important thing to know about, it's on the inside of eosinophils, which are cells that find their way into allergy reaction regions of the body.

701 MAC EOSINOPHIL DISTRIBUTION



Here is an artist's perception of where in the body eosinophils can be found in high concentrations. Now where did eosinophils go? They go to regions of the boundary, the boundary on our skin, the boundary in the mucus membranes of the lung, the nose, the sinus and the gut. So eosinophils seem to find their way to areas that produce allergy reactions. Allergies in the skin like hives, allergy in the gut can occur with inflammatory bowel disease or food allergic reactions, and in the upper respiratory tree the nose, the sinus, the lung we are talking about hay fever and asthma. So tissues with high eosinophils concentrations can have more inflammation. Now when I was in medical school I was taught a lot of lies. And one of the lies I was taught was that eosinophils were the good guy. The eosinophils come into the body wherever there is inflammation due to allergy and they "clean up the mess". While we now know that eosinophils comes into an allergic reaction within the body and it brings with it certain proteins, like major basic protein, that can disrupt and change the normal anatomy. So if you have in your lungs as an asthma sufferer too many eosinophils for a long period of time, those eosinophils will help to change the structure of your lung and you can move from asthma to a form of fixed airway disease or emphysema. So the eosinophils are an important cell to know about. Here is where they are in the human body.

Ferns

006 MAC BRACKEN FERN

The Bracken fern is a common plant throughout the world. One could say it is cosmopolitan in distribution and this particular species is often found in very disturbed worked over areas as sort of a fern weed.

007 MAC HORSETAIL

Horsetails are a group of plants that are related to the ferns and we call them fern-allies. This particular one is a perennial and the plant will grow up to a 4 or 5 feet in dense clusters. The leaves are like, just thin and like a horsetail, hence the common name and then the fertile branches are as you see here just a green stem without any leaves. The leaves are very much reduced and these are terminated by stroboli and you see two of these, which produce the spores which become airborne.

011 MAC CLUB-MOSS

The Club-Moss is a small plant found in forests and along streams. The herb is perhaps a maximum of about a foot quite widely branched and terminates with the stroboli in which the Club-Moss produces the spores, which are becoming airborne.

854 MIC HORSETAIL SPORE

The Horsetail spore is fairly unique. It is fairly large it can be about 15 microns in diameter and very circular and has bodies which we call elaters which are long strands of cells that surround each pore. These spores can be easily identified by the elaters.

855 MIC CLUB-MOSS SPORE

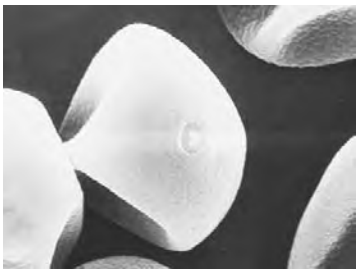
The Club-Moss spore is about average in size 30 to 40 microns round and has a very reticulated and most distinct spore wall, which is easy to identify the Lycopodiums. It is trilete and has one or vague apertures.

856 MIC BRACKEN FERN

The Bracken fern spore is typical of many of the ferns in that you have a trilete morphology, you have a very obscure single pore or sometimes the pore is not obvious at all. The wall of the spore is irregular and rough-like, and that's about the main features of the fern.

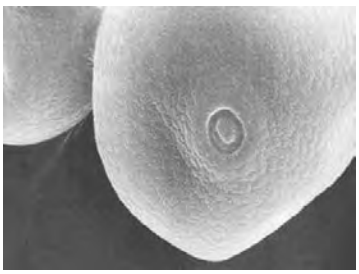
Grasses

013 EM BERMUDA GRASS POLLEN



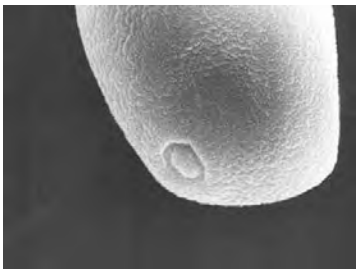
This is a SEM image of the Bermuda grass pollen and again you can see the clear single pore and what it looks like in the center of the grain and the rather smooth surface. The collapsing on the one side of this grain is an artifact due to the SEM technique.

021 EM BAHIA GRASS POLLEN



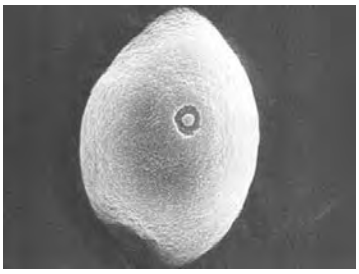
Bahia grass EM photo clearly shows the smooth if not even wall of the grain together with this single pore of the whole grain which has a plug and it has an annulus or ring which you can seen outlined around the whole pore. This is an important and significant source of grass allergens in the Southeast.

022 EM GRASS POLLEN



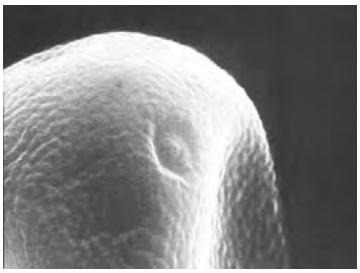
The pollen is typical of the grasses and here is a good illustration using EM of the pore with the pore plug although the ridge is not so easily seen around the edge. This is a wide spread pollen and it is extremely important in the early season of the shed of the pollen and pollinosis for grasses in late spring.

023 EM KENTUCKY BLUE GRASS



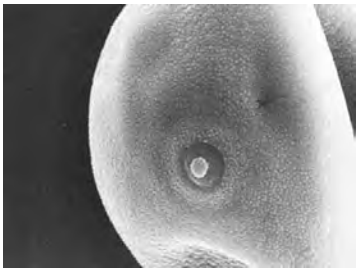
This is an excellent illustration of an EM of Kentucky blue grass pollen. Especially well illustrated is the single pore with a somewhat low ridge around or annulus around the pore and then the cap. This is an important source of allergens in eastern North America.

Grasses



027 EM TIMOTHY GRASS

Timothy pollen is represented here by the EM is one of the most important sources of early summer allergens. A single pore is seen beside an artifact of the SEM which can be ignored.



030 EM ORCHARD GRASS

The SEM image of orchard grass is excellent as far at least the pore is concerned showing the cap, the annular ring, the large size and the rather smooth surface of the grain as a whole.

031 MIC CORN POLLEN

Corn pollen is pretty distinctive among the so called all look a likes of the grass pollen because it is so large. The diameter of the grain is up to about 125 microns. So this is a huge, one of the largest if not the largest, of the grasses. Again you can see at the top a single pore, however, and a relatively thin wall, these many starch bundles that are found within the protoplasm. Because of the large size, and not because it isn't buoyant, because the grasses are generally buoyant and can be found long distances from where they flower, and where they were released from the plants, but in the case of corn the recorded distance known to me is several kilometer distance from the corn - and that is as far as it will travel. However, if the sampler happens to be placed in a high area you will find that situation, but if you happen to put it at head level, then together with the currents that are going to be local and then you can have even these large but light pollen blown for longer distance than that.

032 MIC BERMUDA GRASS

Bermuda grass pollen is typical of the grasses. One large pore, which you can see at 6 o'clock on this image. Here also you observe a rather thick wall even though the outer structural wall is thin. Very often you find the inner wall which is a polysaccharide which is insignificant in many cases. It tends to be rather thick here. Also, notice the inner part of the pollen grain where you have the protoplasm and inside the protoplasm many, many starch grains, and it is important that the starch grains are associated with allergenic proteins that are released through that pore.

033 MIC ORCHARD GRASS

Orchard grass pollen as represented here in a micro is very typical of grasses as a whole. One point I would make is that the intine or the inner wall of the pollen and it shows up extremely well and then within that the protoplasm with the grains of starch.

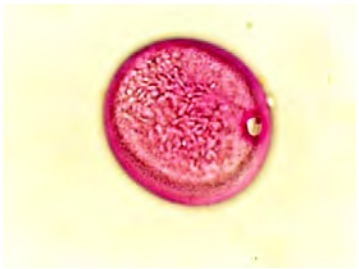
034 MIC TIMOTHY GRASS

Timothy grass pollen is typical in that it is mono-porate and has a smooth surface and is about average size and is certainly a major cause of early allergies.

035 MIC ORCHARD GRASS

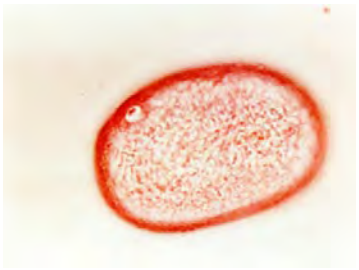
The pollen is typical of the grasses and this particular species produces it somewhat later than the Kentucky blue grass, or the Orchard grass, and what we might call a late spring/early summer wave of grass. It is quite allergenic and produced in abundance.

036 MIC BAHIA GRASS



The Bahia grass pollen is round, usually any where from 20 to 50 micros in diameter with a smooth surface and one single pore, which is well illustrated here.

037 MIC RYE GRASS

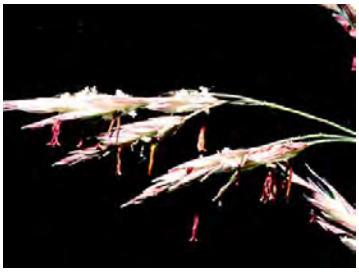


The pollen of rye grass is typical of all the grasses. This seems a little longer than round but it is probably due partly to an oblique view. So again when scanning a mass of grass pollen, be certain to realize that there are different positions and those positions actually distort either length or width.

038 MIC CATTAIL POLLEN

The cattail pollens don't look like grasses. So, this is another indication that it is certainly not in this family. Masses of these clumping of pollens, the so called tetrads, are released by the inflorescence at the top of the plant and they could be collected in the ambient air, but the role they have in the allergenicity is probably not well know. So, this is probably a very minor indication of sensitivity but certainly every August because they are very large in this unified 4-cell state.

Grasses



043 MAC SMOOTH BROME GRASS

This is a close up view of the smooth grass Brome in which you can see slightly tilted extending down from the main inflorescences these reddish strands. These appear to be the filaments of the stamen with the anther which, of course, is contributed to the pollen which has fallen off because the pollen have matured and blown away. But it is an interesting illustration of the growth of these filaments as a male part of the flower so that whole stamen is away from the inflorescence and hence can be picked up by the wind readily and then the pollen produced.

046 MAC SMOOTH BROME GRASS

Smooth Brome grass is introduced from Eurasia and is widespread in North America and contributes a good amount of pollen to the atmosphere.

047 MAC JOHNSON GRASS

Johnson grass is a very troublesome weed in the southern part of the continent and it grows in these large clumps and in cultivated fields along the roads and produces a large amount of allergenic pollen.

050 MAC JOHNSON GRASS

This is a closer view of Johnson grass, which is a plant that is a very troublesome weed in the southern United States.

051 MAC KENTUCKY BLUE GRASS - JUNE GRASS

Kentucky Bluegrass or June grass is a very common plant found in eastern North America in particular. It is a small herb and it is introduced from Eurasia.

057 MAC BARLEY GRASS

Barley is an important grass because, of course, it is a cultivated grain. It is important for our food source. It is, however, largely self-pollinated and as such disperses very little pollen. However, there are other species within this genus that are found in particularly the western parts of North America, that are common weeds widely dispersed and certainly can contribute to the array of grass allergens.

058 MAC DOWNY CHESS GRASS - A BROME GRASS

Downy Chess grass is a Brome that is widely introduced into North America and has become a very important and economic species. It does produce abundant pollen and this is very allergenic.

059 MAC SWEET VERNAL GRASS

Sweet Vernal grass you can see the tops of the inflorescences as we have taken this photograph in the lab so that the grass is not tangling with the anthers moving in the breeze. But you see them here and of course they are well removed from the inflorescences and readily the pollen can be dispersed. This is one of the important early grasses in eastern North America and on the West Coast as a source of pollinosis.

060 MAC SWEET VERNAL GRASS

Sweet Vernal grass is introduced from Eurasia and is common in waste fields, meadows and pastures of eastern North America and also on the West Coast.

061 MAC FESCUE GRASS

There are many species of fescue that are important forage grasses and in grazing areas of the West in particular are very common and, therefore, a major source of pollen.

Grasses

062 MAC MEADOW GRASS - FESCUE

This is a good close up view of the Meadow grass fescue, because it shows quite clearly the drooping large, and they are very long and large, anthers of the male part of the flower which have been extruded out from the inflorescence by the elongation of a middle stalk or filament that has grown and you can see that the lower part of the paired anthers has already come into some form of maturity. The wind will knock that pair of anthers and the pollen will fall out and will be taken away by the wind and hence affect pollination.

063 MAC CRESCENT GRASS - DOVETAIL

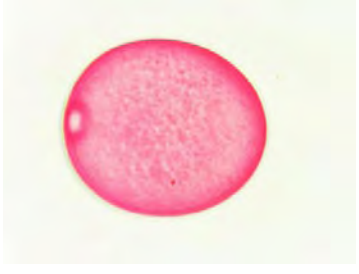
Crescent Grass Dovetail is found in fields and waste places in many parts of the continent. It is a summer flower introduction and certainly does cause inhalant allergy wherever it is common.

064 MAC DOGTAIL - CRESTED GRASS

These two inflorescences are of the Crested Grass Dogtail and show the enlargement of the floral parts especially of the stamens and the by parted stigma of the female as the one matures and the other is receptive to pollination.

065 MAC CRAB GRASS

Crab grass is commonly found in the eastern US and southern parts of the country in lawns, disturbed areas, and is an extremely weedy species. It does contribute in the mid-summer a fair amount of pollen, however, to the atmosphere and is important in the allergic response but the total amount produced is probably average or minimal.



563 MIC MEADOW GRASS

The Meadow grass pollen is very typical and this micro example is probably as good as one can get. You can see in the 9 o'clock position the clear pore surrounded by its annulus, the rather smooth wall and the round to more ovoid shape, this being a little more ovoid. Kentucky Bluegrass and any of the others that have been mentioned this is a good example essentially of all of them.

623 MAC BROME GRASS

Brome grass is an important grass. Grows about foot, foot and a half feet tall in the western part of the United States. The example of its pollen will be found under smooth Brome.

625 MAC JOHNSON GRASS

This is a close photograph of the flowers in the inflorescence of the Johnson grass and again you can see the protruding parts of the flowers that have been extended away from the plant itself to be able to be either a part of the wind and expose either the stigma and/or the anthers to the bushes of the wind as it were but to be taken away by the wind or brought to the stigma by the wind.

628 MAC ORCHARD GRASS

Orchard grass is a very common weed in eastern North America. That introduction from Eurasia has given us one of the most important factors in early summer pollinosis.

629 MAC ORCHARD GRASS

Orchard grass is a commonly introduced grass from Eurasia and it sheds an enormous amount of pollen.

631 MAC RYE GRASS

Rye grass is a widely used meadow in Europe and it is being widely planted in the eastern and southern parts of the United States for parks, any place where a good lawn is needed. It too sheds a great deal of pollen and, therefore, it is a major contributor to pollinosis.

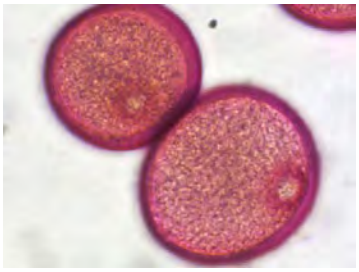
642 MAC CATTAIL

Even though the cattails are not members of the grass family, we are including them here because in fact they look like great big giant grasses and so we are calling them grass-like. They do look like grasses. They are about six feet tall. They are unisexual. Male inflorescence is on the top part of the tail of the cat as it were and the female portion is below that.

Grasses

836 MAC BAHIA - DALLAS GRASS

Bahia grass, or Dallas grass, is particularly frequent in the southeastern region of the United States where it flowers from May to October.

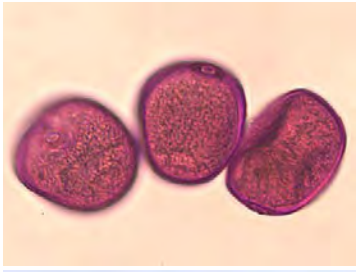


837 MIC BARLEY GRASS

Barley grass is a typical grass, has a typical grass morphology, round about 30 to 40 microns in diameter, smooth surface and of course the hallmark of all the grasses enlarged single pore surrounded by an annulus or ring.

838 MAC BERMUDA GRASS

Bermuda grass is a common introduced grass in the southern part of the continent. It grows in open grounds, grasslands, fields and waste places. It is widely used as a lawn grass, but at maturity it is short enough to miss the mower's blade and may continuously send buoyant pollen from summer through autumn. But the lesson here is keep the grass short if you are using Bermuda grass and you will have very little mature pollen.

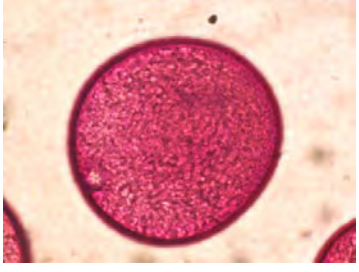


839 MIC BROME GRASS

Here is an example of the smooth grass Brome pollen again very characteristic of any of the grasses with one large pore, smooth surface and a round morphology.

840 MAC CORN

Corn is one of the most important economic plants in the world and we know it is widely cultivated in the United States particularly in the mid-west where it does shed abundant pollen and can contribute to allergenicity.



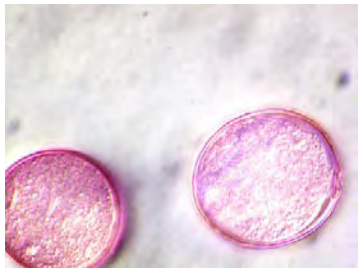
841 MIC JOHNSON GRASS

Johnson grass pollen is shed in the mid-summer right through to the fall in the southern part of the continent and can be a major source of allergens. The pollen is typical of the grass and it is evolutionary related to corn so it shares a number of cross-reactions with corn.

842 MAC RED TOP GRASS - CREEPING BED GRASS

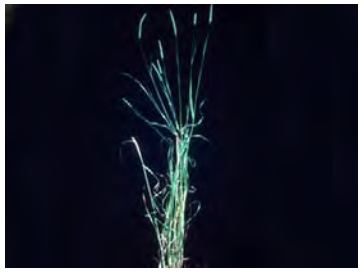
Red top grass, or creeping bed grass, is an extremely common plant found in eastern North America introduced from Eurasia. It produces large amounts of pollen that are very significant in pollinosis.

843 MIC SWEET VERNAL GRASS



This image of Sweet Vernal grass is similar to the other grasses. The uniqueness of the pollen is that it is highly allergenic and it is airborne in the early spring.

844 MAC TIMOTHY GRASS



Timothy is found widespread in moist habitats throughout most of the continent and is commonly cultivated for fodder. The species contributes a large amount of pollen.

Insects

066 MAC FIRE ANT HABITATS

Here is a map of the United States presented in red where the fire ant of Solenopsis invicta is expected to be able to grow and survive. You see, wherever it is nice in the United States all year round the fire ant can live and thrive.

067 BUMBLE BEE - Bombus bombus

Here is a close up view of the bumble bee otherwise known properly as the Bombus bombus. These insects rarely sting humans. In order to get stung by a bumble bee you really have to be trying to catch one. They are non-aggressive.

068 CADDISFLY

Here is a slide of the larvae from the caddisfly as captured at the bottom of a river in northeastern Wisconsin by our colleague, Dave Rades. The caddisfly is a beautiful structure. It spins a web in the bottom of the river as it fishes. It casts a net. It captures diatoms and other single cell bacteria and algae and it feeds on these things. It is a filter feeder and the type of caddisfly you get in a river section is really dependent on the flow of the water. The faster the water, the broader the net. Slow moving streams, fine net and each different type of caddisfly spins a different web.

Cliff Lofgren, PhD

069 FIRE ANT HEAD

This is a close up view courtesy of Cliff Lofgren of an imported fire ant head. Here you see the pincher right at the tip of the nose, an eye on the right and this insect is responsible for producing anaphylaxis in the sensitized host. This is the head of an imported fire ant.

Cliff Lofgren, PhD

070 FIRE ANT MOUNDS (FLORIDA)

The imported fire ant or Solenopsis invicta has taken over grasslands throughout the south any where south of the Mason Dixon Line particularly in the southeastern United States. Here is a field located outside of a local hotel in Florida loaded with mounds of fire ants.

Cliff Lofgren, PhD

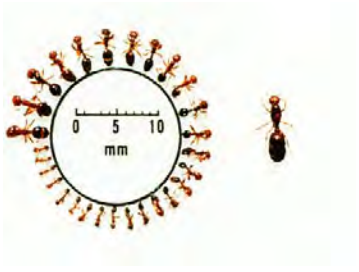
071 FIRE ANT STINGS

Here is the arm of a patient who was stung by fire ants while picking fruit and falling into a nest or mound of fire ants and each little white pustule that you see here is the result of an individual sting. Each sting from a fire ant produces this sterile pustule. It really isn't a bacterial infection, it is the inflammation which is due to the toxicity of the venom within the venom skin.

Cliff Lofgren, PhD

072 FIRE ANTS

Here is a photograph of the fire ants dug up by Cliff Lofgren out of one single fire ant mound. There are 300,000 ants per mound where there is only one queen. Now in the last few years the fire ant nest contains more than one queen so you can get many more than 300,000 ants per nest.



073 FIRE ANT FAMILY

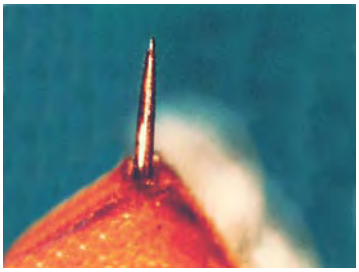
Here is the queen of the fire ant nest on the right and all of its workers. All of its workers are subservient to this queen. After being fertilized in the air, this fire ant queen continues to lay eggs for many, many months.

Cliff Lofgren, PhD

074 FIRE ANT VENOM SAC + PHEROMONE SAC

Here is the fire ant venom sac and stinger. The stinger has a pointed end so that it can be injected into its victim, and you will also notice aside from the big bladder in which is contained the venom, there is a sacular material, that is the pheromone gland. The fire ant, like other ants, has a pheromone sac where it lays down a trail so they can follow each other's trail. They smell there way back home.

075 HONEY BEE STINGER



This is a close up view of the tail end of a honeybee with its stinger. You can't tell it from this view but there are actually barbs on the end of this stinger such that after the honeybee has stung its victim as it flies away it rips away part of his abdomen and that abdomen contains muscles that continue to contract pumping venom into the victim.

076 STINGER

Here is a close up view of the honeybee stinger showing the barbs much like that would occur on the end of a fishhook. The honeybee stinger cannot be pulled out; it must be scraped out.

077 LAKE FLIES - MIDGES (Chironomous plumosus)

This is a close up view of the air intake area of a hospital on a lake out of which is coming millions of lake flies. The lake fly, otherwise known as a midge or Chironomus plumosus in this case, is an aquatic insect that on Mother's Day hatches out. These insects produce great quantities of aeroallergens capable of causing asthma, acute hives, angioedema and malignant allergic rhinitis.

078 MIDGE LARVAE

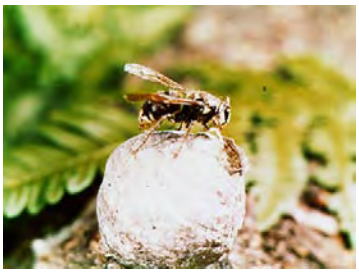
Here is a photograph of the Chironomus plumosus larvae. These midges are babies. These are the larvae. In this stage the larvae is living at the bottom of the lake, it feeds off of small diatoms and it is red because it binds oxygen. It produces different types of hemoglobin that are capable of binding oxygen at very low pO_2's. So, this is a red worm and you are going to find it in fishing. A person who catches fish, cutting open the fish, there are red worms inside. Those are the midge larvae. You will also find red flakes in your Tetramin fish food for your aquatic insect tanks. Guess what, that's the midge, it's the lake fly and it's very allergenic. The part of this insect larvae that is allergenic is the oxygen-binding hemoglobin protein.

079 CATCHING CADDISFLY LARVAE

Here a student helper is wading into the Fox River to put a stone cage into the water. We were capturing caddisfly larvae. Caddisfly is an aquatic insect that goes into the air to reproduce, producing a great amount of aeroallergens.

080 FOX RIVER - AQUATIC INSECT ALLERGEN SOURCE

This is an overview of the Fox River in northeastern Wisconsin. The Fox River is being dammed up here at Rapid Croche. As the water comes over the dam there are a great number of currents that are formed, and in these currents at the bottom of the river, the caddisfly lives. This caddisfly takes to the air later in its maturation period to reproduce. The caddisfly is an aquatic insect that reproduces in the air. When it takes to the air it gives off a great amount of aeroallergen. This aeroallergen we isolated is actually an oxygen binding protein. So, the river fly can become an airborne aeroallergen. You may find some of these body parts in your slides.



081 WHITE-FACED HORNET

Here is a white-faced hornet not quite so close up, but this is as close as the photographer wanted to get.

Mites

INTRODUCTION TO MITES

No PhotoLibrary of aeroallergens would be complete without several views of the most important indoor aeroallergen source material, the house dust mite otherwise referred to as domestic mites. We have categorized the Acari for you here showing the house dust mite and the storage mites. All of these mites are important in terms of producing indoor aeroallergens. For those farming patients, they can inhale mite allergens in the barn when kicking up the dust within the hay. The mites are very important as a cause for allergy. You won't find many of them, if ever, on your outdoor aeroallergen samples. Welcome to the world of mites.

084 EM HOUSE DUST MITE

Here we see the mother of all allergy, the domestic common mite. This is Dermatophagoides farinae and just north of its head you will find a tree pollen that gives you some sense of size here. At the far right hand corner in the lower area, one sees fecal pellets that the dust mite has left behind after a meal. The dust mite is phycophagic. It will chew on some mold or other food sources, come back after defecating it and eat its meal. It secretes an enzyme similar to papain on the outside of its fecal palate and, therefore, it digests its food outside of its body. This is the domestic mite Dermatophagoides farinae and the dust mite fecal pellets.

085 EM DERMATOPHAGOIDES

Frits Spieksma, PhD

This electron microscope view of a smashed, crunched Dermatophagoides species is courtesy of my friend, Frits Spieksma, from Holland. Also in view near the leg portion you find a Cladosporium mold spore. This is good food stuff. At the top left hand portion near the bubble in the screen, about 11 o'clock, fecal pellets. Dermatophagoides farinae.

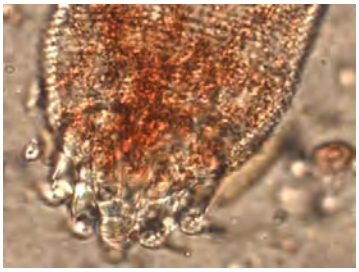
086 EM HOUSE MITE FAMILY

Here's the mite family. The mother mite and the little mite. You might call it Mighty Mite. The whole point is these Dermatophagoides species produce a great amount of indoor aeroallergen. They live well when there is high humidity. They eat the mold, after they eat the mold, they defecate, and that material, the fecal pellets, contains a great deal of the mite allergens.

1200 MIC ERIOPHYID EATING

In this microscopic image taken at 100 X power, this is a leaf mite, an Eriophyid that we captured in our air samples in mid to late summer here in northeastern Wisconsin. The interesting thing about these mites is that all of their legs are at the front end of its body. It uses its legs to bring in the food into the feeding area, the mouth. It has no rear appendages. The size of these creatures is as small as mold spores. So they can range from 70 to 100 microns in length.

1201 MIC LEAF MITE (ERIOPHYID) - FRONT END



This is a leaf mite at the front end of its body and you can see it has 4 appendages angled around the mouth. This is a leaf mite a potential source of inhalant aeroallergens. We captured leaf mites on the air intake filter of the hospital showing and demonstrating that indeed leaf mites can live on air filters on the outdoor air. This is a distant cousin of the house dust mite and storage mite.

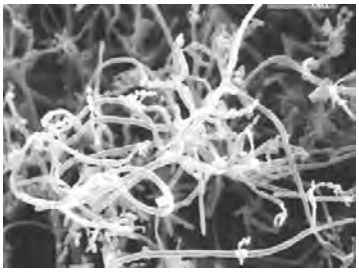
1202 MIC LEAF MITE - ELONGATED

In this microscopic image we see a leaf mite, an Eriophyid, with all its appendages about its mouth. This gives you a good view of what the texture of this arthropod looks like.

1203 MIC LEAF MITE - CRUSHED

Here is a leaf mite taken under 100X microscopic power. This leaf mite, or Eriophyid, was captured in a volumetric air sampler in the late summer in northeastern Wisconsin. We are looking up beneath the little animal and we can see its legs pressed towards its mouth, which is the top right hand portion of the slide.

Mold Spores



088 EM CLADOSPORIUM HERBARUM

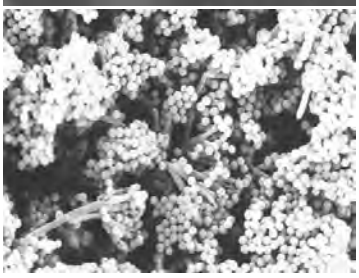
This is an EM view overlooking a mesh Cladosporium herbarum under culture.

089 EM CLADOSPORIUM HERBARUM

Here is a closer view of Cladosporium herbarum showing the hyphae off of which is budding the spores.

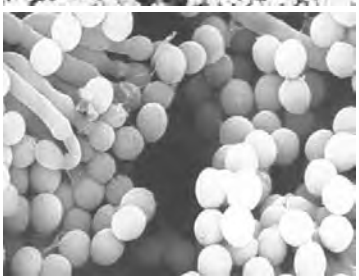
090 EM CLADOSPORIUM HERBARUM

Here is a closer view of Cladosporium herbarum under electron microscope view showing the hyphae and budding off of the hyphae are the individual spores which can cause allergy symptoms. This is Cladosporium herbarum.



092 EM PENICILLIUM

Penicillium species also produce heads at the end of hyphae on to which come many different spores. Here's an overview of Penicillium as it is growing in culture.



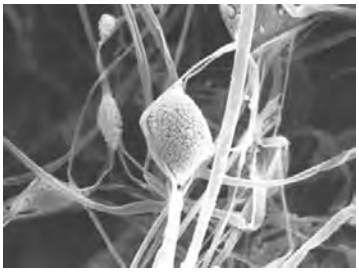
093 EM PENICILLIUM CONIDIA

This is a close up EM view of Penicillium as it is producing conidia at the end of phialides. Beautiful photograph, individual spores coming out. Penicillium causes a great deal of reactivity in an allergic host particularly during the moist, high humidity times of the year.

095 EM PENICILLIUM SPORES

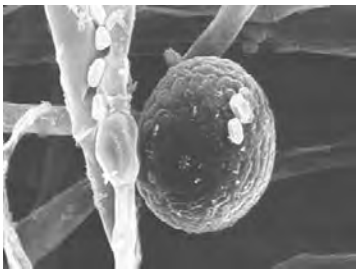
Here's a close up view under EM microscopy showing Penicillium spores individually. These spores have a surface which is slightly granular and stringy on the outside. You could never appreciate this view by light microscopy, this is only available by EM.

097 EM MUCOR HYPHAE



This is a wonderful EM view showing Mucor as it begins to create its bulb and gives off its pores from the hyphae in the background. Almost like a forest of mucor. This was done in culture, not in the air.

100 EM MUCOR SPORE HEAD

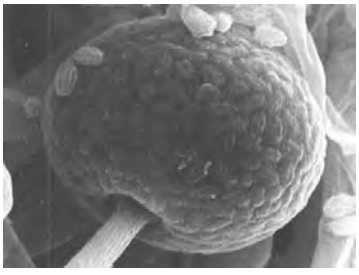


Here is Mucor under EM view showing the bulbus head about to give off many different spores from Mucor. This is a Zygomycete and is giving off its asexual spores. There are very long sporangiophores. At the end of each sporangiophore there is at the tip a sporangium. This gives rise to the dark spores which some people call sporangiospores.

102 EM MUCOR SPORANGIA

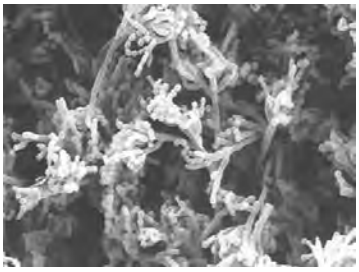
This is mucor under an EM view showing the multiple bulbs that give rise to the spores which produce the allergy symptoms in patients sensitive to mold spores such as mucor. Patients will experience sinus pressure, sinus headaches particularly during periods of high humidity when these spores are given off into the air.

103 EM MUCOR BULBUS HEAD



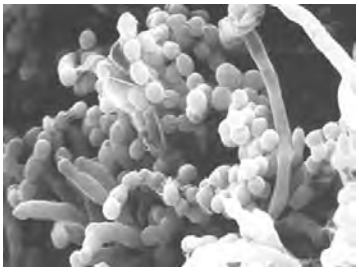
This is Mucor, a close up view under the EM microscope showing a bulbus head of the sporangium. It gives off individual spores each one of which can induce an allergic or asthmatic reaction in the sensitive host. You will notice that the stalk or the hyphae going up into the head supports this structure. This is reproducing itself by means of asexual means. It is a zygomycete.

107 EM PENICILLIUM NOTATUM

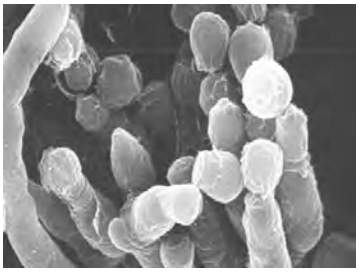


Here's an overview of Penicillium notatum which shows the brush like appearance of these mold spores as grown in culture. This is not the source of penicillin for penicillin was identified in Penicillium chrysogenum.

109 EM PENICILLIUM CONIDIA

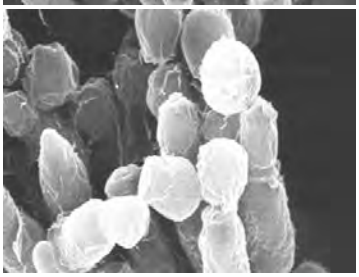


Here is a closer view showing the conidia that are simple or branched giving off individual spores from Penicillium.



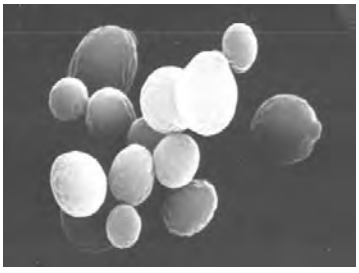
110 EM PENICILLIUM CONIDIA

This is a beautiful photograph by EM showing Penicillium notatum as the phialides are giving forth individual spores. Very nice photograph. The conidia or spores are coming out of the phialide.



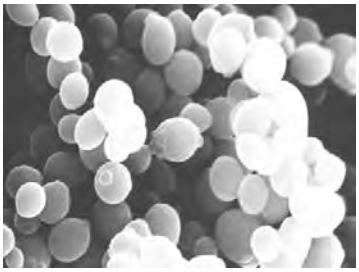
111 EM PENICILLIUM NOTATUM CLOSE-UP

This is a close up view showing the conidia or spores of the Penicillium notatum coming out of the phialide at the terminal end. These fungi reproduce themselves by asexual means. It's budding.



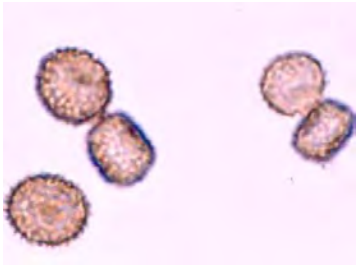
113 EM CANDIDA ALBICANS

This is an electron microscope view of Candida albicans spore. They are smooth shaped, almost circular to oval in structure and very small being 5 to 10 microns in diameter. Rarely will one find this in an air sample. We thought it was pretty enough to include here in our North American Aeroallergen PhotoLibrary.



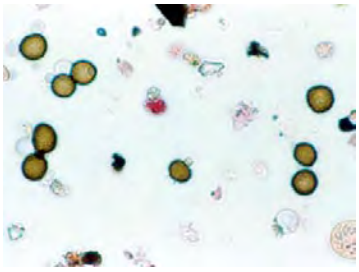
115 EM CANDIDA ALBICANS

Candida albicans under EM appears in groups and clusters. This is grown in culture. This was not from an air sample. Here we find the different smooth egg shaped structures closely grouped together. This is Candida albicans one of the wet slimy molds.



1000 MIC CORN SMUT - USTILAGO MAYDIS

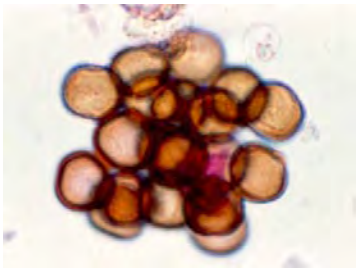
This is corn smut also known as Ustilago maydis. It is one of the more common species of smut fungi in North America. Corn smut occurs wherever you plant corn in any variety of corn. The spores are roughly 8 to10 micrometers in diameter and it is spherical to sub-spherical and ornamented. This slide shows smut spores without any stain added. An interesting fact about smut fungi, especially corn smut, is that some of them are edible. In particular corn smut is eaten before the spores have matured and this smutty corn is considered a gourmet delicacy.



1002 MIC SMUT SPORES IN TULSA

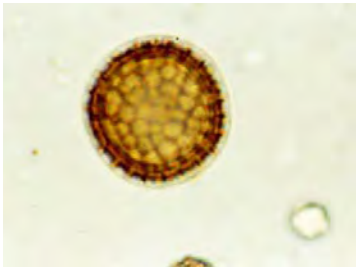
This is an air sample from Tulsa, Oklahoma. The sampler is a volumetric sampler and is stationed at 40 feet above ground. The image shows 9 spores and these are all smut spores. I believe that they are all Ustilago maydis corn smut. The appearance of these spores with the 40X objective shows a slightly fuzzy appearance due to the ornamented nature of the spore wall.

1003 MIC SMUT SPORE CLUMP



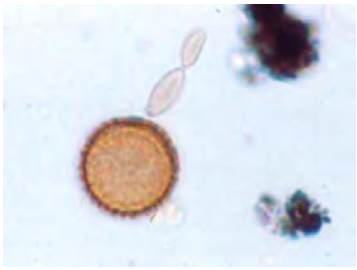
This is a clump of smut spores. This is a characteristic we sometimes see that they are clumped together in the atmosphere.

1004 MIC TILLETIA SPORE



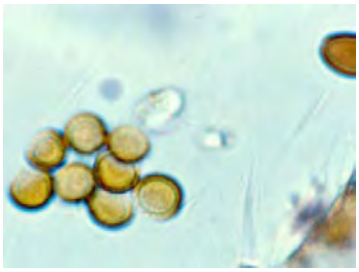
This air sample shows a single smut spore in the genus Tilletia. The spore has a reticulate wall and focusing with a fine adjustment will show the reticulate pattern. This image was at the 100X objective and the spore is roughly 15 micrometers in diameter.

1006 MIC SMUT + CLADOSPORIUM SPORES



This air sample shows a single smut spore and 2 Cladosporium spores. The single smut spore in the center is ornamented roughly 12 micrometers in diameter and is tentatively identified as Ustilago stratiformis. The 2 spores on the upper part of the picture are 2 small Cladosporium spores very common in the atmosphere.

1007 MIC USTILAGO TRITICI

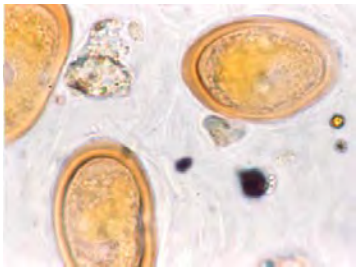


This is another example of Ustilago tritici. The slide was stained with glycerin jelly mounting medium containing basic fuchsin and the image was shot using the 100X objective. One feature of this spore in addition to the unevenly thickened wall is the small size. The smut spores are only about 6 micrometers in diameter.

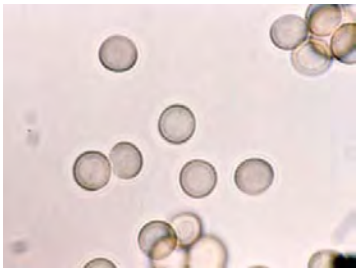
1008 MIC USTILAGO TRITICI CLUSTER

This is another cluster of Smut spores in the air sample. This is Ustilago tritici. One of the characteristics of the spores from this species is the uneven thickening on the spore wall. There are thick and thin areas and interestingly enough the ornamentation is different on the thin area.

1009 MIC RUST TELIOSPORES

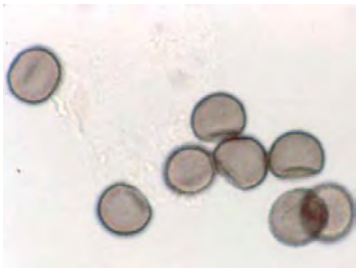


Rust spores can be common in the atmosphere at certain times of the year and these are rust teliospores. They are roughly 20 micrometers in length and 15 micrometers in width. Rust fungi are plant pathogens and these teliospores are the stage that occurs in late summer. They are more common in agriculture areas.



1010 MIC STEMONITIS SPORES

These are Stemonitis spores from a sample from the fruiting body. The spores are gray, thin walled and very finely ornamented using the 100X oil immersion objective. The spores are thin walled and in air samples may show some collapse.



1011 MIC RETICULARIA

Reticularia is another slime mold and the spores are gray, 8 to 10 micrometers in diameter and show signs of collapse due to the thin wall. Slime molds are primitive fungal like organisms. The vegetative stage of the slime mold is slimy. It looks like a giant ameba, but the reproductive stage is fungal like. They can be found on wet areas such as on the forest floor, on the bark of trees, under shrubs following rainfall and the spores are readily airborne and sometimes can be found in high concentrations in the atmosphere.

1012 MAC SLIME MOLDS - FULLIGO

This is the reproductive structure of the slime mold. The genus is Fulligo. This particular image was captured on the campus of the University of Tulsa on some mulch underneath some shrubs.

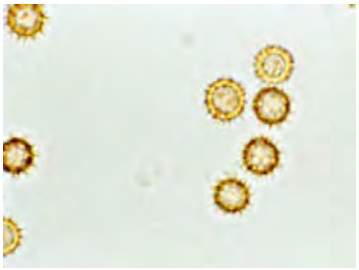
INTRODUCTION TO GASTROMYCETES

The Gastromycetes are a group of fungi in the Basidiomycetes. Gastromycetes include puffballs, a group of similar fungi that are sometimes called earthballs, and also stink horns. Stink Horn spores are actually distributed by flies. However, both puffballs and earthballs produce abundant spores that are airborne.

1013 MAC PUFFBALL - CALVATIA CYATHIFORMIS

This is Calvatia cyathiformis, a common puffball throughout the South. The spores are airborne often during rain. The mechanism of release is that when a raindrop hits a mature fruiting body, spores will puff out often in a small cloud. Strong wind or even the movement of small animals on the surface of the puffball can also cause dispersal into the atmosphere. This particular puffball is about 4 inches in diameter, however, it can get larger and a different species of Calvatia known as giant puffball can be 12 to 18 inches in diameter.

1014 MIC PUFFBALL BASIDIOSPORES

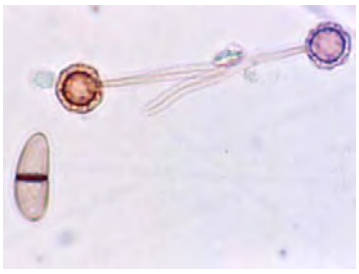


These are basidiospores from the puffball Calvatia cyathiformis. The spores have very distinct spines. They are small approximately 4 to 5 micrometers in diameter and are often abundant in the atmosphere during rainfall.

1015 MAC GEASTER (GASTROMYCETES / PUFFBALL)

The Gastromycetes are a group of fungi within the Basidiomycota. They are commonly called puffballs, earthballs, stink horns. This Geaster is a good example of the puffball. During rainfall a drop of rain will hit the fruiting body and spores will puff out often in a cloud. Strong wind or the movement of small animals or even large insects on the mature fruiting body will cause the same dispersal.

1016 MIC PUFFBALL SPORES - LYCOPERDON



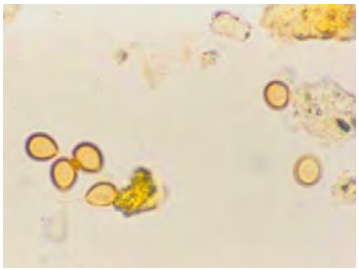
This air sample shows 2 puffball spores and in the lower left hand corner an Ascospore. We'll focus on the puffball spores. These puffballs are in the genus Lycoperdon. Like other basidiospores, an attachment is often visible. In the puffballs the attachment might be quite long and the attachment here almost looks like a tail. The spores are ornamented and because of the ornamentation it looks like a very thick rough wall. However, careful focusing will show that the wall is densely spiny.

1017 MIC PISOLITHUS TINCTORIUS BASIDIOSPORES

These are basidiospores of Pisolithus tinctorius, an earthball. The spores are highly ornamented with very distinct spines. The spores are approximately 4 to 6 micrometers in diameter.

1018 MAC PISOLITHUS TINCTORIUS

Pisolithus tinctorius is a fungus in the Gastromycetes. This is an earthball. The fruiting bodies are normally found partially buried in the ground with only the very top portion exposed. One of these has been cut opened to show the granular inside. The top part of the fruiting body contains masses of spores while the bottom part almost looks like gravel.

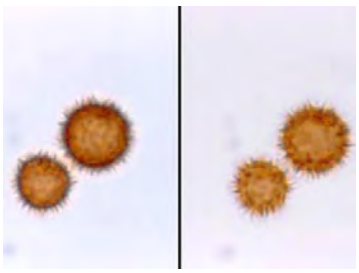


1019 MIC BOVISTELLA RADICATA

This is an air sample showing some puffball spores. I believe that these are Bovistella radicata. They are very common in the rain. These spores are roughly 4 to 6 micrometers in length with an elongate attachment known as a pedicel.

1020 MAC EARTHBALL - SCLERODERMA CITRINUM

Scleroderma citrinum is a common earthball in the Gastromycetes. Within the fruiting body are masses and masses of spores. The fruiting body that is cut open shows the black interior, which are masses of spores.



1021-22 MIC SCLERODERMA CITRINUM

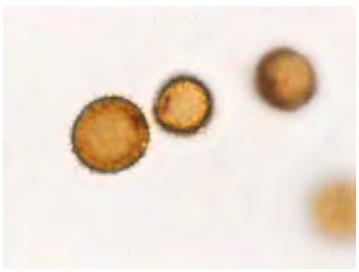
These are spores of Scleroderma citrinum, a Gastromycetes. The spores are very highly ornamented and what you see here are two versions of the same spores with just a slight difference on the fine adjustment of the microscope to look at the spore surface and the spine morphology.

1023 MAC SCLERODERMA POLYRHIZON

This is Scleroderma polyrhizon. It doesn't even look like a fungus. It looks like a pile of dirt on the lawn but this is actually a close up showing the masses of spores in the open fruiting body. Scleroderma is a type of earthball closely related to the puffballs. Instead of having a puffing type dispersal the outer wall of Scleroderma gradually wears away over the winter leaving the massive spores ready for wind dispersal in the spring.

1024 MAC SCLERODERMA POLYRHIZON FRUITING BODY

These are fruiting bodies of Scleroderma polyrhizon. Although they look like rocks they actually are a fruiting body of a Gastromycete. These fruiting bodies normally occur in the ground and they are partially buried. Look back at image 1023 to see the Scleroderma polyrhizon in the field.



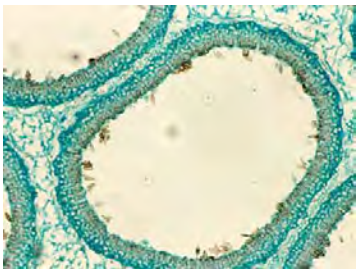
1025 MIC SCLERODERMA POLYRHIZON BASIDIOSPORES

These are basidiospores of Scleroderma polyrhizon. They are roughly about 6 micrometers in diameter and have an ornamented wall.

1026 MAC BRACKET FUNGI - GANODODERMA APPALANATUM

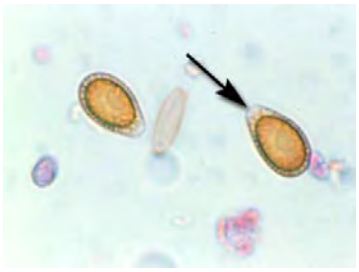
A large group of fungi in the Basidiomycota are called bracket fungi. These commonly are wood rotting fungi and we commonly find them on the barks of trees. However, they can sometimes appear on the ground actually growing from the roots of the tree. This particular bracket fungus is Ganoderma appalanatum commonly distributed all over North America. This particular bracket fungus is sometimes called the Artist Conch, because the pore surface is white and leaning on it, cutting into it lightly with a stylus often makes a very dark impression and artists have been known to draw pictures on some of these brackets and offer them for sale.

1027 MIC BRACKET FUNGI BASIDIOSPORE PRODUCTION



The basidiospores in bracket fungi are produced in pores on the lower surface of the fruiting body. Spore dispersal is dependent on moisture and we frequently find the spores in the atmosphere when the humidity is highest somewhere between midnight and 6:00 AM. The spores are shot away from the basidium, the structure on which they form, a fraction of a millimeter but this clears them from the basidium and allows them to drop into the atmosphere where they are swept into the wind. Mushrooms and bracket fungi have a very interesting dispersal mechanism. A crystal of hydroscopic material is excreted from the basidium at the base of the basidiospore. Moisture from the atmosphere condenses on this crystal and the drop increases in size. Eventually the drop coalesces with a thin film of moisture around the whole spore. When this happens the center of gravity is shifted away a fraction of a millimeter but it is enough to fling it off the basidiospore. It's a neat mechanism.

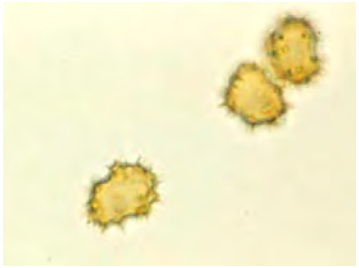
1028 MIC GANODODERMA BASIDIOSPORES



Ganoderma basidiospores are probably the most distinctive basidiospore that you find in air samples. In the Tulsa area, they are common in the atmosphere from late May through late October although the season is shorter in other areas of the country. The spores are roughly 10 micrometers in length, have a transparent external wall and a golden brown internal wall. There is a distinctive germ pore at the apex of each spore and there are also spines that connect the inner and the outer walls. On the spore on the right there is an arrow pointing at the germ pore. Also on this slide you will notice a Cladosporium spore in the center slightly out of focus.

1029 MAC GANODODERMA LUCIDIUM

This is a bracket fungus, Ganoderma lucidium, another common species of Ganoderma that we find throughout North America. The top of this is often shiny as the species name lucidium implies.



1030 MIC THELEPHORA SPORES

Thelephora spores are somewhat unusual basidiospores, because they have an irregular shape and are spiny. They almost look like misshapen potatoes. They are approximately 4 X 6 micrometers in diameter.

1031 MIC TRAMETES BASIDIOSPORES

Trametes is a large genus of bracket fungi. They are very commonly distributed throughout the world. The spores are absolutely colorless. In this image the spores have been stained. Like most basidiospores there is an attachment where the spores developed on the basidium. Often we can't see this because of the position of the spores on the slide, but at the arrow you can actually see the hilar appendage, the attachment point on this spore. These basidiospores form in pores on the bracket fungus. Look back at slide 1027 to see where these spores develop.

1032 MAC TRAMETES VERSICOLOR - TURKEY TAILS

A common bracket fungus is Trametes versicolor, and this is called Turkey Tails and you can see why. It looks like a turkey tail. Also, on this same slide there are some small mushrooms. Trametes versicolor normally occurs in clusters like this one and each shelf or each bracket is normally 2 to 4 inches in diameter.

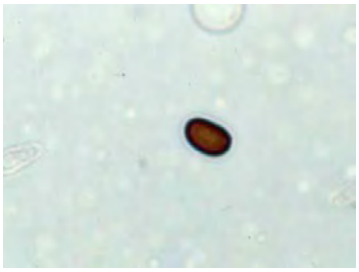
1033 MAC MUSHROOM

For many people probably the most familiar fungi are the mushrooms. Mushrooms actually belong to the group Basidiomycota and the spores produced by these fungi are called basidiospores. The spores form on gills underneath the cap of the mushroom and they are dispersed into the atmosphere at times of high humidity. For a closer look at the basidium and basidiospores on the gills, look at slide #1036.

1034 MAC AGARICUS CAMPESTRIS

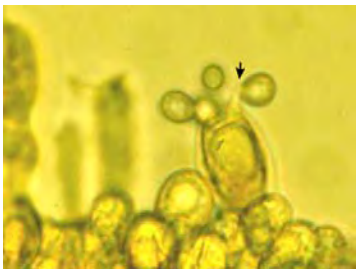
Agaricus campestris is a common mushroom and is very closely related to the edible mushroom we buy in the grocery store. This often comes up on lawns and pastures in the summer during rainfall.

1035 MIC AGARICUS SPORE



This air sample shows a small single basidiospore in the center. This basidiospore is in the genus Agaricus.

1036 MIC AMINITA VIROSA

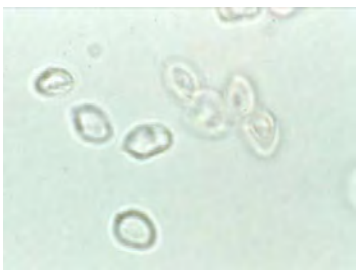


This is a small portion of a gill from the mushroom Amanita virosa. I pulled out a small portion of the gill with tweezers and mounted it in some stain. This is the image using the 100X objective. In the center you see a basidium with 4 basidiospores. The arrow is pointing to where the basidiospores are attached to the basidium. As the spores mature a small crystal is extruded from the basidiospore at the arrow and this crystal is hydroscopic and moisture coalesces from the atmosphere. This drop of moisture, called Bullar's drop, gradually increases in size and coalesces with a thin film of moisture that surrounds the spores. This causes a shift in the center of gravity and the spore is shot away from the basidium for a fraction of a millimeter. This allows the spores to drop free into the atmosphere and be dispersed by the wind. This dispersal usually occurs at the time of highest atmospheric humidity and often occurs between midnight and 6:00 AM.

1037 MAC AMINITA VIROSA - DESTROYING ANGEL

This is Amanita virosa, also known as the Destroying Angel. It is one of the most toxic mushrooms known. Spores from this mushroom are colorless which makes them very difficult to see in air samples. Image 1036 is a close up of the gill from this mushroom.

1038 MIC ARMILLARIELLA BASIDIOSPORES



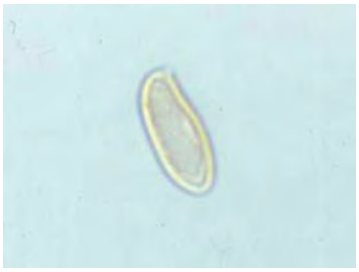
Armillariella basidiospores are colorless. They are difficult to see in air samples because they are colorless. They are small spores as well only about 4 to 5 micrometers in length.

1039 MAC ARMILLARIELLA TABESCENS MUSHROOM

Armillariella tabescens is a common mushroom. It often occurs in the fall and in very dense clusters. This particular mushroom is actually a root rot fungus and will occur on the ground over the roots of trees. Very often this fungus can actually kill the tree and the fruiting body still continue to come up each fall as the roots gradually rot away. Although widely distributed, Armillariella tabescens is probably more common in the South.

1040 MIC BOLETUS SPORES

The genus Boletus is an usual genus of mushrooms. Instead of gills this has pores. However, it is not a bracket fungus. It is fleshy like other mushrooms. The spores of the genus Boletus tend to be elongate and often are golden yellow color.



1041 MIC BOLETUS BICOLOR

Boletus bicolor is a basidiospore in the genus Boletus. The spores are elongate and often a yellowish color. This particular basidiospore in this image shows the hilar appendage, the attachment, very well in the upper right hand corner of the spore. It is approximately 6 to 7 micrometers in length and 4 micrometers in width.

1042 MAC CHLOROPHYLLUM MOLYBDITES MUSHROOM

One of the most common mushrooms in the South is Chlorophyllum molybdites. This even has a common name Morgan's Lepiota or Green Gill Lepiota. As the mushroom ages the gills turn a green color and in fact it is almost an olive green color. This mushroom often appears in the summer after a heavy rainfall and we often see it in what is called a fairy ring and you can look at image 1043 to see a ring of Chlorophyllum molybdites.

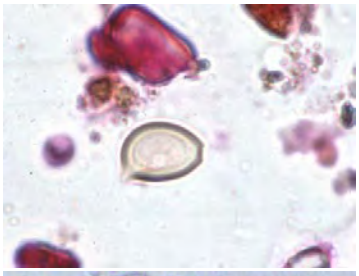
1043 MAC CHLOROPHYLLUM MOLYBDITES FAIRY RING

This is a fairy ring caused by the fungus Chlorophyllum molybdites. You often see these occurring in the summer after a heavy rainfall and for a closer view look at image 1042.

1044 MIC CHLOROPHYLLUM MOLYBDITIES COLORLESS SPORES

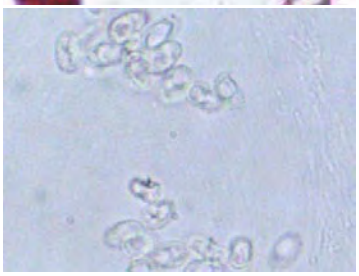
The spores of Chlorophyllum molybdites although colorless are sometimes easy to see. They have a thick wall, a distinctive germ pore and a hilar appendage. The attachment peg is often visible.

1081 MIC CHLOROPHYLLUM MOLYBDITES



This is a slide of Chorophyllum molybdites in an air sample. Although the spore is colorless its very distinctive with its thick wall, prominent germ pore and prominent hilar appendage.

1082 MIC CLITOCYBE TARDA



These are basidiospores from Clitoybe tarda. The spores are colorless, small in size roughly 4 to 6 micrometers in size, and difficult to see and identify in air samples.

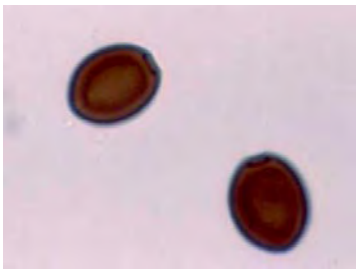
1045 MAC CLITOCYBE TARDA MUSHROOMS

This is Clitocybe tarda a very distinctive mushroom because of it's light lilac color. The spores are colorless and very difficult to identify in the atmosphere.

1046 MIC CONOCYBE LACTEA SPORES

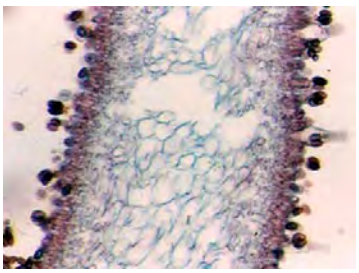
Conocybe lactea has very distinctive basidiospores. They are golden in color, approximately 12 micrometers in length, 8 micrometers in width, a distinctive germ pore and a small hilar appendage at the base.

1047 MIC COPRINUS SPORES

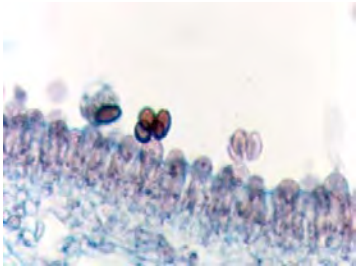


Coprinus comatus basidiospores show a prominent germ pore. These are approximately 4 X 6 micrometers in diameter.

1048 MIC COPRINUS GILL



This is a section of the Coprinus gill at low magnification showing the basidia on both sides of the gill. This is a section and stained sample of the gill.

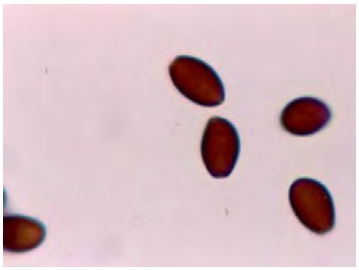


1049 MIC BASIDIA ON COPRINUS GILL

This is a sample of a Coprinus gill that has actually been cut with a microtone and stained. You can clearly see the basidia on the surface of the gill and the basidium at the center has 4 basidiospores. This is a perfect example of a basidium with 4 basidiospores.

1050 MAC COPRINUS MICACEUS - INKY CAPS

This is a dense cluster of Coprinus micaceus mushrooms. The genus Coprinus are commonly called inky caps, and this image shows why as the mushrooms age they gradually dissolve into an inky mass. This process is often called deliquescence.



1051 MIC COPRINUS QUADRIFIDUS SPORES

These are spores of Coprinus quadrifidus. Like all basidiospores these are single celled. Basidiospores are attached to the basidium with a structure called the hilar appendage and the hilar appendage at the base of the spore is visible on 2 of the spores in the center of this slide.

1052 MAC COPRINUS QUADRIFIDUS CLOSE-UP

This is a close view of Coprinus quadrifidus mushrooms. They occur in clumps and often the individual mushrooms are attached as you can see at the base of a clump. Like all mushrooms the spores form on gills and are dispersed into the atmosphere with a mechanism that requires moisture.

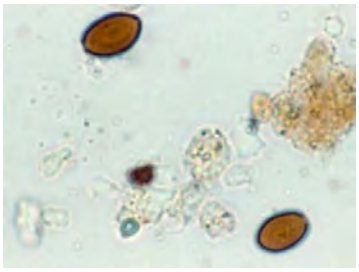
1053 MAC COPRINUS QUADRIFIDUS - INKY CAPS

This is a cluster of Coprinus quadrifidus. The genus Coprinus are commonly called Inkcaps. As the mushroom ages they gradually turn darker and convert to a black, inky mass.

1054 MAC INKY CAPS

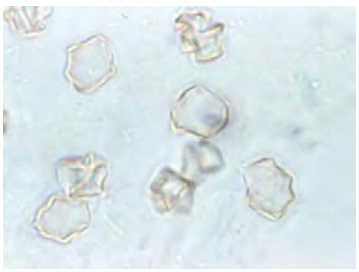
The genus Coprinus are commonly called inky caps. They are widely distributed throughout North America and often occur in dense clusters. This particular species of Coprinus is Coprinus quadrifidus.

1055 MIC COPRINUS BASIDIOSPORES



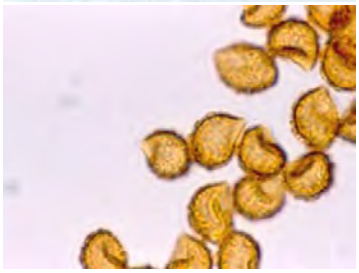
Coprinus basidiospores are often the most prominent basidiospores in air samples. At times their concentrations are quite high. Basidiospores in this genus range in size from small basidiospores that are no more than 4 micrometers in length to larger ones that may be as much as 12 micrometers long. The ones on this image are approximately 6 micrometers in length.

1056 MIC ENTOLOMA CLYPEATUM BASIDIOSPORES



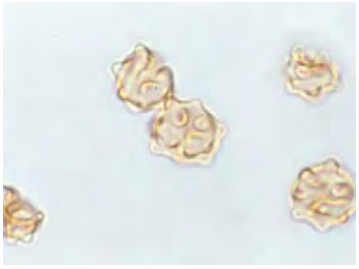
Entoloma clypeatum basidiospores have an irregular shape. One might often think it looks like broken glass. Although individually they look transparent or colorless, they actually have a very faint pink tinge.

1057 MIC GALERINA BASIDIOSPORE CLUMP



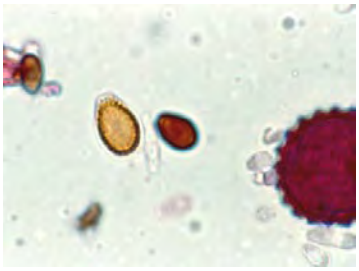
This is a clump of Galerina basidiospores from a spore print. The spores are golden in color and the surface of the spores are warty. One of the distinctive features is a very prominent hilar appendage. Galerina basidiospores although not frequent can be seen in the fall.

1058 MIC INOCYBE SPORES



This species of Inocybe has lobe spores and are very distinctive. In fact these are easier to see on air sample slides because of the distinctive lobed appearance.

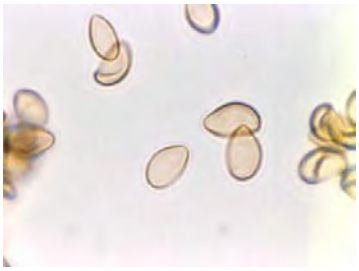
1059 MIC COPRINUS + GANODERMA BASIDIOSPORES



This shows an air sample showing both a Coprinus and a Ganoderma basidiospore. The Ganoderma basidiospore is on the left and is golden in color. The Coprinus basidiospore is in the center and is slightly out of focus. On the right is a ragweed pollen grain. Looking at these 3 bioaerosols distinctly shows the difference between many spores and pollen and that's the size difference. Because of the smaller size of the basidiospores, it is possible that they can penetrate deeper in the respiratory tract. This may explain why it causes more asthma than rhinitis.

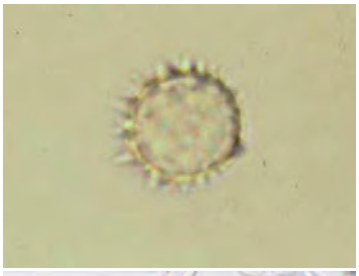
1060 MAC GYMNOPHILUS MUSHROOMS

We do often see mushrooms occurring on wood as this Gymnopilus example shows. These fruiting bodies were growing right from a branch. Gymnopilus is a genus of mushrooms in the family Cortinariaceae. This family is distinctive because of the golden color of the spores. We often see Gymnopilus spores in the atmosphere although it would be very difficult to identify to the genus level.



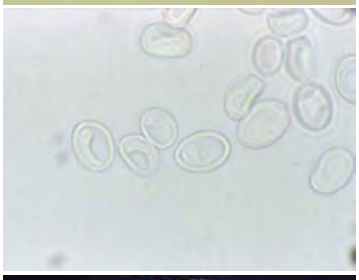
1061 MIC INOCYBE SPORES

The genus Inocybe is a common genus of small mushrooms. They are very common in lawns and in fields often occurring between the blades of the grass and hardly noticeable. The spores are usually pale golden color and it may be either elliptical in some species such as this Inocybe fastigata while other species of Inocybe have lobed spores as in image 1058.



1062 MIC LACCARIA BASIDIOSPORE

This is a Laccaria basidiospore. The spores are highly ornamented but they are colorless and in spore trap samples they are very difficult to identify.

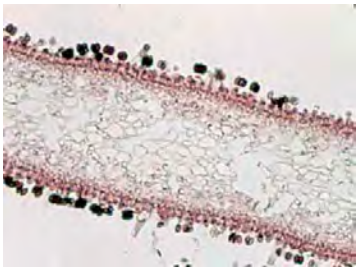


1063 MIC LEPIOTA AMERICANA SPORES

Lepiota spores are common in the atmosphere but they are difficult to identify because the spores are colorless. This sample is from a spore print from Lepiota americana.

1064 MAC LEPIOTA AMERICANA MUSHROOMS

Lepiota americana is a well known mushroom in the genus Lepiota. It occurs in clumps and the cap morphology is very distinctive with reddish scales on the surface and a reddish stalk. The spores are colorless and although may be abundant they are difficult to identify in air samples.



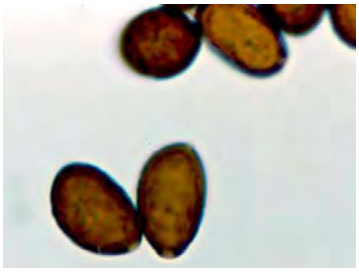
1065 MIC MUSHROOM GILLS

This is a sample of mushroom gills that have been sectioned and made into permanent slides. The gills clearly show the basidia lining the surface of the gills with their basidiospores.

1066 MAC PANAEOLINA FOENISCII MUSHROOMS

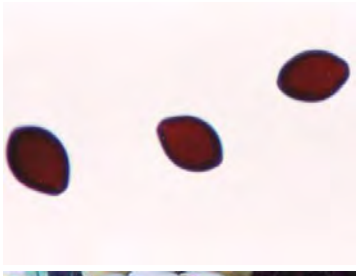
Panaeolina foeniscii are very small mushrooms. In fact, some call these LBMs, little brown mushrooms. They occur between the blades of grass that come up early in the morning and often by mid-day they are shriveled. These particular ones are actually hallucinogenic.

1067 MIC PANEOLINA FOENISCII BASIDIOSPORES



The basidiospores of Panaeolina foeniscii are quite large. The spores may be 12 to 15 micrometers in length and the surface is rough giving it a lumpy appearance. It has a distinctive germ pore and the hilar appendage is also often distinctive. These would occur on air samples during the summer after rain.

1068 MIC PANAEOLUS FIMICOLA BASIDIOSPORES



Panaeolus fimicola is a large brown basidiospore that is related to Coprinus spores but is larger.

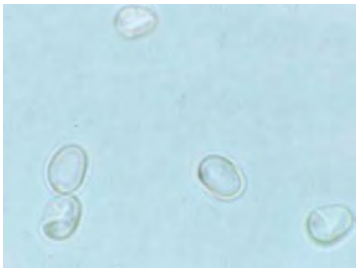
1069 MAC OYSTER MUSHROOM - PLEUROTUS OSTREATUS

Pleurotus ostreatus is also called the Oyster Mushroom. While you can still find it easily in the natural environment growing on various trees, it is also cultivated and considered a gourmet delicacy. It produces abundant spores and the spores are believed to be highly allergenic.

1071 MIC PLEUROTUS OSTREATUS BASIDIOSPORES

The spores of Pleurotus ostreatus are colorless. The slide from a spore print has been stained to the show the spore shape and size. The spores are roughly 6 to 8 micrometers in length and 3 to 4 micrometers in width.

1072 MIC PLEUTEUS CERVINUS SPORES



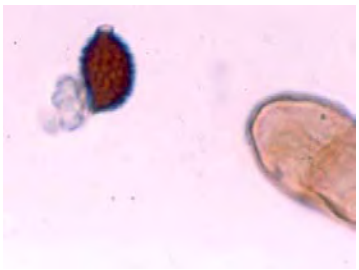
Pleuteus cervinus spores are colorless and small. They are approximately 5 micrometers in length, 3 micrometers in diameter.

1073 MAC PLEUTEUS CERVINUS - DEER MUSHROOMS

Pleuteus cervinus is called the deer mushroom. It is edible and quite tasty. Individually the spores are small and colorless. However, in mass the spores are a pink color.

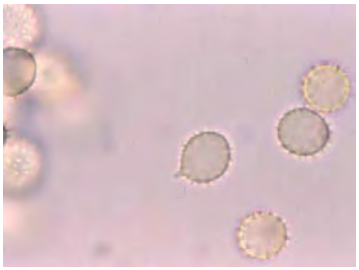
1074 MAC / MIC PSATHYRELLA MUSHROOMS

The genus Psathyrella is a genus of small little brown mushrooms that often come up on the lawn. The spores of some Psathyrella species are small, brown and cylindrical and in many respects looks very similar to Coprinus spores. This is an example of Psathyrella fruiting body and Psathyrella spores in the lower right hand corner. Although we often see spores like this in the atmosphere, they may be easily mistaken for Coprinus spores.



1076 MIC PSATHYRELLA VELUTINA BASIDIOSPORE

The mushroom Psathyrella velutina has a very distinctive basidiospore. Although it is small, possibly 6 micrometers in length, it is ornamented. It has warts on the surface. The germ pore is elongated and it is often referred to as apical snout. Although other species of Psathyrella have cylindrical unornamented spores, Psathyrella veluntina is very distinctive and can be easily identified in air samples.



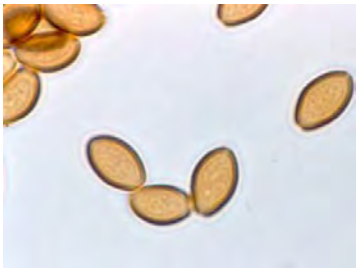
1078 MIC RUSSULA BASIDIOSPORES

The genus Russula is a large genus of mushrooms. The basidiospores are highly ornamented. There may be spines, warts or ridges present on the surface of the spore. The spores, however, are colorless and on air samples may be difficult to see.

1079 MAC STROPHARIA MELANOSPERMA MUSHROOMS

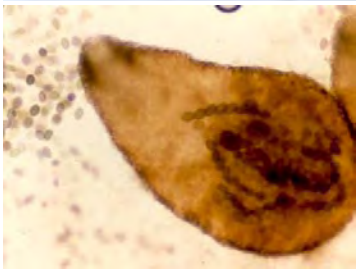
Stropharia melanosperma is a common mushroom occurring in the summer in many areas of North America. It's characterized by slightly purplish cast to the gills. You find this in the grass and very commonly occurring on lawns, even in cities.

1080 MIC STROPHARIA MELANOSPERMA SPORES



The spores of Stropharia melanosperma are a yellowish brown individually. The spores are 7 to 9 micrometers in length with a germ pore. The spores are distinctive and can readily be seen on air samples throughout the summer.

1103 MIC INTRODUCTION TO ASCOMYCOTA

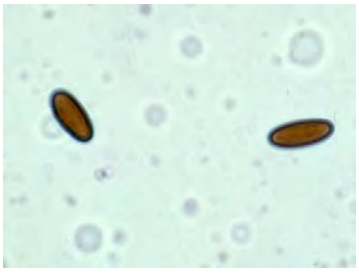


The division Ascomycota is a large division of fungi. There may be as many as 30,000 species of Ascomycetes in this division. The Ascomycetes range from small unicellular yeasts to large complex structures such as Morels which have a large fruiting body or reproductive structures. What characterizes this division is the presence of ascospores. These are the sexual spores. Ascospores form within an ascus and very often the asci, plural of ascus, forms within a fruiting body. This image shows a flask shaped fruiting body called a perithecium with numerous asci. Within each ascus there are 8 ascospores and the 8 spores can be seen lined up in this image. These 8 spores form following sexual reproduction. This reproduction starts in the young ascus when 2 nuclei fuse in to form a zygote. Following the formation of the zygote, meiosis occurs to get 4 nuclei. This is followed by a mitotic division to get 8 cells or 8 spores. These are usually released from the ascus by a mechanism that shoots the spores out when the spores are matured. What usually happens is that moisture is absorbed by hygroscopic compounds within the ascus. Pressure builds up and then the spores are shot out. This usually means that the spores are released when moisture is available often during rainfall itself or other times during periods of very high humidity. As a result, ascospores are frequent in the atmosphere during rain and also occur early in the morning when the humidity is very high.

1083 MIC AMPHISPHAERIA ASCOSPORES

This is a group of 8 ascospores. Possibly these are spores in the genus Amphispheaeria. Ascospores we often seen in the atmosphere - still in groups of 8. This goes back to their method of formation. Eight ascospores are formed within each ascus and are released due to high pressure that develops within the ascus. All 8 spores are frequently shot out explosively at a single time and will often remain together while airborne. These ascospores are 2 celled. However, ascospores can range from small single cell spores to very large multi-cellular spores.

1084 MIC ASCOSPORES



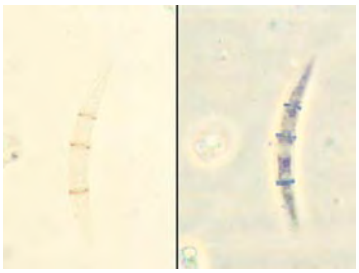
This image shows 2 ascospores. They are different, pigmented, single celled spores and like all ascospores shows no attachment structure or no attachment scar.

1085 MIC CALOPLACA ASCOSPORES

This group of 8 ascospores is possibly the genus Caloplaca. Like many other ascospores these often stay together in a cluster of 8 spores while in the air.

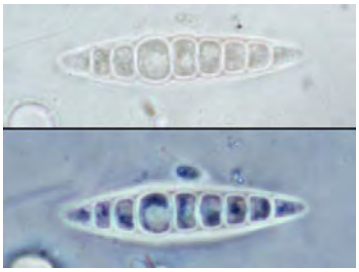
1086 MIC LEPTOSPHAERIA + DIATRYPACEAE SPORES

This is an air sample showing 2 different ascospores. On the right is Leptosphaeria but the other 7 spores on the slide are ascospores in the family Diatrypaceae. The one of the right, the Leptosphaeria, is multi-cellular while the others are single cell spores. Neither type has an attachment scar.



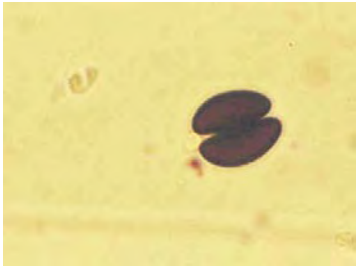
1087 MIC PHAEOSPHAERIA ANNULATA

This image shows the same spore on both bright field and phase contrast. The bright field is on the left; the phase contrast is on the right. This is a spore of Phaeosphaeria annulata. It is a 4-celled ascospore. Again like all ascospores there is no attachment scar. The septa dividing each of the cells is very prominent in this genus and can clearly be seen on both the bright field and phase contrast view.



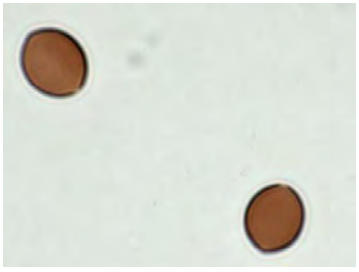
1088 MIC ASCOSPORE

This is another image showing both bright field and phase contrast microscopy of the same spore. The image on the top is bright field, the image on the bottom is phase contrast. These are multi-cellular ascospores. No attachment scar is visible on the spores and a thin mucilaginous sheath can be seen surrounding the whole spore.



1089 MIC XYLARIACEAE

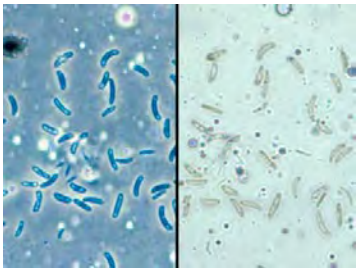
There are 2 ascospores near the center of this field. They are in the family Xylariaceae.



1090 MIC CHAETOMIUM

One of the more common Ascospores that we see in both outdoor air and indoor air is the genus Chaetomium. The spores are lemon shaped and have a jelly pore on both ends of the spore. These spores are typically golden brown to dark brown and they are singled celled. Sometimes this genus has been mistaken for a Coprinus basidiospore, but careful focusing will show that germ pores are present on both ends and there is no attachment peg on this spore.

1091 MIC DIATRYPELLA

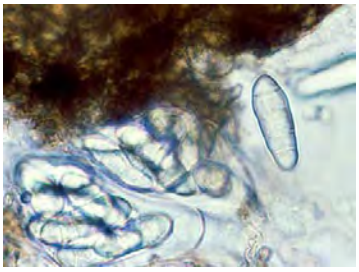


One Ascospore type that we see during rainfall in abundant numbers the genus Diatrypella. The spores are thin sausage shaped spores. They are colorless and often in great numbers especially in the springtime. This image shows the spores in both bright field on the right and face contrast on the left. Members of the family Diatrypaceae have all similar spore types and also appear as colorless sausage shaped spores. Diatrypella spores are typically about 4 microns in length.

1092 MIC DIDYMELLA

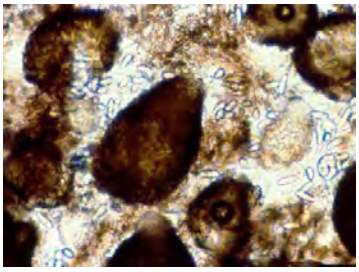
Ascospores are frequently abundant in the atmosphere especially during periods of rainfall. One type of spore that we frequently see are small 2 cell spores of Didymella type. This is an example of this type of spore. Careful focusing is usually needed to see these spores because they are completely colorless. The septum dividing the 2 cells is also sometimes difficult to see and requires careful focusing.

1093 MIC LEPTOSPHAERULINA PERITHECIUM



Leptosphaerulina produces ascospores within a perithecium. This image shows a perithecium that has been crushed to release the asci. Two asci are visible in the lower portion of the image. Each ascus contains 8 ascospores. A single ascospore is visible on the right hand side of the screen and this is clearly seen to be a multi-cellular spore. A close up view of the spore is seen in image 1095.

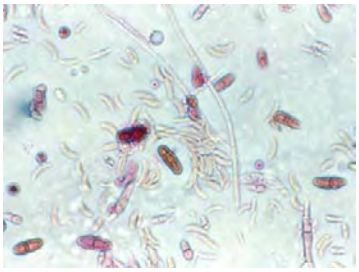
1094 MIC LEPTOSPHAERULINA ASCOSPORES



The genus Leptosphaerulina produces ascospores within a flat shaped structure called a perithecium. Within the perithecium are numerous asci and within each ascus are 8 ascospores. This image shows a number of perithecia that had been lightly crushed to show the asci and the ascospores. A close up of the asci is seen in image 1093, and a close up of the single ascospore is seen in image 1095.

1095 MIC LEPTOSPHAERULINA ASCOSPORE

One genus of Ascomycetes that is easy to recognize is the genus Leptosphaerulina. The spores of Leptosphaerulina are colorless. However, they are large multi-cellular spores with both transverse and longitudinal septa. This multi-cellular spore is easy to recognize because of the septations.



1096 MIC DIATRYPACEAE ASCOSPORES

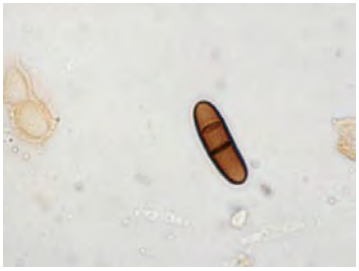
This air sample is from the springtime during rainfall in Tulsa, Oklahoma. It is a low magnification image and the image shows numerous ascospores all through the field. The most abundant ascospore present are the small sausage shaped spores that belong to the family Diatrypaceae.

1097 MIC MORCHELLA ASCOSPORES

Ascospores are formed within an ascus. There are 8 spores formed within each ascus and these result from sexual reproduction. Within the developing ascus, 2 haploid nuclei fuse to form a zygote. The zygote then undergoes mitosis to form 4 spores, followed by an additional mitotic division to form 8 ascospores. These are frequently lined up as seen in this image of Morchella. This is actually an ascus. There are many asci visible in this field from a morel. Image 1098 shows the whole fruiting body of a morel.

1098 MIC MORELS

This image shows morels. The delectable, edible fungus better known as Morchella esculenta. These are all Ascomycetes and this fruiting body produces ascospores in the depression at the top part of the structure. In each depression there are numerous asci that produce ascospores. A close up of the asci and the ascospores is visible in image 1097.



1099 MIC PARAPHAEOSPHAERIA ASCOSPORE

This air sample shows an ascospore in the genus Paraphaeosphaeria. It is a 3-cell spore and deeply pigmented. Like other ascospores there is no attachment.

1100 MIC PLEOSPORA ASCOSPORE

Pleospora ascospores are common in the atmosphere. They are large, deeply pigmented, multi-cellular spores with both transverse and longitudinal septa. This image also shows a Diatrypaceae Ascospore to the left of the Pleospora. It is very difficult to see because it is a colorless spore. To the right and slightly above the Pleospora is another spore that may also be an Ascospore. However, it is out of focus and difficult to see.

1102 MIC MULTI-CELLULAR PLEOSPORA ASCOSPORE

Pleospora Ascospores are common in the atmosphere. They are large, multi-cellular spores with both transverse and longitudinal septa.

1104 MIC SPOROMIELLA ASCOSPORE

Sporomiella is another ascospore that we sometimes see in the atmosphere, although it is more common in agricultural areas than it is in the city and is especially common around areas where there are cattle or other grazing animals because the fungus is associated with the dung of the herbivores. The spore is a 4 cell spore but sometimes the spore comes apart. Image 1105 shows the Sporomiella ascospore that has split apart.

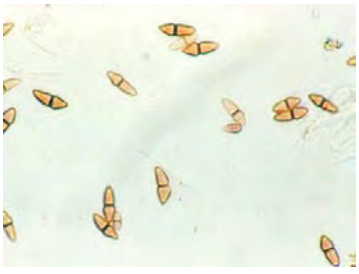
1105 MIC 4-CELLED SPOROMIELLA ASCOSPORES

Sporomiella is a common ascospore we often see in the atmosphere especially around agricultural areas. The spore is actually 4 celled but it sometimes splits apart and this image shows one that has split apart. Look at the image in 1104 to see an intact Sporomiella.

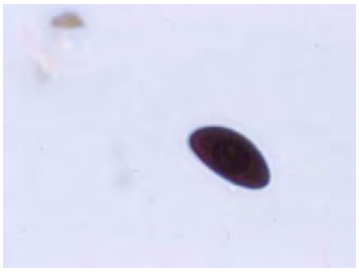
1106 MIC ASCOSPORES IN AIR

This is a wonderful slide with 3 ascospores. They are all multi-cellular. The top two are 2 celled while the bottom one is 6 celled. The spore on the bottom is Leptosphaeria probably the most common ascospore that we see in air samples. This slide is typical of what you would see in the atmosphere.

1107 MIC VENTURIA ASCOSPORES



Ascospores from the genus Venturia are frequent in the springtime. Venturia is a plant pathogen and it attacks a number of species especially apples and pears and related fruit trees. The spores are 2 celled with 1 cell slightly larger than the other.

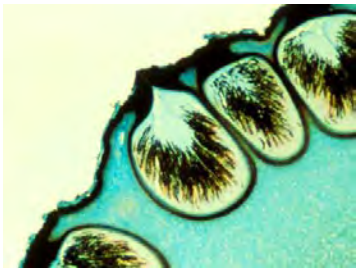


1109 MIC XYLARIA HYPOXYLON ASCOSPORE

This is a single ascospore from Xylaria hypoxylon. Xylaria type ascospores are very common in the atmosphere. They are single celled and very deeply pigmented, frequently appearing black. The pigment in these spores and in most fungal spores is melanin the same pigment found in humans and other animals when exposed to sunlight. The function of the melanin is protection from UV damage which can harm the DNA.

1110 MAC FRUITING BODY OF XYLARIA

The genus Xylaria contains fungi that form a black carbon looking fruiting body. These typically form on fallen wood such as fallen branches or rotting twigs and rotting logs. Within the fruiting body ascospores develop. Image 1111 shows a section cut from a Xylaria fruiting body and image 1109 shows a single spore from Xylaria.



1111 MIC XYLARIA CLOSE-UP

This image shows a section cut through a Xylaria fruiting body. The whole fruiting body can be seen in image 1110. This section has been cut with a microtone and has been stained. What you see are 4 perithecia and formed within each perithecium are asci and ascospores. A close up of the single ascospore is seen in image 1109.

1112 MIC ALTERNARIA

Alternaria is a very abundant spore in the atmosphere. It is often the second most abundant spore type you see. Alternaria is a well known allergen and Alternaria has been associated with severe asthma. The spores are multi-cellular with both transverse and longitudinal septa. The spores occur in chains when they form and the attachment scar is visible often at either the beak end, the thinner end, or the basal end. In the spore visible across the field there is an attachment scar visible on the left hand side.

1113 MIC ALTERNARIA SEPTATIONS

This image shows 2 Alternaria spores. Although the septations are not as visible in this particular image the shape of the spores and the attachment scars on both ends make it obvious that it is Alternaria.

1114 MIC ALTERNARIA CHAINS

Alternaria spores develop in chains. Sometimes the spores stay together in a chain even when they have been dispersed into the atmosphere. This image shows 4 Alternaria spores, 3 are still in a chain. The spore on the lower left is the most mature while the one in the upper right hand corner is the youngest and least developed.

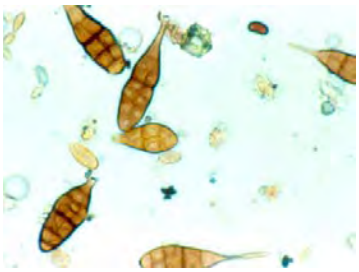
1115 MIC ALTERNARIA: BEAK-LIKE APPEARANCE

This is a close of a singular Alternaria spore. The transverse and longitudinal septa are clearly visible as is part of the elongate beak that is going off the edge of the slide.

1116 MIC ALTERNARIA - UNUSUAL

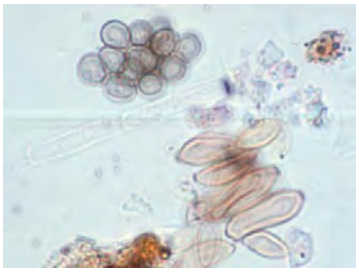
Although Alternaria is typically characterized by both transverse and longitudinal septa, there are 1 or 2 species of Alternaria that rarely show the longitudinal septa. This image shows 4 Alternaria spores - only showing the transverse septa. The long beak is apparent on these spores as is the attachment scars at the base of the spore.

1117 MIC ALTERNARIA + CLADOSPORIUM



This air sample shows a number of Alternaria spores. The Alternaria spores are the large multi-cellular spore with a beak. The spores have been described as looking like a chicken leg, bowling pin or even a snowshoe. The spores are deeply pigmented and have both transverse and longitudinal septa. There are a number of the species of Alternaria and this is often the second most abundant spore type in the outdoor air. Throughout the field of vision, there are other spores. There are some Cladosporium in the upper left hand corner; there are basidiospores in the lower right hand corner as well as other spores throughout the field.

1118 MIC BOTRYTIS + CLADOSPORIUM



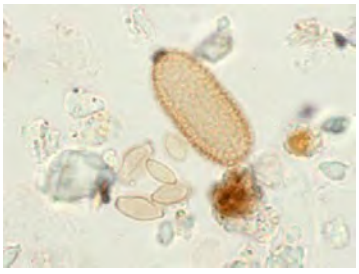
This air sample shows 2 distinctly different fungal spores. In the upper portion there is a cluster of Botrytis spores. These are unicellular spores. They are thinned wall and often show some signs of collapse. They frequently have a gray overcast color. On the lower portion of the slide is a clump of Cladosporium spores. These are frequently in shades of yellow to light brown and have very distinctive attachment scars on either ends. The Botrytis is most likely seen following rainfall.

1119 MIC ASEXUAL SPORES - CLADOSPORIUM

The atmosphere is dominated with asexual spores during dry weather and the most abundant of the asexual spores belong to the genus Cladosporium. This is one species of Cladosporium and this is Cladosporium sphaerospermum. In this species of Cladosporium the spores are usually unicellular, they are often elliptical to lemon shaped and have a very prominent protruding attachment scars.

1120 MIC CLADOSPORIUM - ATTACHMENT SITE

This sample of Cladosporium shows just 2 spores. A common characteristic of Cladosporium is that they may be single celled or multi-cellular. One spore here is single celled but the second spore is 2-celled. One of the most prominent features on Cladosporium is the attachments. On both spores you can see prominent attachments, although they look darker it's just a trick of the light, and focusing up and down will show this light refraction change.



1121 MIC CLADOSPORIUM CLADOSPOROIDES + HERBARUM

This air sample shows two different Cladosporium species and two very distinct species. The smaller one which has a cluster of 5 spores is Cladosporium cladosporoides. Again the attachments are quite distinctive. The larger spore diagonally in the center of the field is Cladosporium herbarum with a very highly ornamented cell wall.

1122 MIC CLADOSPORIUM

This slide shows two different species of Cladosporium. One has smooth walls and is Cladosporium cladosporoides and is the more abundant. We often see clusters of Cladosporium in the atmosphere on dry days and this is the most abundant airborne spore. In Tulsa we have often seen levels of Cladosporium exceed 100,000 spores per cubic meter.

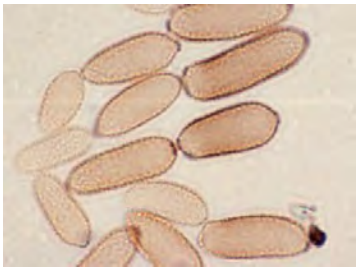
1123 MIC CLADOSPORIUM CLOSE-UP

This air sample has a large cluster of Cladosporium spores. These are ornamented and as you look at the spores you can see single cell spores and 2 celled spores and even one 3 celled spore in the upper left part of the image.

1124 MIC CLADOSPORIUM CLADOSPOROIDES

Cladosporium cladosporoides is one of the more common species of Cladosporium in the air and Cladosporium itself is often the most abundant spore type in the atmosphere especially on days with dry weather. This cluster that is visible on this image actually shows the manner in which Cladosporium grows with one spore, giving rise to younger spores. The attachments are very distinctive on a number of Cladosporium spores which can be seen in this image.

1125 MIC CLADOSPORIUM ATTACHMENTS

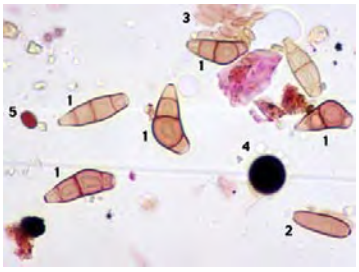


This image shows an air sample with a cluster of Cladosporium spores. This is one of the larger species of Cladosporium and the spores are roughly 20 to 25 micrometers in length and have ornamented walls. The attachment scars are still visible and still prominent in this species.

1126 MIC CURVULARIA

Curvularia is a common asexual spore that we see in the atmosphere. The spores are very distinct and it is very recognizable. The spore is multi-cellular with only transverse septa. The central cell is frequently enlarged asymmetrically and this gives the spore a curved appearance. In addition the end cells are usually paler in color and the attachment scar is very prominent.

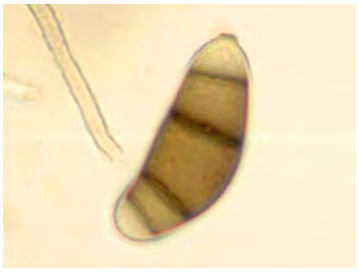
1127 MIC CLASSIC MOLD SPORES IN AIR SAMPLE



This air sample shows a number of different fungi. The most prominent spores on this image are Curvularia spores. #1. Curvularia spores have an enlarged central cell and a curved appearance. The spore wall is very thick and the spore length is frequently 15 to 20 micrometers in length. When viewed from its side, the curved appearance is very noticeable as seen in the spore in the center of the image. However, when viewed on its back the curved appearance of the central cell is not visible and the images on the left side of the screen show this lack of curvature. #2 is Dreschslera another common genus of asexual fungi. The spore size is slightly smaller for this particular Dreschslera spore. #3 is a cluster of Cladosporium spores. Part of them are slightly out of focus but nonetheless the prominent attachment scars on either end of the spore are visible in a number of the cells. #4 is Nigrospora. It's spherical in outline and very deeply pigmented and usually appears black. It is about 15 micrometers in diameter. #5 is a small Coprinus basidiospore. The spore on the upper right is probably also Curvularia but is slightly out of focus.

1128 MIC CURVULARIA

This image is a culture of Curvularia. You can see the spores budding off the conidiophore. The cells have thick walls in the spores and the central cell is showing enlargement in a number of them and the curvature is also visible on a few of these spores.



1129 MIC CURVULARIA - HIGH POWERED VIEW

This is a high-powered view of a single Curvularia spore from culture. The enlarged central cell is visible and the lighter end cells are also visible. The attachment at the top of the spore is also prominent.

1130 MIC DRESCHSLERA SPORE

This image shows a Dreschslera type spore in the atmosphere. There are several genera of similar thick walled spores that are present in air samples: Dreschslera, Bipolaris, Helminthosporium. It is often difficult to distinguish these genera. One feature that distinguishes them is the attachment scar, but other features are method of germination, which of course is not visible on the air sample. So, it is often best to just list these as Dreschslera type spores.

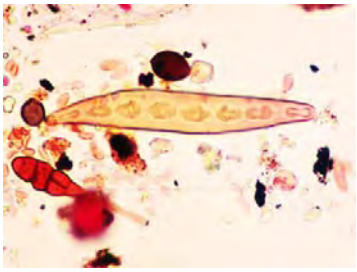
1131 MIC DRESCHSLERA

Dreschslera type spores are common in the atmosphere. They range greatly in size from smaller spores that may be 15 micrometers in length to very large ones that are 60 to 70 micrometers in length. They all have thick walls and they are pseudoseptate, meaning the cross walls do not go all the way through.

1132 MIC DRESCHLERA - THICK WALLS + PSEUDOSEPTAE

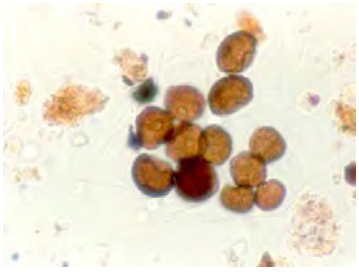
Dreschslera are common asexual spores. They are typified by thick walls and they are pseudoseptate. They vary greatly in length from small spores to very large spores.

1133 MIC ALTERNARIA, DRESCHSLERA, CLADOSPORIUM CLUSTER



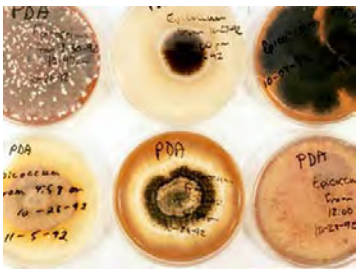
This air sample shows a number of different types of spores. The largest spore on the sample is Dreschslera or Dreschslera type spore, which stretches across the center of the field. The thick walls and pseudo septate cells are typical characteristics of Dreschslera. Above the Dreschslera is a deeply pigmented basidiospore and below and to the left is an Alternaria spore. Directly to the left is a slime mold spore. In some ways this image almost looks like a seal playing with a ball. In the background throughout this slide is clusters of Cladosporium spores.

1134 MIC EPICOCCUM SPORES



This air sample shows a group of Epicoccum spores. The magnification is only 40X objective in the microscope. The spores are approximately 20 micrometers in diameter. They are multi-cellular spores with irregular septations. They are transverse, longitudinal and also at odd angles. The overall appearance of this spore is somewhat like a soccer ball.

1135 MAC EPICOCCUM CULTURES

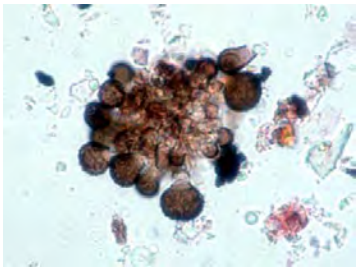


Epicoccum commonly occurs in the atmosphere. When cultured we see a great variation in morphology. These six cultures were all cultured from airborne samples and all grown on potato dextrose agar. However, we see a great variation in the morphology of the cultures. Some cultures such as the one in the upper right formed almost no mycelium and massive clumps of black spores. Where as others, like the lower right, form very few spores and abundant fluffy orange colored hyphae. The cultures in the center show both aerial hyphae and spores and those on the left mainly aerial hyphae. Despite this variation in morphology these are all the same species, Epicoccum nigrum. Both environmental conditions and genetics seem to play a role in this cultural morphology.

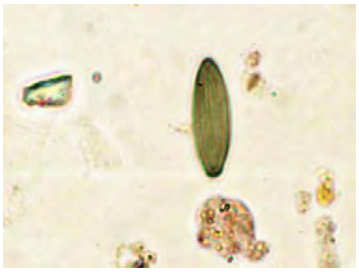
1136 MIC EPICOCCUM CLOSE-UP

This is a single Epicoccum spore in the atmosphere at high power using the 100 X objective. The microscope was focused on the outer wall showing the warty appearance on the surface of Epicoccum spores.

1137 MIC CLUSTER OF EPICOCCUM - A SPORODOCHIUM

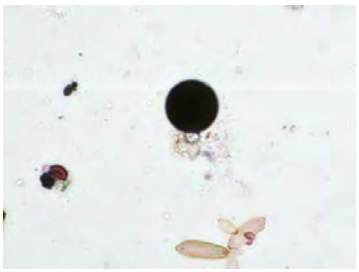


This is an usual image of Epicoccum to see in the air sample. Epicoccum in culture or in even on natural substrates on leaf surfaces or in decaying vegetation produces spores in a cluster called a sporodochium. This image from the atmosphere shows the whole sporodochium, which had become airborne.



1138 MIC MYROTHECIUM SPORE

Green is an unusual color for fungal spores, but it is characteristic of the genus Myrothecium. This Myrothecium spore is elongate, it has a prominent attachment at the base and it has longitudinal striations. But the most distinctive feature of the spore is the olive green color.

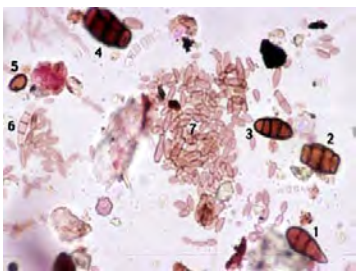


1139 MIC NIGROSPORA

In the center of this air sample is a single Nigrospora spore. It looks circular in outline, but in reality it is a lens shaped spore.

1140 MIC NIGROSPORA SPHAERICA

This image shows a culture of Nigrospora sphaerica. In its center is a single Nigrospora conidium. Deeply pigmented and the spore is actually lens shaped. This is very distinctive in an air sample because nothing else looks like this. In fact, it is so dark and so perfectly round that many people don't believe that it is a real spore.



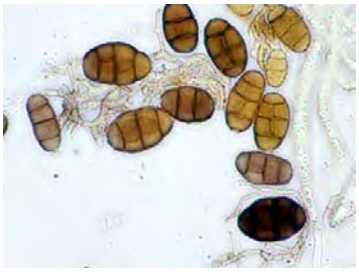
1141 MIC TYPICAL LATE SUMMER AIR SAMPLE

This image shows a typical outdoor air sample from late summer. Spore levels are very high and many familiar molds are on this image. You should know all of these. What is #1? It's Alternaria. What is #2? It's a Pithomyces spore. What is #3? This appears to be an immature Pithomyces where the longitudinal septa are not visible yet. What is #4? This is another Pithomyces spore. What is #5? This is a Ganoderma basidiospore. What is #6? This 4-celled spore is an Ascospore. You should also be able to recognize several other Ascospores also on the field but not numbered. What's #7? This, of course, is Cladosporium, the most abundant airborne spore on this sample and usually in the atmosphere in general. Remember that when you are counting airborne spores you have to count every spore visible in the field and this means all of the Cladosporium.

1142 MIC PESTALOTIOPSIS SPORE

Pestalotiopsis is an unusual spore. It has appendages. The central cells of the spore are usually dark gray while the appendages are clear. The appendages almost look like long tails on the end of the spore.

1143 MIC PITHOMYCES



This image shows a culture of Pithomyces. The spores visible on the image are of different ages and actually are quite distinctive. The mature Pithomyces spore has both transverse and longitudinal septa but several of the spores in this image show only transverse septa.

1144 MIC PITHOMYCES CLOSE-UP

Pithomyces is common in the atmosphere. The spore is characterized by both longitudinal and transverse septa. In this spore, however, the transverse septa are very apparent but the longitudinal septa are not. At the base of the spore a colorless attachment is usually seen. You may have to focus up and down with a fine adjustment to see this colorless attachment peg but it is usually present.

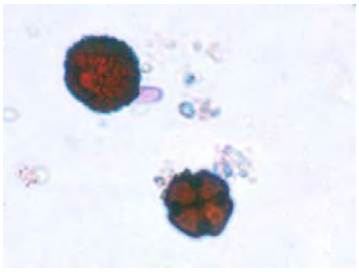
1145 MIC PITHOMYCES SPORE

Pithomyces spores are common in the atmosphere. The spores are somewhat barrel shaped and are characterized by both transverse and longitudinal septa. In this particular sample the longitudinal septa are not clearly visible, but focusing with a fine adjustment may bring this into focus. Pithomyces spores generally appear in the atmosphere by themselves rather than in clusters.

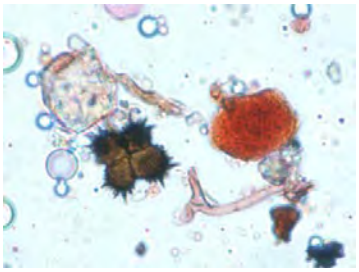
1146 MIC PITHOMYCES ATTACHMENT PEG

This Pithomyces spore is slightly out of focus but what is in clear focus is the colorless attachment peg at the base of the spore.

1147 MIC SPEGAZZINIA - FOUR-CELLED

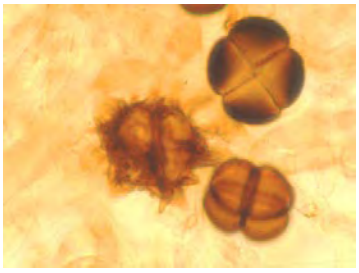


Spegazzinia is a fungal spore that you occasionally see in the atmosphere. This air sample shows a single Spegazzinia spore in the center. In the upper left hand corner it is actually an Epicoccum spore but it is slightly out of focus. The Spegazzinia spore has 4 cells and it looks a little bit like a four leaf clover. It is deeply pigmented and its septations are usually quite prominent.



1148 MIC SPEGAZZINIA APPENDAGE

Spegazzinia is a spore that we occasionally see in the atmosphere. In image 1147 you saw a Spegazzinia with a smooth wall. In the center of this image is a Spegazzinia that has an ornamented wall with very large appendages almost looking like spicules sticking out of the spore. The four cells are still quite prominent. In some respects this Spegazzinia spore almost looks like a lethal weapon. It has even been suggested that it looks like a cluster of anti-submarine mines.



1149 MIC SPEGAZZINIA

This image shows Spegazzinia in culture. In images 1147 and 1148, you saw Spegazzinia in air samples both the smooth wall version in 1147 and the ornamented spore in 1148. This cluster shows both the smooth walled spores and an ornamented spore in the center. This four-celled asexual spore occasionally occurs in the atmosphere but it is never very abundant.

1150 MIC STEMPHYLIUM

This large asexual spore belongs to the genus Stemphylium. This spore has both longitudinal and transverse septa and is often thought to be quite similar to Alternaria. However, the beak is always very short and never extended like Alternaria. One additional feature is that it is always restricted around the center of the spore. It almost looks like a waistline.

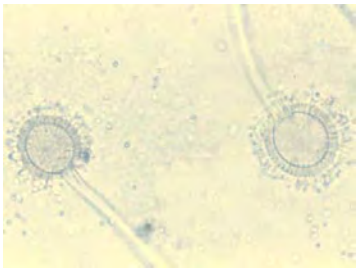
1151 MIC TETRAPLOA

Tetraploa is a very large asexual spore that you occasionally see in air samples. It has long appendages and the spore almost looks like a lunar landing craft designed by NASA.

1152 MIC TORULA

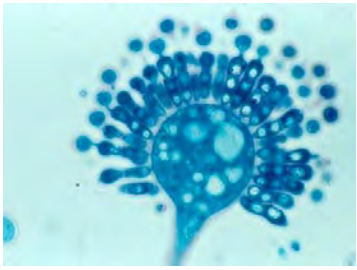
Torula is a multi-cellular asexual spore. It often has 3, 4, 5 even 6 cells. A single spore often looks like a string of beads. Sometimes people are confused and think each cell is a separate spore but in fact the spore is multi-cellular and what you see in this image are just 2 spores. It is very easy to recognize Torula because it is deeply pigmented and it's prominent even at low magnification.

1153 MIC ASPERGILLUS CONIDIOPHORE



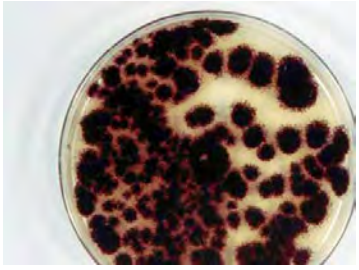
Aspergillus is a common genus of asexual fungi. There are approximately 150 species of Aspergillus that naturally occur on the soil. However, the spores do get airborne. Indoors it is one of the more common fungi. This is an image of 2 conidiophores from a culture of Aspergillus. The conidiophore is the structure that produces the asexual spores, the conidia. The conidiophore has a long stalk and the top of the stalk is enlarged into a spherical vesicle.

1154 MIC ASPERGILLUS CONIDIOPHORE



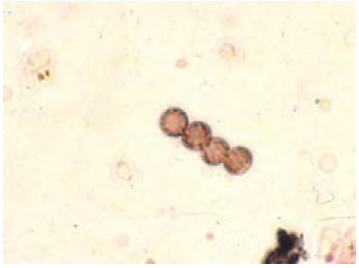
This is a section and stained sample of an Aspergillus conidiophore. The inflated top of the conidiophore, called the vesicle, is visible in the center of this field. The vesicle produces finger like structures called phialides that surround three quarters of the vesicle. It's the phialides that actually produce the conidia and several can be seen in the process of conidia formation on this image.

1155 MAC ASPERGILLUS NIGER CULTURE



This is a culture showing numerous colonies of Aspergillus niger. The individual conidia are pigmented and in mass the color appears black.

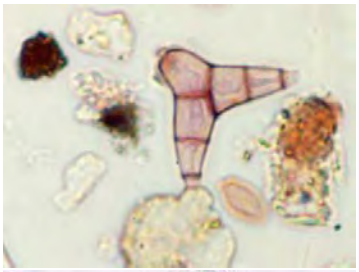
1156 MIC ASPERGILLUS NIGER IN AIR



This outdoor air sample shows four Aspergillus niger conidia. Although Aspergillus is normally a soil fungus the spores do occur in the air and because of the pigmentation this is actually identifiable down to the species level as Aspergillus niger.

1157 MIC BISPORA

Bispora is a two-celled spore. You can see 3 of them in this image. The septa between the 2 cells of the spore is very dark and very prominent. In the background are some colorless spores that are somewhat out of focus in this image.

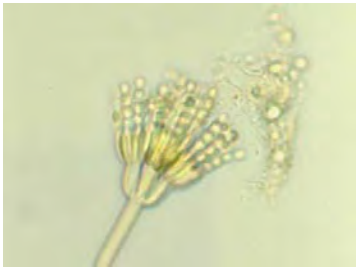


1158 MIC DIPLOCLADIELLA

This air sample shows an unusual spore, Diplocladiella. It is a multi-cellular spore that can be described as having 2 legs and a torso. Each side of the spore is approximately 20 micrometers in length.

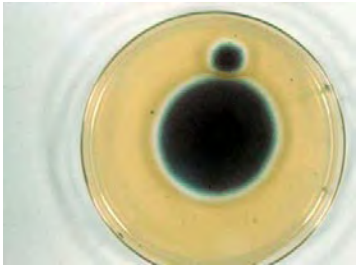
1159 MIC FUSARIUM

This image shows a number of Fusarium spores. This is from a culture. However, Fusarium does occur in the atmosphere especially during and after rainy weather. The spore is elongate, it is often described as sickle shaped or canoe shaped, it is multi-cellular with only transverse septa. The spore is sometimes confused with Leptosphaeria but they are really quite distinctive. The Fusarium is always colorless while Leptosphaeria, an ascospore, often has pigmentation. When you see Fusarium spores in an air sample, they usually occur as single spores not in large clumps.



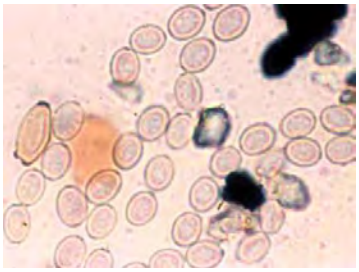
1160 MIC PENICILLIUM

Penicillium is a large genus of asexual fungi. There are approximately 250 species of Penicillium. In nature it typically occurs in soil samples. However, the spores can become airborne. It is especially common in indoor air. The conidiophore is quite distinctive almost looking like a little brush. At the end of the conidiophore branches into finger-like projections and spores are produced from the ends. The spores individually are single celled and look similar to Aspergillus spores however the conidiophores are quite distinctive.



1161 MAC PENICILLIUM CULTURE

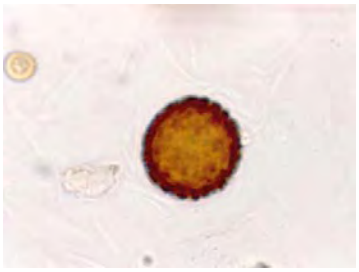
This is a culture of Penicillium. The mycelium is usually white but in areas where spore production has started you often see pigmentation. The spores in mass look blue, green, gray, yellow, brown or even black. Penicillium is frequently found in basements, attics or on the moldy orange in your refrigerator.



1162 MIC PENICILLIUM + ASPERGILLUS

The majority of the spores in this air sample are Penicillium or Aspergillus spores. In air samples it is almost impossible to distinguish the two genera apart. Both have either spherical or elliptical spores and there are attachment scars on either end of the spore. In the left hand side of this image is a single Cladosporium spore.

1163 MIC PERICONIA

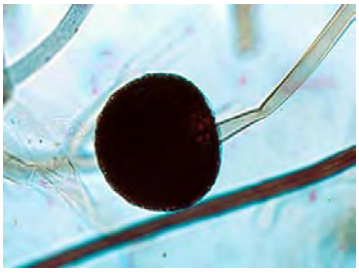


Periconia is a genus of asexual spores. The spores are single celled, they're spherical and are pigmented. Spores are usually quite ornamented. This particular species of Periconia has a warty ornamentation on the surface of the spores. The warty surface is shown in a little bit more detail on image 1164. Periconia spores are often confused with smut spores.

1164 MIC PERICONIA SURFACE

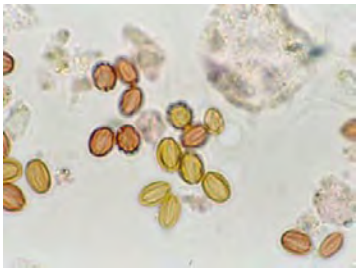
This image of Periconia in the atmosphere has been focused to show the warts on the surface of the spores more prominently.

1165 MIC RHIZOPUS



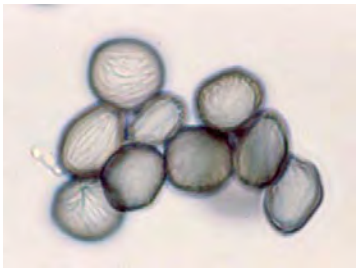
Rhizopus is a genus of fungi in the Zygomycota, sometimes called the Zygomycetes. It forms its asexual spores enclosed within a sporangium. This is a single sporangium that is visible. There may be as many as 10,000 spores.

1166 MIC RHIZOPUS IN AIR



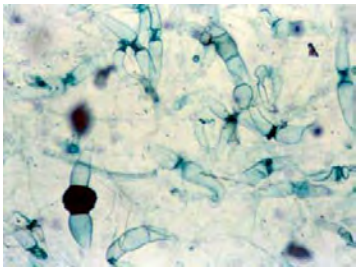
This air sample shows a cluster of Rhizopus spores. The ornamentation on the spore is faintly visible in this air sample. Because of the striations, it is difficult to focus clearly on these spores and they look fuzzy.

1167 MIC RHIZOPUS SPORES

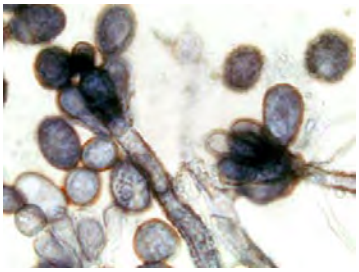


This is a high magnification look at Rhizopus spores from a sporangium. The striations on the individual spores are very apparent here as the irregular shape of the spores. For more details of the surface of this spore, examine the electron micrograph of Rhizopus spores.

1168 MIC SEXUAL REPRODUCTION OF RHIZOPUS

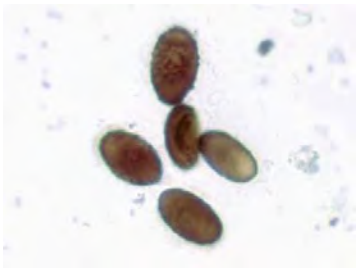


This image shows sexual reproduction in the genus Rhizopus. Although this is not found on your air samples, Rhizopus does reproduce sexually. The results of sexual reproduction is a spore called Zygospore, and there is one fully mature Zygospore visible on the lower left hand part of this image. Other parts of this image show sexual reproduction just beginning.



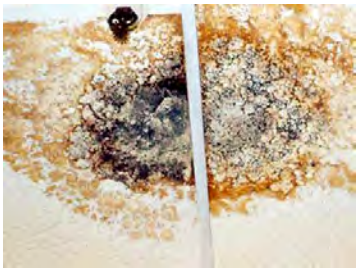
1169 MIC STACHYBOTRYS CULTURE

This image shows 2 conidiophores from a culture of Stachybotrys. There is a lot of interest in Stachybotrys, because of indoor contamination and the toxins produced by this fungus. The conidiophore has several phialides on the top. Each phialide is capable of producing spores, which typically stay together in a slimy mass at the top. The individual spores are highly ornamented.



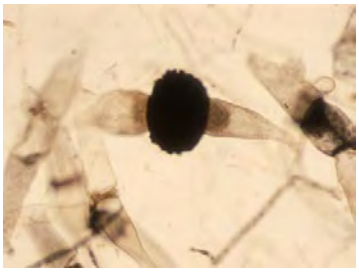
1170 MIC STACHYBOTRYS SPORES

This is a cluster of Stachybotrys spores from an air sample. The spores are oval and range from gray to brown to almost black. The spores are ornamented, the surface is warted and the warts are often black as well. The spores are approximately 10 micrometers in length and 6 micrometers in width. This particular sample was from indoor air where we frequently see it in water soaked buildings. However, Stachybotrys can occur in the outdoor air because in nature it is a soil fungus.



1171 MAC STACHYBOTRYS ON CEILING TILES

There has been a lot of concern in the media about Stachybotrys contamination in indoor environments. The genus Stachybotrys produces powerful mycotoxins. The fungus frequently occurs on substrates that contain cellulose but requires a lot of water. We frequently see it in areas where there have been leaks and this bathroom ceiling was soaked due to a leak from the floor above and this contamination was entirely Stachybotrys.



1172 MIC RHIZOPUS IN CULTURE

This image shows sexual reproduction in a Rhizopus culture. The large black spore near the center of the slide is called a Zygospore and results from sexual reproduction. Other areas of this image shows sexual reproduction just beginning with the mating of compatible hyphae. This structure will not be found in air samples but does occur in culture.

ASEXUAL SPORES OF SUMMER

During dry sunny days in late summer and fall, the atmosphere is dominated by asexual spores. These are also called imperfect fungi, Deuteromycetes, or simply mold spores. Most prominent in this group are Cladosporium and Alternaria. These two genera are often the two most abundant spore types present in the atmosphere and the two most common spore types you will see on your outdoor air samples.

118 EM FUSARIUM SOLANI

This is an EM view of Fusarium solani showing the curved nature of this spore. You cannot see under EM view the septa that would appear and also there is no obvious interpretation that under light microscope it would be completely colorless.

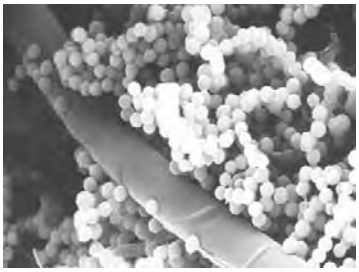
119 EM FUSARIUM SPORES

Here's a closer view showing the Fusarium mold spore, as it would appear in the air.

121 EM FUSARIUM SOLANI CULTURE

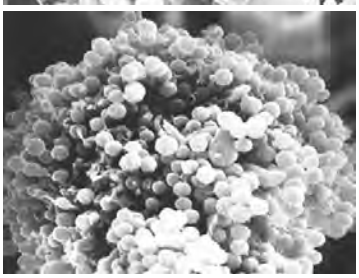
This is a wonderful overview of Fusarium solani showing the curved septate spores as they are given off into the air. Fusarium solani.

126 EM ASPERGILLUS NIGER CULTURE



This is a close up view under electron microscope of Aspergillus niger. What one finds here is a hyphae, kind of like that tube or sewer pipe type structure, and it's smashing down on top of the spores.

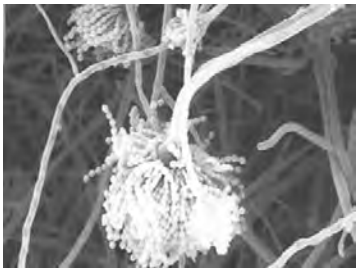
127 EM ASPERGILLUS NIGER HEAD



Here you see a slight over exposed EM photograph of the bulbus head of Aspergillus niger. This head is producing thousands of different conidia. This mold spore is reproducing asexually.

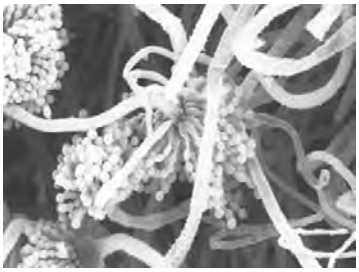
128 EM ASPERGILLUS NIGER

This is an overview of Aspergillus niger as it is growing in a matted field. It is a little bit whited out but what I would like you to appreciate is the fact that each one of these heads is giving off hundreds, if not thousands, of individual spores.



131 EM ASPERGILLUS FLAVUS

Here is a full photo view of the head of Aspergillus flavus. A bit over exposed but it demonstrates that there are individual spores coming out. Shooting from this mat like structure are the heads of this Aspergillus flavus species.

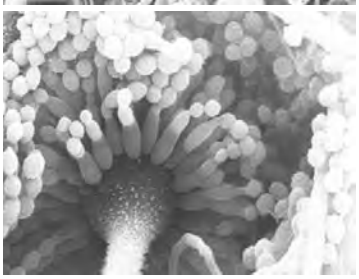


132 EM ASPERGILLUS FLAVUS

This is a closer view of the head of the ascomycete Aspergillus flavus. Again look at the back end of the slide deep down you will see the fibrous mesh out of which these hyphae are growing. This is the hyphae of Aspergillus flavus.

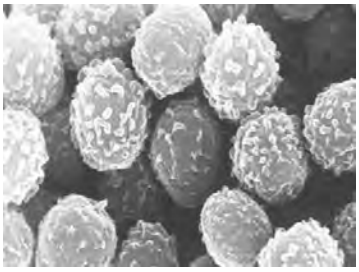
133 EM ASPERGILLUS FLAVUS HYPHAE

This is a high overview of Aspergillus flavus as it is growing up. These hyphae are shooting using the heads out of which will come the allergenic spores.



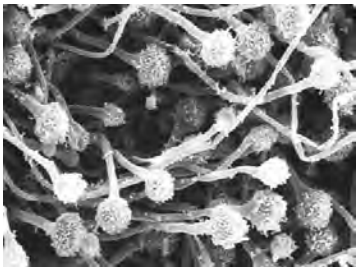
135 EM ASPERGILLUS FLAVUS HEADS + STALK

This is a wonderful view looking up into the end of the stalk, the bulbus end of the hyphae of Aspergillus flavus.



136 EM ASPERGILLUS FLAVUS CONIDIAL HEADS

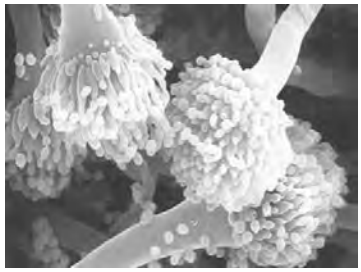
Here is a close up view of Aspergillus flavus individual spores right at the tip of the phialide as they are coming out. You will notice that the surface of these spores is granular. You can't see this under the microscope. You might otherwise notice that these are just darker, brownish to black globules almost egg shaped under the microscope at 100 X. This is a wonderful view of the allergen packed within Aspergillus flavus.



137 EM ASPERGILLUS FUMIGATUS

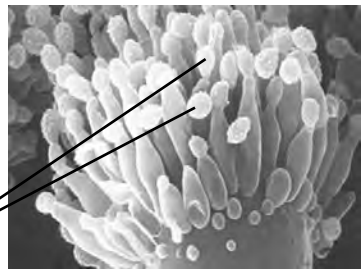
Here is an image under electron microscopy view. An overview of the conidial heads of Aspergillus fumigatus. This is a whole field of fungus that we are looking over.

138 EM ASPERGILLUS FUMIGATUS CONIDIOPHORE



This is an EM view enlarged showing the bulbus terminal conidiophore of Aspergillus fumigatus. There are 4 of them in view and they give rise to the individual conidia or spores. Each one of these little spores that are budding off of the end of this conidiophore can cause significant allergic reactivity particularly in asthmatic patients. These spores can fly deep within the bronchial lumen and cause asthmatic reactions. This classic view, close up, Aspergillus fumigatus.

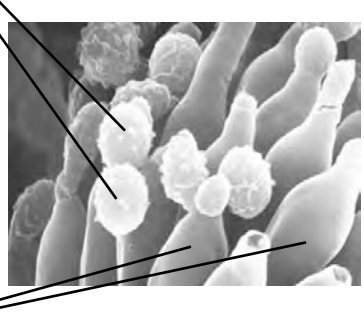
139 EM ASPERGILLUS FUMIGATUS TERMINAL HEAD



This is a beautiful EM view showing Aspergillus fumigatus phialides as they are producing conidia, or spores

conidia (spores)

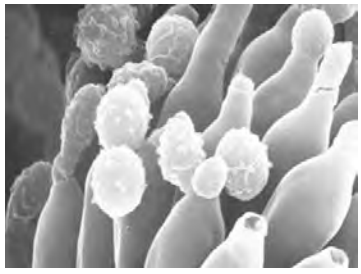
140b EM ASPERGILLUS FUMIGATUS CONIDIAL PRODUCTION



This is a beautiful close up of the bulbus terminal head of Aspergillus fumigatus. This is a classic production of spores. Look at the tips of these phialides, the sac like structure and here the spore is being given off. The tiny spore head has tiny granules that you can almost pick up particularly central in the field. Aspergillus fumigatus.

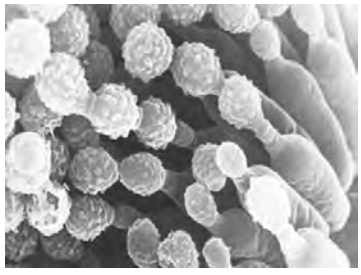
phialides

140 EM ASPERGILLUS SPORES BUDDING OFF

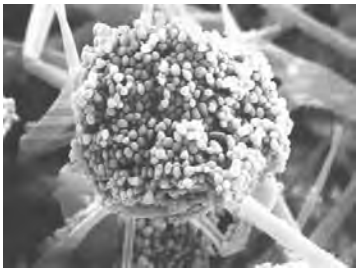


This is an EM close up showing the conidial production of Aspergillus.

141 EM PHIALIDES OF ASPERGILLUS FUMIGATUS

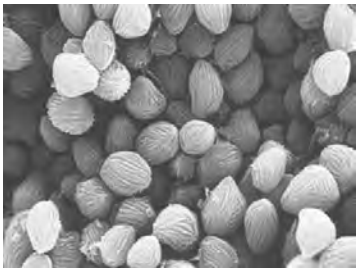


Here we are looking down on the sac like structure of Aspergillus fumigatus at the top of which there are budding off mold spores. These spores can take to the air and cause particular bad symptoms of allergy and asthma. Look at the spores and find that they are granular on the outside.



142 EM RHIZOPUS NIGRICANS

Rhizopus nigricans is a fungus that is commonly found in fruits within our refrigerators. It's in house dust, and it is present in soil as well. Here you are looking at an EM view of the bulbus head, out of which come many thousands of different individual spores. The sporangiophore gives rise to the stalk and this stalk or sporangiophore gives rise to the head.

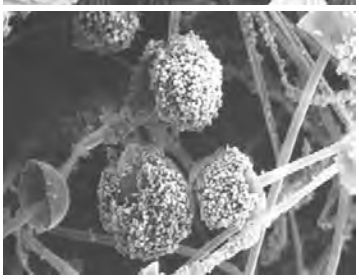


143 EM RHIZOPUS

This is a wonderful photograph. This is the spore coming off of Rhizopus. Each individual spore can impact an allergy punch. You won't find the linear demarcations under your microscope because this is only possible to see by this wonderful EM view.

144 EM RHIZOPUS HEADS

Rhizopus individual spores. Take a look at this. This looks great. You will never see this by light microscopy. This is available under EM view only. Look at the different channels on each individual spore.



145 EM RHIZOPUS NIGRICANS

Here's an overview of Rhizopus nigricans by EM view. You can see the stalks, the bulbus heads and the thousands of individual spores that become airborne. Imagine this in your potted plants within the home or outside or even in your refrigerator on rotten fruit.

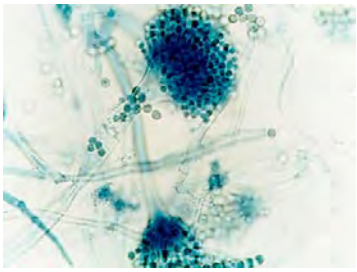
147 MIC ALTERNARIA IN AIR SAMPLE

Here is Alternaria. It is clubbed shaped almost like a drum stick appearance, mild brown in color with smooth surfaces. It has an average length of 37 microns or 9 to 20 microns in diameter. This is the classic mold spore Alternaria.

148 MIC HEAD-TO-TAIL ALTERNARIA DUMBBELLS

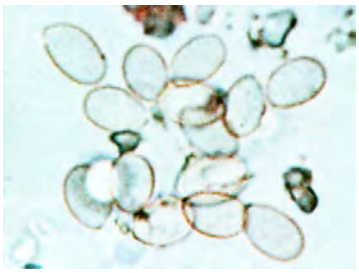
Here on this slide we find 2 mold spores from Alternaria. It looks like a club or dumbbell shape with a long appendage that one could grab on to as one beats the rug for example. It is lightly tan in color with multiple septations. Alternaria is what you are looking at.

149 MIC ASPERGILLUS FUMIGATUS



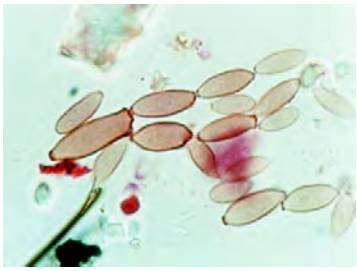
This is a classic example of Aspergillus fumigatus. You see the bulbus end where you have a sort of mushroom cap appearance. This fungus has small dark smooth surface spores within that bulbus tip.

150 MIC BOTRYTIS SPORES



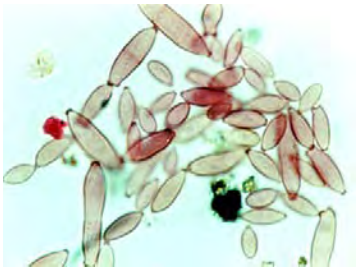
Here we find under 100X magnification the transparent smooth and non-septate egg shaped structures of Botrytis spores. They are 8 to 15 microns in length and 6 to 9 microns wide. They can be found in especially high numbers during thunderstorms. This is Botrytis.

152 MIC CLADOSPORIUM HERBARUM



Here under light microscope view we find Cladosporium herbarum. This is a cylindrical to barrel shaped structured spore. It appears in chains. It has a smooth outer surface and it can be pale to pink in color to light brown. It is minutely warty on the surface but it is very difficult to pick from this view under the microscope.

153 MIC CLUSTER OF CLADOSPORIUM HERBARUM



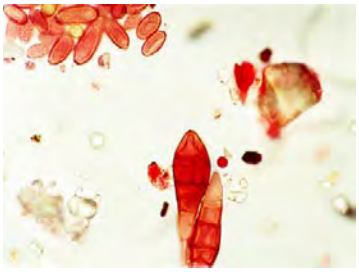
This is a cluster of Cladosporium herbarum with smooth barrel shaped structures. It's pale brown to pink in color and they seem to be budded at their ends and tightly structured together almost in chains. They are 3 to 10 microns in length, being 2 to 5 microns in width. Occasionally, there are septa present as well.

154 MIC FUSARIUM

This is a light microscope view of Fusarium. It's curved, it is septate and it is completely colorless. The spores are 25 to 50 microns in length and curved at the tips. They are 3 to 5 microns wide. Oftentimes you will find them in an oblique view and this may be difficult to identify if you don't see the curvature. Sometimes it is difficult to find the septa, here in this view you can't see the deviations of the septa.

155 MIC HELMINTHOSPORIUM

Helminthosporium appears as a single spore with multiple pseudo septa. It looks as though there are septa here, but really under closer view there are not any within the smooth surface, kind of dark in color, 50 to 100 microns in length. There are very thick walls to Helminthosporium. It's one of the easiest molds you can identify in air samples.

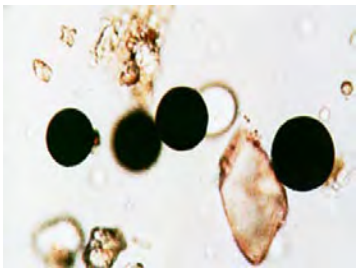


156 MIC MOLDS IN AIR SAMPLE

This is a light microscope view showing Alternaria at the 6 o'clock position. Two of them, one face up and one face down. Classic Alternaria. In the top left hand part of the view one finds Cladosporium. Cladosporium often appears in groups and clusters and each one of these has to be counted when analyzing your air sample. So, you would count each individual spore in the group, in the cluster, of Cladosporium in making your mold determination that day.

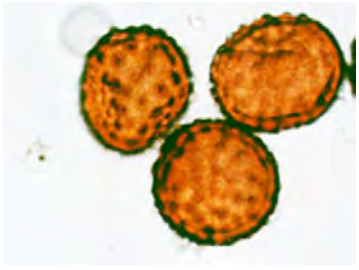
157 MIC CLADOSPORIA IN AIR SAMPLE

This is an air sample at 100 X power magnification and you see right in the middle of the field some Cladosporium. These are single celled, 10 droplets, that often appear in clumps and chains. They are grouped together but here they are separate. They are egg shaped, pale yellow to brown, they have smooth surfaces and they occasionally have septations. Their length is 3 to 10 microns and their diameter, or width, 2 to 5 microns.



158 MIC NIGROSPORA

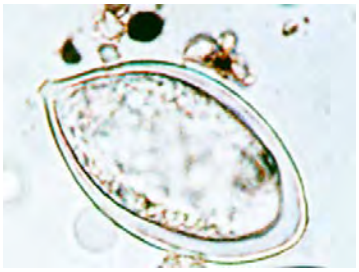
Nigrospora as seen under this view of the microscope at 100X, one finds the conidia, which have been forcibly discharged from the conidiophore. They are single celled, dark to black, very smooth on the outside, the shape is more like an egg and it is found in nature on grass, dead lawns particularly in the autumn months. These are very easy to identify under the microscope particularly during the fall months of the year.



159 MIC PERICONIA

This is a light microscope view of Periconia. It shows the brown spores, which are very similar to smuts. These are 10 to 15 microns in diameter. Periconia is found in soil and dead leaves and grasses. So look for this particular spore during the fall times of the year.

160 MIC PERONOSPORA



Peronospora are colorless ovate shaped spores with granular contents. They can be 20 to 30 microns in diameter. They have a thick wall and somewhat granular on the inside. It is difficult to think of this as Botrytis but in a way they sort of look the same. They have transparent walls in any case. Peronospora, however, does have the granular contents.

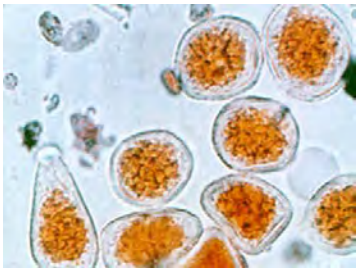
161 MIC PITHOMYCES

This is an air sample under light microscopy of Pithomyces. You see 3 large individual spores that are septate transversely and they are pretty large. At the apex there is a short side branch of filaments that one can find and these can be 18 to 30 microns long and 10 to 15 microns wide. You will also find a single basidiospore in this picture.

162 MIC POLYTHRINCIUM

Here is a light microscope view of Polythrincium. Polythrincium is pear shaped, it can be pale brown in color and has one septum transversely. This almost looks like a kernel of corn, doesn't it, except for the septum. It can be 16 to 25 microns in length and 13 to 25 microns wide. It is usually pink in color and sometimes a light brown.

163 MIC UROMYCES



Uromyces. These are rust spores present under oil immersion 100X microscopy. You will notice that they have a one-celled structure, and it is more or less ellipsoid in shape. There is a tear off point where it has come off from its mother. This is a basidiomycete; it infects leaves and different plants as well. You will find a great deal of rust and smut present within your air samples particularly if your air sampler is within 10 miles of a local granary or a farmer's field. This is a particularly important allergen clinically especially in the summer and fall months of the year.

165 MIC TORULA

Here under light microscope we find a great number of Torula species. This spore is brown in color and 15 to 30 microns in length. There are multiple septae. It is very rough, it's got walls, it looks warty and it almost looks like a string of rusty pearls stuck together.

166 MIC TORULA

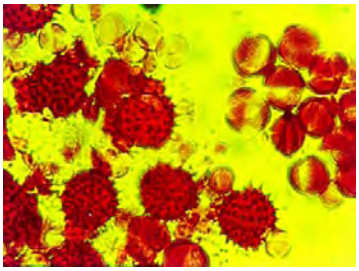
This is a classic view under the light microscope at 100 X of Torula. Torula is brown in color. It's a conidia that has a length of anywhere between 15 to 30 microns, and it has multiple septae that are transverse. It has a warty surface with very thickened walls. It can appear on branch chains or it can be cylindrical. Here you see that they are sort of rounded and stuck together these different septa. This is a classic view again of Torula.

Patients

INTRODUCTION TO PATIENTS

Throughout the many years that Dr. Walter Lewis and I have been studying aeroallergens and allergy patients, it all boils down to the patient. It is the allergy patient that tells us what to be looking for. Once we identify symptoms, we look for causes of symptoms, and that's why we do pollen and mold count determinations. Even after all of our efforts to identify allergens from pollens, from mold spores, to extract allergens and identify them and characterize them and insect proteins, you know what, there are still some larger allergens we can't capture in the microscope view. What you are going to find now in this section of the Aeroallergens of North America CD-Rom project are images of patients and things they encounter in their home life and around their personal world that can cause allergy. We are also going to demonstrate for you some views of diagnostic allergy skin testing. I hope you enjoy this section of the Aeroallergen PhotoLibrary.

083 BEE POLLEN PILL CONTENTS



Here is a microscopic view of a bee pollen pill. Now, bee pollen is produced by bees for other bees. Nowhere does it state on the bottle that it is made for humans, and yet there is a whole industry selling bee pollen pill for human use. What one finds under the microscope is maple pollen and sunflower seeds. The spiny sunflower seed pollen is present most on the left hand side, and it looks like a maple pollen on the top right. These bees have collected the pollen for themselves. Keep that in mind when you see patients who experience itching of the mouth, swelling of the lips or asthma attacks, which don't otherwise have an explanation.

167 CAT FRIENDLY ASTHMATIC

This is one of my patients who explained to me when she brought in this photograph that it might be difficult for her to avoid what she is allergic to. She is unwilling to give up her cat for obvious reasons. This is an aeroallergen you will not find under the microscope.

168 ASPIRIN ALLERGY: ANGIOEDEMA

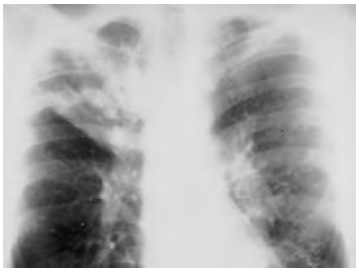
Here's a patient of mine, a bit out of focus, maybe, maybe not. What he really has got is angioedema of his right eye. This came about after taking as aspirin tablet. Now is he allergic to aspirin or is he sensitive. He really doesn't care; he can't take it. Some patients actually have IgE antibody to aspirin moieties. So you can be sensitive, you can be allergic; bottom line is, that avoidance is the treatment of choice.

169 ALLERGEN SKIN TESTS

Here's a picture of diagnostic allergy skin testing. It is quite interesting. His chief complaint to me was, "Doc, my wife doesn't believe me any more" and when he told me his story of not being able to be around the lake when the lake flies would come out well, I didn't really believe him because he said he had to go stay in a hotel for several weeks and I kind of thought that may be he is trying to get away from home for several weeks. We obtained some insects, created an extract, and the very center of his back you see the mosquito bite like lesion. It is actually a diagnostic skin test using the midge or lake fly extract of the adult and the larvae below it. He is also allergic on the right hand side to other insect extracts. So he is not allergic to cats and dogs and grass and trees and mold spores or even dust mite. This is an insect allergic patient and had we not been looking for insect allergy, we would have missed his diagnosis.

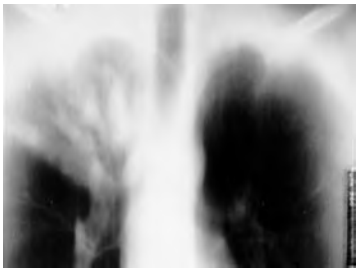
170 SPACERS

Here is a photograph of different spacers available for use with inhaled bronchodilators. Perhaps the most popular one is the AeroChamber shown on the top right. It's a tall, cylindrical material, very washable, very durable, lasts for months at a time.



560 ALLERGIC BRONCHOPULMONARY ASPERGILLOSIS

Here's a chest X-ray of a psychiatrist who has Allergic Bronchopulmonary Aspergillosus. In the top right hand portion of the slide or his right upper lobe, it is collapsed. It has finger like projections of dark whitey stringy mold. This patient would get in the mood to relate to his patients by smoking marijuana. Now unfortunately for him in the marijuana there is Aspergillus fumigatus. He inhaled it, it lives in his lung and he is allergic to it. So he can't avoid what he is allergic to. It's actually inside of his body and we cannot get it out. Therefore, he's stuck on medication all the time. He's never going to be free of wheezing and coughing. He's stuck on steroids, or prednisone, to control the inflammation that comes from within because of his allergy to the fungus in his lung.

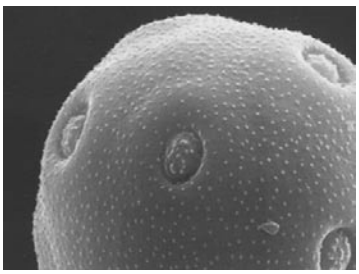


561 FUNGUS IN THE LUNG

This is a view of the chest X-ray of a psychiatrist with Allergic Aspergillosus showing the collapsed right upper lobe of his lung and also the thick finger-like projections of fungus growing. This patient had inhaled marijuana that contained Aspergillus and unfortunately for him he became allergic to the mold within his lung. He cannot avoid what he is allergic to. He carries it with him in his chest.

Shrubs

193 EM GREASEWOOD POLLEN CLOSE-UP



This is an excellent close up view of an EM image of the Greasewood pollen showing very clearly the various pores and the scattered small wart like excrescences on the surface of the grain.

196 EM GREASEWOOD POLLEN

This is a good pollen image of the Greasewood, and it shows the typical scattered but fewer pollen typical of the chenopod type grain.

363 MAC SILK-TASSEL BUSH

The silk-tassel bush is common in the southwestern United States and it sheds abundant pollen.

371 MAC NORTHERN BAYBERRY - WAX MYRTLE

The Northern Bayberry or Wax Myrtle is found in coastal areas of the northeast and also inland as you go toward the south in eastern North America. It flowers, as you see in the inflorescence illustrated here in the early spring and, therefore, it is an early spring offender as far as pollinosis is concerned.

372 MAC SOUTHERN BAYBERRY

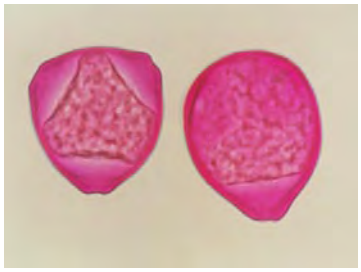
The Southern Bayberry or Wax Myrtle is commonly found in the southeastern United States along coastal areas and also inland. The shrubs can reach 10 to 12 feet high.

521 MAC GROUNDSEL BUSH

Groundsel Bush is found in the southern United States and on the West Coast in that region and the shrub reaches 10 to 12 feet, very spreading, with a series of white flowers. The plants are unisexual.

522 MAC GROUNDSEL BUSH - CLOSE-UP

This close up view of the Groundsel Bush shows the white flowers and it is difficult to see whether this is the staminate or the pistillate plant, but let's hope as far as allergy is concerned that it is pistillate therefore there is no pollen produced.



562 MIC NORTHERN BAYBERRY POLLEN

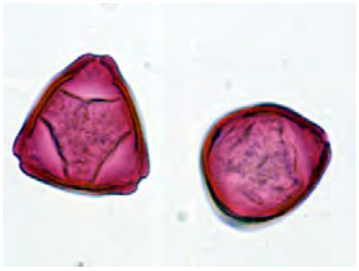
The pollen of the Northern Bayberry is I think very beautiful. It's the most attractive pollen grains that we have in North America. It is 3 pororate, its about 25 microns in diameter and you will notice that one of the features below the aspidate pores, that is to say that the pore that extends out from the normal wall, are these 3 thickenings, one below each of the pores. This is the intine and the intine is said to contain large quantities of the proteins and glycoproteins that are the allergens from this pollen.

601 MAC SILK-TASSEL CATKINS

This Silk Tassel Bush is evergreen so that you are going to find the leaves at all times of the year, and in this closer view you can see the tassels, or catkins, of the male inflorescences.

602 MAC SILK-TASSEL BUSH CLOSE-UP

This is a close view showing the evergreen leaf of the Silk-Tassel Bush together with a close view of the tassel or catkin holding the male inflorescence.



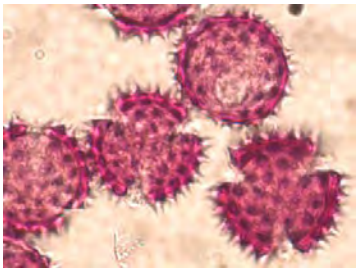
646 MIC BAYBERRY POLLENS

The Bayberry, or Wax Myrtle, from California has 3 pores and typical of the others, and with the aspidate morphology, but it also is associated with members of the birch family.

647 MIC SOUTHERN BAYBERRY

The Southern Bayberry, or Wax Myrtle, pollen is 3 porate with each pore extended from the center of the grain in a dome shape so called aspidate morphology. The intine is conspicuously thickened below these pores and in fact it looks rather like a birch pollen and there is a reason for that interaction because the family of the bayberries and the birch families are closely related botanically.

845 MIC GROUNDSEL BUSH POLLENS



The Groundsel Bush pollen is typical of the aster with the long spines. It is probably partially wind dispersed and partially facultatively dispersed, but there is a report of several species producing so much pollen that it can be seen in the air as the wind blows off the bushes. So, that is a sign that if not purely wind dispersed, it certainly does get into the wind with a strong breeze.

846 MIC CHAPARRAL BROOM SHRUB

Chaparral Broom is a small shrub found in the deserts of western United States.

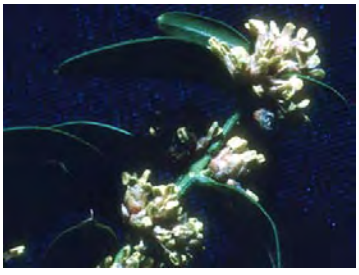
847 MIC CHAPARRAL BROOM POLLEN

The Chaparral Broom pollen is typical of the long spined pollen group of the family Asteraceae. This is interesting to include this species because there are reports that it is wildly used for the last decade or so as ground cover in California because it is so drought resistant, and of course, here is an example then of a potentially allergenic plant that is brought into the local home landscape and so those individuals who use this ground cover should be very careful about adding to the allergen sources especially if they are allergic to any members of the Asteraceae.

848 MAC CALIFORNIA BAYBERRY

Californian Bayberry, or Wax Myrtle, is a shrub, a very aromatic shrub, that is widely used in cultivation as well as native in California.

849 MAC BOXWOOD FLOWERS



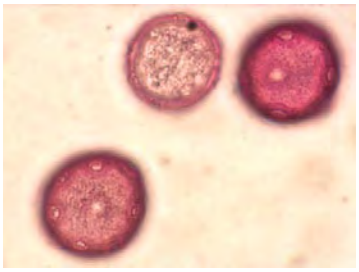
The Boxwood Shrub is one used in cultivation widely in North America particularly in the warmer areas. It was introduced from Europe and it does shed abundant pollen in the early spring.

850 MIC BOXWOOD POLLEN

Boxwood pollen is polyporate, which means that it has many pores perhaps up to a dozen which are the gaps of course in a wall which is very reticulated and is quite an unusual wall formation. These are released by the boxwoods in the spring and since they are usually put into gardens around the homes, then I think the possibility that the allergenicity exists is very real and it should be examined.

851 MAC GREASEWOOD

Greasewoods are found in the western United States in dry deserts of California, Utah and Arizona.



852 MIC GREASEWOOD POLLEN

The pollen is produced by the Greasewood Shrub in fairly large amounts, because it is a shrub up to 10 feet tall. The pollen is a typical chenopod type pollen of which there are many, many weeds in the same area, and you have these pores scattered over the surface, but there are fewer than typical. Usually the Greasewood pollen will have up to only 16 of the pores. So, it can be easily distinguished from the large number of leading weedy chenopod pollen types that are going to be found in the west.

853 MIC SILK-TASSEL BUSH

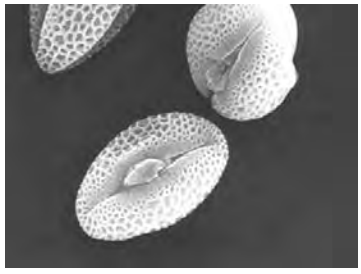
The pollen of Silk-tassel Bush looks very similar to that of oaks. Its about 30 microns in diameter, has the 3 pores and 3 furrows so it is a compound of what we call 3 colporate grain but the easiest way to separate the tassel bush pollen is that the wall is highly reticulated and like a series of ridges or furrows where that of the oak is generally roughened but it does not have a distinct reticulation. There is very little information on the allergenicity of the pollen though vast amounts of it is spread. This should carefully be examined by skin testing to see if there is a sensitization has occurred especially in California and Arizona.

Trees

171 EM BLACK WILLOW POLLEN

The Black Willow pollen as shown in this EM illustrates 2 of the apertures which show very long colpus in the pore region although very often the pore region is not very well defined and the most important aspect of the willow pollen is this coarse reticulum with alumina in varying sizes with a decrease in the alumina size as you go towards the two poles.

172 EM BLACK WILLOW POLLEN



This is an interesting view of the Black Willow pollen using EM in which you see a full view of a single furrow with its accompanying pore region. I think what is interesting is the coarse reticulum not only narrows with the alumina getting smaller towards the pole, but as you see in both sides of the furrow you get a reduction in the reticulum to almost a smooth surface.

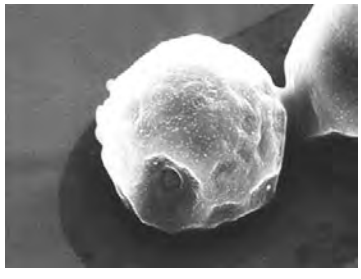
174 EM BLACK WILLOW POLLEN

Black Willow pollen is shown in this EM shown in 2 very dramatically different views. It is quite extraordinary. You see the one furrow with the accompanying reduction in the wall of the reticulum toward the furrow of three, and then the polar view slightly oblique but clearly shows the 3 apertures and the area of the pore with the exuding tissue.

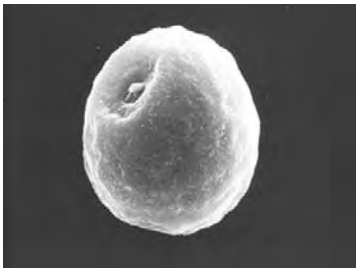
175 EM BLACK WILLOW CLOSE-UP

This is a view of the Black Willow pollen close up using EM. Again, the long furrow and the area of the pore in the equatorial zone. This is a very clear view of the reticulation and the varying sizes of the alumina.

178 EM HACKBERRY POLLEN

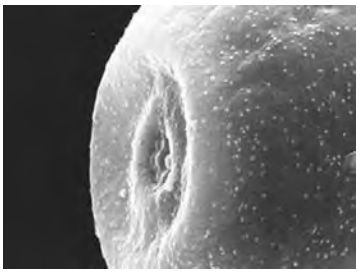


This is an example of a SEM image of the Hackberry pollen in which one inundated pollen pore at 6 o'clock is obvious and there should be at least 3 or 4 in view which are difficult to see. The one at about 11 o'clock you can see the side view of that. The surface, as you will see, is granular and somewhat irregular but that may be partly due to the preparation of SEM.



179 EM HACKBERRY POLLEN

This SEM image of the Hackberry pollen shows clearly the one pore which is an artifactual sink here is not going to be because of the procedure but otherwise gives the overall circular spherical view of the pollen which is rather large. It is up to 16 microns in diameter.

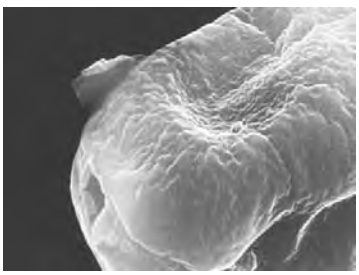


180 EM HACKBERRY POLLEN

This is an excellent close up view of a SEM image of the Hackberry pollen showing a single pore. Surrounding that, of course, the wall with the small granules that are finely scattered over the surface.

182 EM BLUE GUM POLLEN (EUCALYPTUS)

Blue Gum, or Eucalyptus, pollen is a very interesting looking pollen as this SEM will illustrate. The grains are about 30 microns in diameter, triangular in shape, and are 3 colporate - which means there are 3 pores at each corner of the triangle and the part of the aperture, the furrow, extends on both sides of the pore.



183 EM BLUE GUM POLLEN CLOSE-UP

This SEM close up of the Blue Gum pollen shows the corner of the triangle where you see the pore and the furrow extending on both sides which will extend up into that hollow of the triangle.

186 EM EUCALYPTUS - BLUE GUM POLLEN

This image of the Blue Gum or Eucalyptus pollen which showed the triangular form and you can see at 6 o'clock the area where the pore extends partly out in fact and the furrow extends into the hollow at the top and of course below and this is duplicated at the other 3 positions of the triangle. So this unique kind of pollen though widely insect pollinated produces so much pollen in a very open flower that if there is sufficient wind it will be released what we might call facultatively wind dispersed.

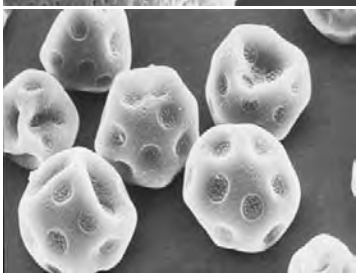
187 EM AMERICAN SWEET GUM POLLEN

American Sweet Gum pollen is illustrated by this EM shows a spherical grain about 40 microns in diameter with numerous pores over the surface.

188 EM AMERICAN SWEET GUM POLLEN CLOSE-UP

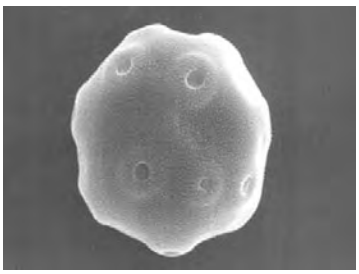
The American Sweet Gum pollen EM shows the surface of the grain very clearly here. The two pores with their granules and the cell wall with an almost closed reticulum. In other words the actual holes or cavities are small and irregular.

191 EM SWEET GUM POLLENS



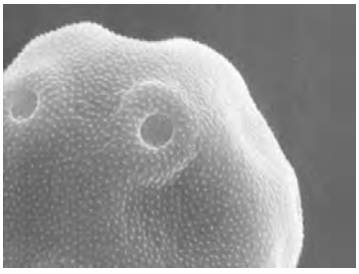
This is a great overview of the American Sweet Gum pollen even though every side is the same. But it gives you an opportunity to see the different numbers of pores that you might see in any one focus. The Sweet Gum pollen, much of it is airborne, there may be some insect pollination as well and the levels of allergenicity are not well understood.

197 EM ENGLISH WALNUT POLLEN



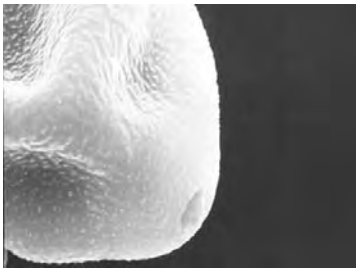
The English Walnut pollen is typical of the major types in North America in that you have a spherical grain and the very clear annually pores which again are not scattered evenly over the entire surface but are what we call heteropolar in that you find none in one pole and some in the other pole and the total number of pores would approach 8.

198 EM ENGLISH WALNUT POLLEN CLOSE-UP

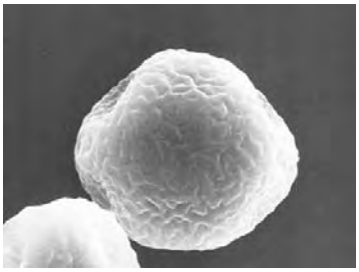


This is an excellent close up of the English Walnut pollen using EM showing 2 pores and the clear ring structure around each and the granular nature of the wall.

203 EM AMERICAN ELM POLLEN SURFACE

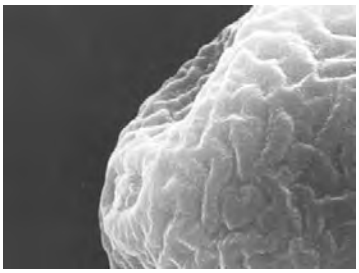


This is an excellent SEM view of a single pore. It is slightly aspidate, that is to say, extended from the general wall. It also gives the detail of the wall itself and though slightly roughened as observed in the micro here we can see the details of the granular appearance and sometimes ridges although they may be partially artifacts.



205 EM AMERICAN ELM POLLEN SURFACE

This is an SEM image of the American elm pollen. There you see the roughened or wrinkled or what we might call corrugated surface of the pollen, which is much more clear than under the micros. It is difficult, however, to imagine the pores. There will probably be about 5, at least 5 pores, perhaps there are 2 shown on the left side of the one whole grain but it is difficult to see.



206 EM ELM POLLEN SURFACE

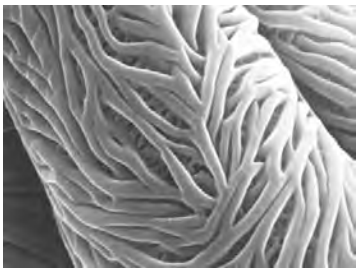
This is an excellent SEM image showing the morphology of a single pore in the American elm pollen. To the top, of course, is an artifact but at about 9 o'clock the circular form in the pore, the cap on the pore, is a very good illustration. This is one of the best examples of seeing this wrinkling or corrugation of the wall, which is typical of the elm.

208 EM RED MAPLE POLLEN

This is an excellent SEM image of a Red Maple showing the major characteristics of the typical maple not if you would look up the Box elder maples, which are somewhat different and the difference lies in the wall because here you can see major reticulations throughout the surface as well as the characteristically long, colpi or furrows and occasionally the maples may also have a pore although not illustrated here you could have a colporate morphology as well. So if you see that pore in the center in the equatorial area of each of the furrows, do not be discouraged it may well be a maple.

209 EM RED MAPLE POLLEN SURFACE STRIATIONS

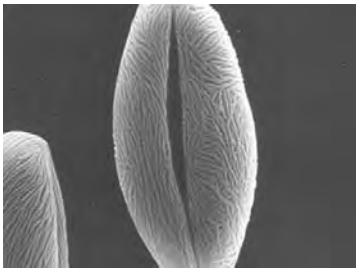
The Red Maple close up SEM pollen image is just superb showing this major striation along the whole surface of the outer wall of a sexine.



210 EM RED MAPLE POLLEN SEXINE STRUCTURE

One does not often see such an excellent view of the wall of these pollen that are only in total diameter of 20 to 30 microns and here you have the details of the outer wall which is the sexine showing this major striation and then you can get a glimpse into the inner portions of the wall as well which is a series of pillars that go at right angles to the striations.

211 EM RED MAPLE POLLEN FURROW



Red Maple is typical of many of the maples being elongate 20 to 40 microns in width and length and with this very characteristic striation of the outer wall and a very long furrow.

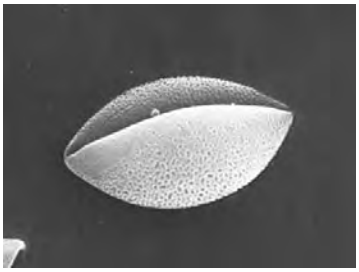
212 EM RED MAPLE POLLEN CLUSTER

Red Maple pollen depending on its position will appear to have 1 or 2 furrows and I think there are good illustrations here showing 2 typically depending upon its position and its orientation or a single one.

214 EM DATE PALM POLLENS

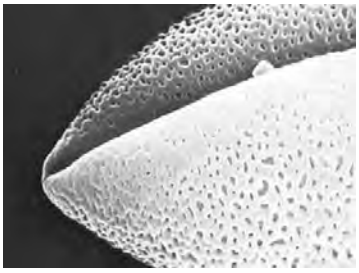
This is an excellent EM overview of the Date Palm pollen showing very clearly over and over again no matter what position of the grain the single long, narrow furrow. The grain itself is about 11 to12 microns in diameter and perhaps 25 microns long and the wall is fairly smooth, and if you notice there is a curve in the shape of the grain that resembles a crescent moon.

215 EM DATE PALM POLLEN CLOSE-UP



This Date Palm SEM image shows very clearly the details of the pollen grain. You will see the curved furrow, long and narrow, reaching to the two poles and you can see also the fine articulation of the wall, which is otherwise relatively smooth. So this is a very unique type of pollen.

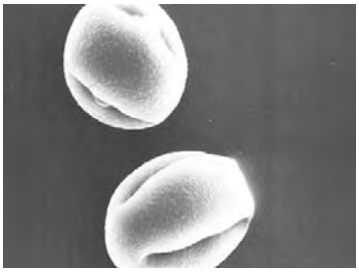
216 EM DATE PALM POLLEN FURROW



This is a good example of the detail of the Date Palm pollen toward the one end where the furrow comes right up to the tip and you see the details of the reticulum in the wall.

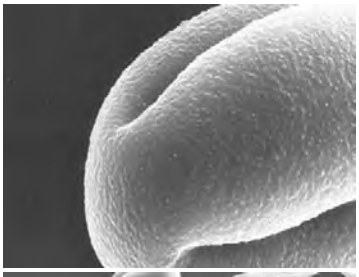
217 EM DATE PALM - 2 VIEWS

Date Palm pollen showing two views, one we don't see the furrow and the other which is quite obvious. The one with the obvious one looks like a football.



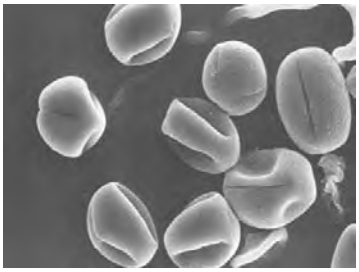
218 EM AMERICAN BEECH POLLEN

This EM image of the American Beech pollen is really excellent because it shows the equatorial view where you have the relatively long furrow and you can see the central position of the pore. So this is a compound aperture or colporate aperture and circular to an elongated formed grain.



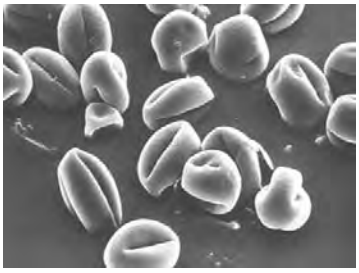
219 EM AMERICAN BEECH POLLEN SURFACE

This EM image of the American Beech pollen shows a part of the polar region extending down to about the equatorial in which you see the 2 furrows and a roughened surface of the grain.



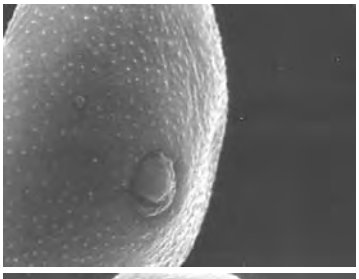
220 EM AMERICAN BEECH POLLEN COMPOSITE

This EM composite image of the American Beech pollen I think is very good because it shows in some cases on the equatorial zone the long nature of the furrow but the various numbers of furrows you will see depending upon the position of the grain and when you have an elongated rather than a circular grain you will, of course, see more positions that are equatorial that is to say you are looking at it on the side.



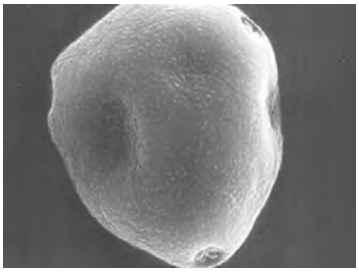
221 EM AMERICAN BEECH POLLENS

This is an image showing a composite of the American Beech pollen. Again you can see the elongated form of the equatorial view or the almost circular form of a few polar views. Again it is important to obtain both to get an understanding of the morphology of the pollen grain.



222 EM AUSTRALIAN PINE POLLEN CLOSE-UP

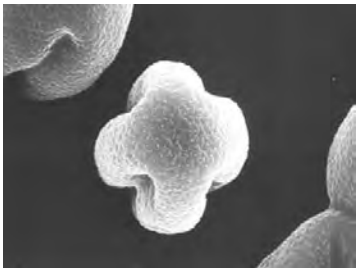
The Australian Pine pollen in EM showing one of the three pores somewhat aspidate and with a little ring around the pore as well and again the granular fairly smooth to a little rough edges.



223 EM AUSTRALIAN PINE POLLEN

An EM view of the Australian Pine pollen showing the 3 pores in polar view and the typical surface which is with some granules and somewhat oblique.

225 EM WHITE ASH POLLEN EQUATORIAL VIEW

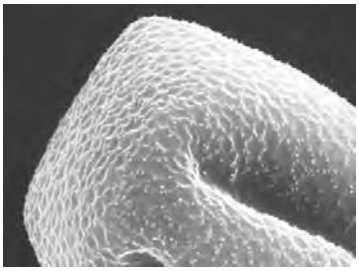


White Ash pollen is 4 colporate and you can see in this image looking at the polar view the indentation of the furrows and the pores would be in the equatorial area. The surface is fairly roughened almost reticulate but rough is probably the easiest way to define it.

226 EM WHITE ASH POLLEN

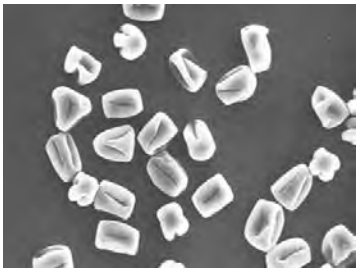
This side view, or equatorial view, illustrates very well the long furrow and particularly the box like attitude if you will of the morphology of the grain with these 4 apertures.

227 EM WHITE ASH POLLEN SURFACE



This EM representation of the part of the grain of the White Ash shows that uneven surface which is almost reticulate with small bumps scattered here and there and you see the ends of 2 furrows.

228 EM WHITE ASH POLLEN OVERVIEW

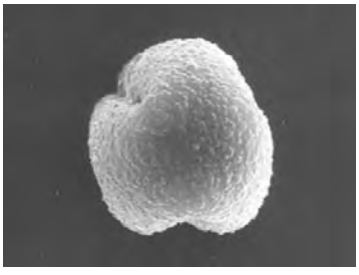


This overview of White Ash pollen grains I think is a good illustration of the different views that you are likely to see in a slide. Again the rectangular shape showing the equatorial view and then occasionally more square when you are looking at a polar view. I think the illustration of the long furrows, or colpi, is clear.

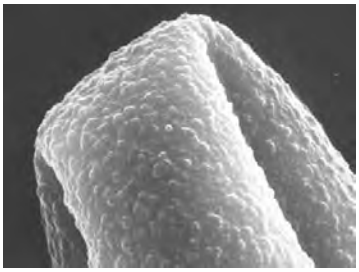
230 EM LIVE OAK POLLEN

This is an excellent SEM of the Live Oak pollen showing 2 of the 3 apertures and very long furrows. Not obvious at all are the pores and they may or may not be. The wall is rough and has the excrescences scattered irregularly over the surface.

231 EM LIVE OAK POLLEN POLAR VIEW

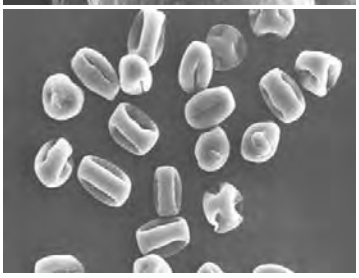


Live Oak pollen from a polar view slightly oblique shows clearly the 2 of the 3 furrows, which are reaching up, into the polar area.



232 EM LIVE OAK POLLEN SURFACE

This is a close view of the Live Oak pollen, which shows one end of the grain with the 2 furrows and the very regate wall surface.



233 EM LIVE OAK POLLENS

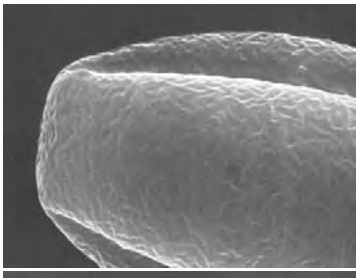
This overview of the Live Oak pollen illustrates in the majority the longate pollen grain with 2 of the 3 apertures and occasionally you can see an oblique pollen view which will show you the ends of the 3 apertures. So again position is very important when making the total counts of any pollen type.

234 EM LIVE OAK POLLEN OVERVIEW

This is a very good overview photo of the Live Oak showing the grain, which is elongate about 35 to 40 microns in length, 20 to 25 in width and the rough surface. A photograph like this is very valuable for confirming in the different positions the morphology of the same pollen type and this is important to know because this is one of the most important tree allergens in North America.

235 EM BOX ELDER MAPLE POLLEN

The Box Elder Maple EM has a rough surface, or rugulate surface, with a long furrow. There are 3 of these furrows. The grain, of course, is longer than narrow about 40 microns long and about 20 wide.



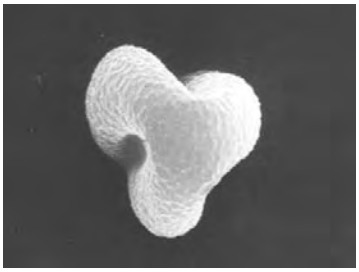
236 EM BOX ELDER MAPLE SURFACE

Box Elder Maple SEM illustrating one end of the pollen grain shows the furrows coming almost to the pore and the rugulate surface of the grain.

238 EM CALIFORNIA WESTERN SYCAMORE POLLEN

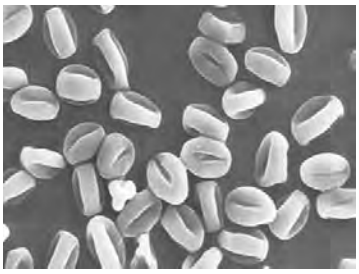
This shows the California Western Sycamore grain somewhat elongate with 2 of the 3 major furrows. So it is 3 colporate and their rather thickened sexine, which has a rough edge.

239 EM CALIFORNIA WESTERN SYCAMORE



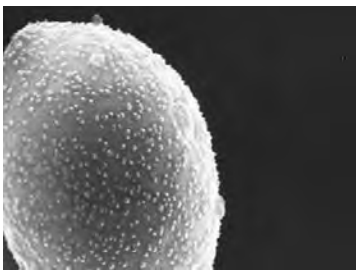
California Western Sycamore is shown here in polar view of its pollen and again you can see very clearly the position at least of the 3 furrows, or colpi, and the roughened surface of the grain.

240 EM CALIFORNIA WESTERN SYCAMORE POLLENS



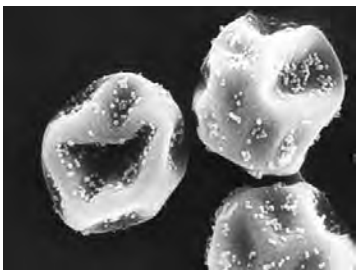
This is an excellent overview of the California Western Sycamore showing it in its various positions and orientations, showing at least 2 of the furrows sometimes only 1 depending upon position. Very rarely will you see a good polar view, but I see one in the center to the left of the screen.

242 EM WHITE MULBERRY SURFACE



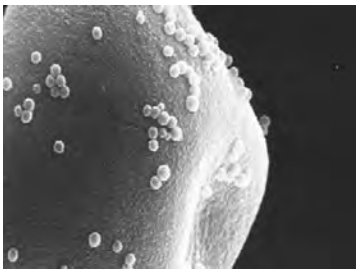
This is an EM image of the White Mulberry pollen which shows very clearly on the right side of the grain a round, rather small round circular pore, and this is 1 of 2 that is present and the SEM shows, of course, very nice wall morphology where you have the little granular dots scattered irregularly.

246 EM MONTERREY CYPRUS POLLENS



EM image of the Monterrey Cyprus pollen which shows very clearly the excrescences of the warts, irregularly placed over the surface of the grain. Unfortun-ately because of the technique of the SEM, and its very thin wall of the pollen, they are the artifacts of shrinkage. It is very difficult to tell much more except that the grain is around 30 to 40 microns in diameter and there is an area probably on the lower right hand side, the area of the broken irregular pore which is characteristic of this pollen grain.

247 EM MONTERREY CYPRUS SURFACE

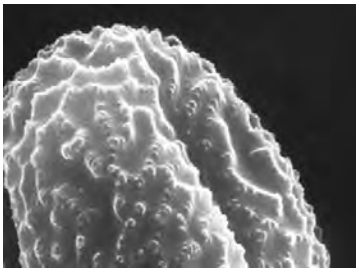


This is a close up of the Monterrey Cyprus pollen showing the circular warts or excrescences scattered over the surface of the grain.

248 EM OLIVE POLLEN

Olive pollen using EM showing very clearly the long furrows and not so well the pores in the center of the aperture but in particular you see the rough surface which is actually a reticulated surface of the grain. That shows up fairly well in the lower part on the image.

Trees



250 EM OLIVE POLLEN

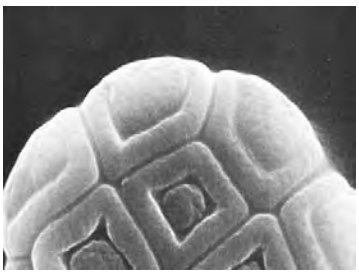
This is a close up of the Olive pollen. Again you can see this reticulation very clearly and you see the end of the furrow but that wall is most distinctive from other members of the family and that includes privet and your ash.

251 EM OLIVE POLLEN OVERVIEW

This is a good overview of Olive showing different positions of the grain. The elongated morphology shows up as well as the long furrows, but as you get to a more polar view you can see 2 at least of the 3 furrows in the oblique positions.

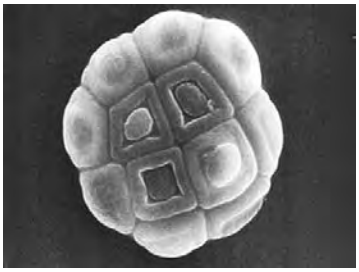
252 EM ACACIA POLLENS

This illustrates a clustering of the Acacia polyad pollen and in each cluster you can see the different square forms in the cells and the walls. The whole polyad can be up to about 150 microns in diameter. So we are talking about a very large cell body.



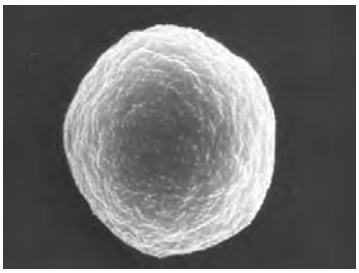
254 EM ACACIA SURFACE

The Acacia using EM shows the square body of each cell with the pore in the center. There is a cap on the pore that ultimately, of course, under certain circumstances will be released and the 2 will exit.



255 EM ACACIA POLYAD POLLEN

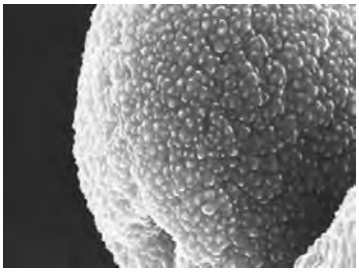
This is an interesting Acacia polyad pollen because it shows the extrusion of 2 of the masses from 2 cells. You can see the protrusion, at least a cap perhaps on one.



256 EM COTTONWOOD POLLEN

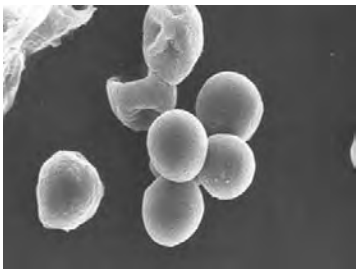
This is a good EM image of Cottonwood showing the rough surface of a relatively thick wall and in this view there is no apparent aperture whatsoever.

257 EM COTTONWOOD POLLEN SURFACE



This close up view of the cottonwood pollen shows at the bottom of the image an example of the pore if not a very good pore, but for cottonwood it is a good pore.

258 EM COTTONWOOD COMPOSITE



This is a composite view of the cottonwood pollen using SEM. On the left hand side, you can see fairly clearly from the polar view the view of 2 pores very rough, different in size, and the side view of them is the only apparent aspect and they have no special depth but they do go through the wall surface.

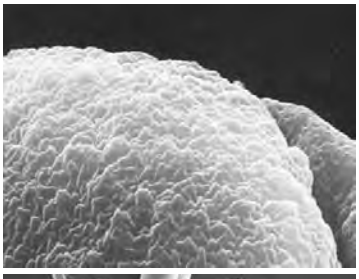
261 EM SCOTCH PINE POLLEN

Behind these 2 bladders is the cell of the pollen but the bladders make up a very important part of morphology at maturity. As you see here they are quite large, and they aid in the dissemination of the pollen, which is very wide.

262 EM PINE POLLEN

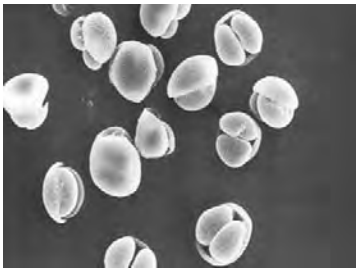
This is a Scotch Pine view which is opposite to 261, the previous slide, which shows the cell in full view of the pollen and then these developed bladders on the back side.

263 EM SCOTCH PINE POLLEN SURFACE

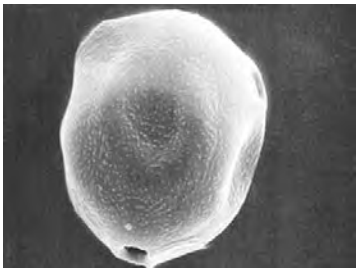


This is a close up of the pollen showing a very rugose surface of the grain.

265 EM SCOTCH PINE POLLEN COMPOSITE



Here is a cluster of Scotch Pine pollen using EM again showing the side views and then the front and back views. You can see the bladders by the side, on the top or at the bottom and vice a versa for the cell.

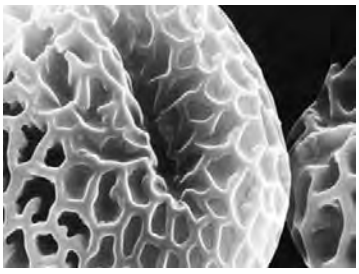


266 EM WHITE BIRCH POLLEN

White Birch pollen is characterized by 3 large pores, and an otherwise average sized grain between 20 to 30 microns in diameter, and a surface that has some rough portions to it. The grain looks very similar to the Bayberries and Wax myrtles in the Myrtaceae.

269 EM COMMON PRIVET POLLENS

Common Privet pollen in SEM clearly shows the morphology of the 3 furrows in different oblique views but more particularly the very characteristic reticulated outer cell wall and this is parallel to the olive. The olive, of course, is a related genus in the same family.

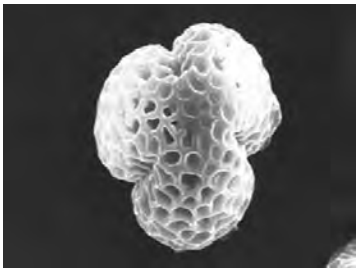


270 EM COMMON PRIVET RETICULATED SURFACE

Here is a close up of the EM example of the pollen of Common Privet and this is a wonderful illustration of the intricacy of the reticulum. Notice to the left side you will see the internal architecture of this outer wall in which you have columns feeding down into the lower layer, which is called the nexine.

271 EM COMMON PRIVET POLLENS

This group photograph of the Common Privet pollen illustrates well the long furrows and the insignificant or difficult to discern aperture in the center, which is part of the compound aperture, is the os. This is not always apparent, but you can see bridges across the equatorial zone.

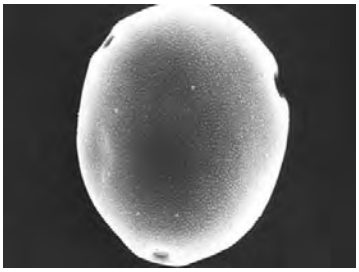


272 EM COMMON PRIVET POLAR VIEW

This is a great EM of the Common Privet from the polar view looking down into the grain and, of course, down the 3 furrows. This pollen is both insect pollinated and facultatively wind dispersed. So if you have a large shrub it is very easy to find large amounts of pollen in your local atmosphere. So the best idea here is to be sure to prune the hedge whenever you can to keep the floral load low.

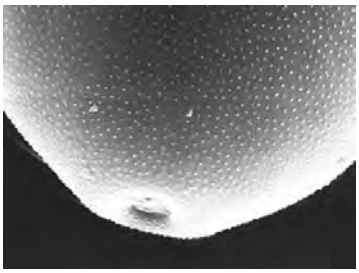
273 EM PECAN POLLEN

This is a view of the 3 apertures using SEM showing the very smooth surface of the grain and somewhat elongated Pecan grain.



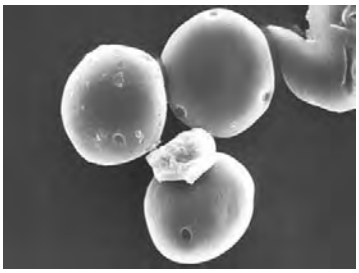
274 EM PECAN POLLEN SURFACE

This shows 1 of the 3 pores of the Pecan pollen and the small granules along the surface, which are very evenly spaced. Otherwise it looks like a very smooth grain.



276 EM BITTERNUT HICKORY

Bitternut Hickory SEM illustration of the 3 grains here show very clearly the positioning of 3 pores in the equatorial area evenly dispersed and the very smooth grain surface.

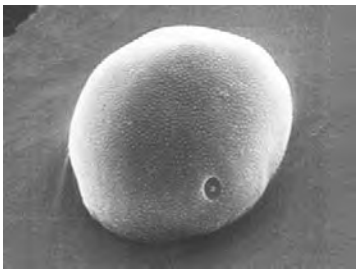


277 EM BITTERNUT POLLEN SURFACE

This is a Bitternut Hickory close up SEM view and it is interesting because even though it is quite clearly smooth when you observe this grain under the light microscope here you can see very even tiny granules scattered over the surface and the clear cut pore is obvious.

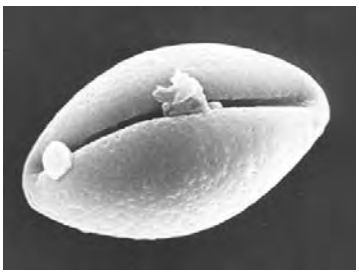
278 EM BITTERNUT HICKORY POLLEN

This is a good example of the Bitternut Hickory pollen showing the 1 pore in view and then the indentations one can visualize on the 2 axillary sides of the other pores.



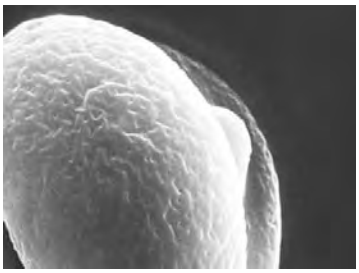
279 EM GLANDULAR MESQUITE POLLEN

The Glandular Mesquite represented here by SEM technique shows very clearly the 1 of the 3 furrows with its pore again a compound aperture and there will be 2 other such apertures at the other side of the grain. And again the elongate form and a fairly smooth if somewhat pitted wall.



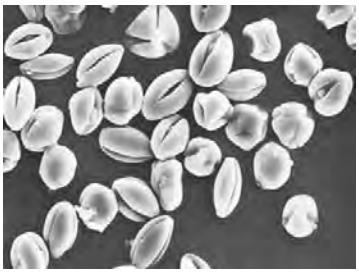
280 EM GLANDULAR MESQUITE APERATURES

This is Glandular Mesquite pollen showing a position where you can see very clearly the 2 apertures. The users refer to 279 for a single furrow.



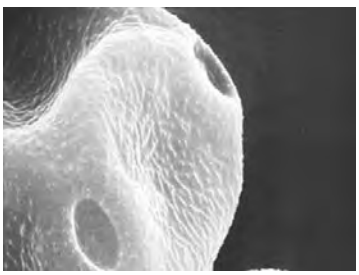
281 EM GLANDULAR MESQUITE POLLEN SURFACE

This is a close view SEM of the Glandular Mesquite pollen in which the wall detailing is quite distinctive and you can see the small pits and the shallow ridges along the whole surface of the wall. Important here is the one aperture which again you can see the compound nature of it, the long furrow which you can see partly and then protruding from about the center of the axis of the grain the pore.



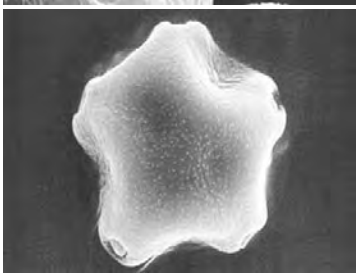
282 EM GLANDULAR MESQUITE POLLENS

This is a fine overview of the different positions of the Glandular Mesquite pollen using SEM. You can see quite clearly the longitudinal aperture, the furrow, in the majority of the grains but if you look carefully at the top for instance you can see an oblique polar view where you have the 3 furrows coming nearly together at the pore or toward the 5 o'clock on the lower right hand corner you can see an oblique polar view where the 2 furrows are very obvious.



284 EM RED ALDER POLLEN SURFACE

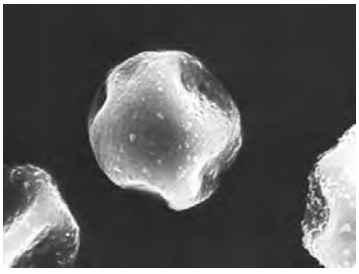
This is an excellent view of the Red Alder pollen showing 2 pores that have lost their caps, I think, and the rather irregular surface with the small bumps on the surface of the wall.



285 EM ALDER POLLEN

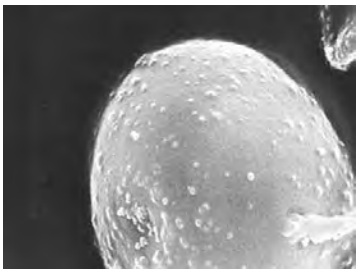
Alder EM's are very interesting because we get a feeling of the 3 dimensions. This is almost exactly the same example as a micro that we have just seen. The polar view shows quite clearly the 5 pores that are extended from the normal surface of the grain.

286 EM OZARK CEDAR POLLEN



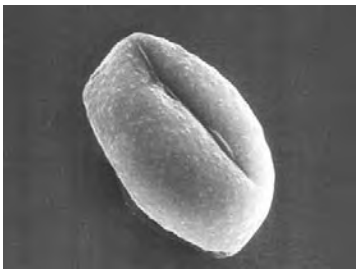
This is an example of another Cedar found in the Ozarks, and although this is slightly distorted by the SEM procedure, on the right at about 4 o'clock, you can see the aperture area where the large irregular shape pore exists.

287 EM OZARK CEDAR POLLEN SURFACE



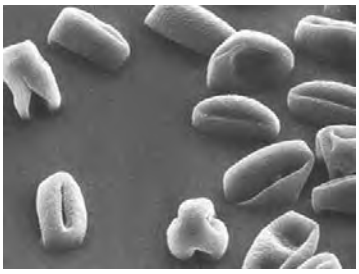
This is an excellent image of the Ozark Cedar. On the left side of the grain you can see the rough area where there is an aperture, a pore, and then the so called excrescences or warty protrusions scattered throughout the surface of the grain.

290 EM RED OAK FURROW



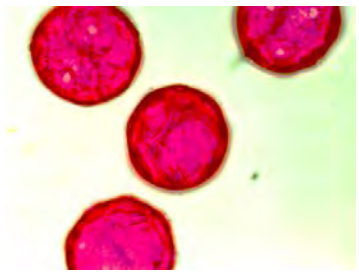
This is a good image of the Red Oak using EM pollen. I would say the characteristics are very typical of the genus of oaks as a whole - the elongate morphology, 3 furrows and a rough surface.

293 EM RED OAK POLLEN COMPOSITE

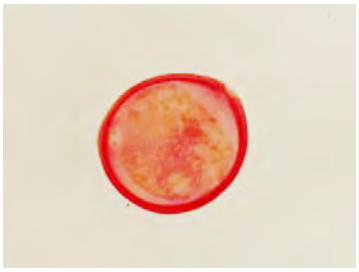


This is a good overview of the Red Oak pollen which I think shows particularly in the lower part of the view both an excellent polar view with the 3 apertures and then in contrast the elongated form which is the equatorial view showing the 1 long aperture out of 3.

294 MIC BLACK WALNUT POLLENS

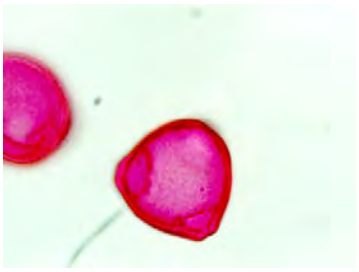


Black Walnut pollen is a spherical grain rather large about 40, perhaps larger microns in diameter, relatively smooth surface and covered in part by numerous pores. The interesting difference of the Black Walnut from for instance the hickories, which they are related, is that at one end of the grain there will be no apertures at all. There will not be any pores over the surface. So the surface of the pore, the pore surfaces, will be in the equatorial zone and either one end or the other end of the pollen but not both. This is a very distinctive feature. As far as I know it is the only one in North America. So it is easy to pull out the walnut pollen and we have a number of important species that shed abundant pollen, so this is significant.



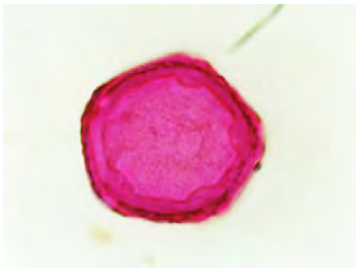
295 MIC HAZELNUT POLLEN

The Hazelnut pollen is a spherical grain about 20 to 25 microns in diameter with 3 distinct pores in the equatorial area very much resembling the pollen of birches. They are slightly extended from the surface and surrounded by a ring which is fairly prominent, and the surface is generally smooth.



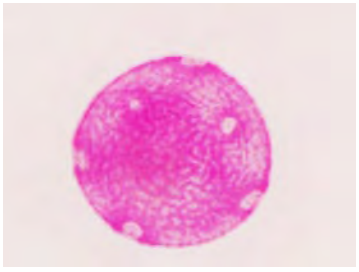
296 MIC HAZELNUT - 3 PORORATE

The Hazelnut pollen is 3 pororate sometimes extended from the surface with a ring around these very distinct pores and notice also that below the pore the intine, or the inner wall is very much thickened below each. The pore is about 25 microns in diameter, circular and with a relatively smooth surface.



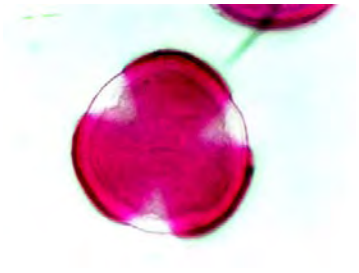
297 MIC AMERICAN ELM POLLEN

The American Elm pollen is a round grain about 30 to 35 microns in diameter and it usually has 4 to 8 pores but often 5 which is represented here in the equatorial area. What is unique about the grain is that you can have 5 in a regular position on the equator but then suddenly you are going to have several pores that are either above or below the equatorial area. So it results in an unusual ring, which is asymmetrical. The surface is rough and irregular, and it is produced of course by the elms in large amounts.



298 MIC AMERICAN ELM POLLEN

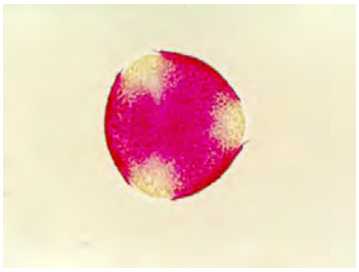
This micro image of the American Elm pollen shows I think quite clearly the 4 peripheral or equatorial pores, but that you have suddenly 2 pores toward the center on this looking toward the polar axis. What they are they are off centered on the equatorial zone so you have 6 pores. So, it is not unusual to find these irregular numbers and irregular positions in the elms. In fact, it is one of the distinctive features.



299 MIC RED MAPLE POLLEN FURROWS

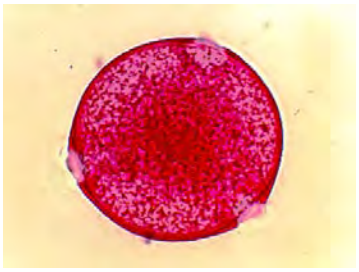
Red Maple pollen is illustrated here by a polar view. You are looking from the top of the grain down to the equatorial region, which clearly illustrates 3 long furrows of which you can see the tips coming into the polar region and are quite broad. The grain is elongate and the length can be 40 microns, the width about 25 microns, the surface is variable in the maples. In this particular case you can't see the edge and this will be discussed under EM.

300 MIC AMERICAN SYCAMORE APERATURES



The American Sycamore pollen as shown here from the pole shows the 3 apertures which are colpi, or furrows and they are fairly long but the grain is more or less round about 20 microns in diameter.

301 MIC AMERICAN BEECH POLLEN

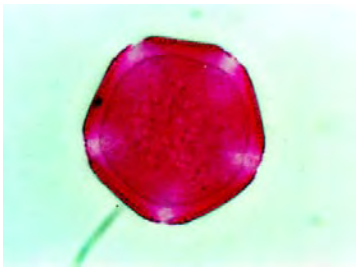


This is a pollen from the American Beech and it is a good example showing from the polar view down to the equator the positioning of the apertures. The furrows are fairly long and you can just see the penetration into the polar region. But I think what is exemplified is the general area of the pores being each of the 3 positions of this circular view, of course, of the polar region even though the frame is somewhat elongated and is large. The diameter will reach 50 microns.

302b MIC ASH POLLEN

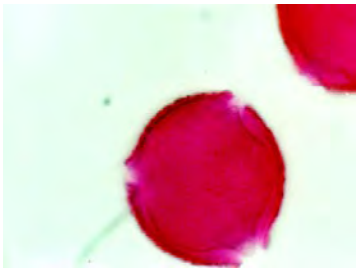
Ash pollen can have 5 apertures, or as you see illustrated here 4 apertures. Otherwise the same structures are rather more squared like as you can see from this polar view and an elongate grain.

302 MIC ASH POLLEN - 5 APERATURES

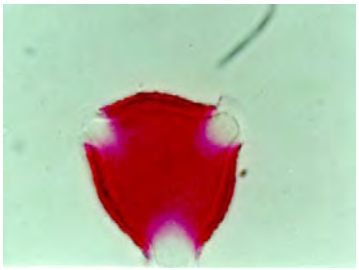


Ash pollen is very characteristic. You will see in this illustration 5 apertures. Both a pore and a short furrow is found in each and from this photo here you can see the symmetry at the equatorial area. The grain is about 30 microns in diameter and is relatively elongate.

303 MIC OAK POLLEN - 3 FURROWS



Oak pollen in general is intermediate in size. They are elongated grains with 3 apertures. The apertures can vary somewhat. They can have 3 long furrows without a pore, they can have a vague pore or they can have a very distinctive pore. So a very different species of the oak will have a difference in that kind of morphology and then another characteristic is that the wall surface is rough. It is rather rugulate.



304 MIC LIVE OAK POLLEN - 3 APERATURES

Live oak pollens is typical of the whole genus in that you have an elongated grain with 3 apertures and a rough wall surface. The 3 apertures are dominated here at the polar view by the fairly long colpus, but clearly the 3 pores in the equatorial area.

305b MIC ROCKY MOUNTAIN JUNIPER POLLEN

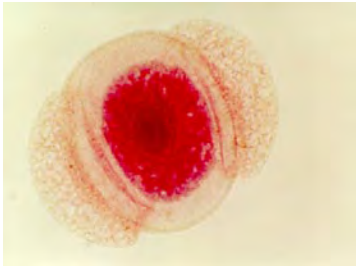
The Rocky Mountain Juniper pollen illustrated in this micro image shows a very circular grain 25 to 30 microns in diameter, thin outer wall and a very thick inner wall to this stellate center, which is the entire protoplasm of grain concentrated there with a pore like area above that which eventually will more clearly break and the germination can take place.

305 MIC ROCKY MOUNTAIN JUNIPER POLLEN

Rocky Mountain Juniper pollen is typical of the cypresses and the cedars. Let's look at this image. It is a circular grain, around 25 microns in diameter, with a very thick inner wall which is difficult to see here, and thin outer wall - but what is important also is that in the center the entire protoplasm of the cell is concentrated into this irregular shape. What you can't see clearly is that the wall above that irregular shape is very thin. It is what we call a pore, or a dissolving part of the wall, when the inner materials are ready to germinate.

306 MIC ACACIA POLYAD POLLEN

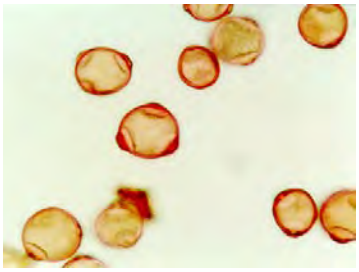
The Acacia pollen is really a cluster of pollens called a polyad and here you see the even in this surface view a dozen different cells making this polyad and it is anywhere from a dozen to 25 cells. They are heavy, they don't go very far even though they can be wind dispersed. Their level of allergenicity isn't well understood.



307 MIC WHITE PINE POLLEN BLADDERS

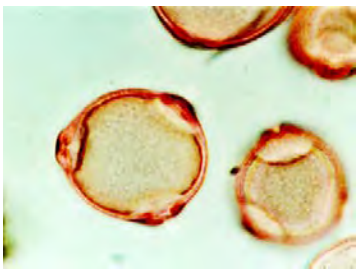
This is a micro example of the White Pine pollen, which illustrates the cell of the pollen in the background and the 2 bladders that are developed with maturity of the pollen as a part of the mechanism of distribution in the wind.

308a MIC BIRCH POLLEN COMPOSITE



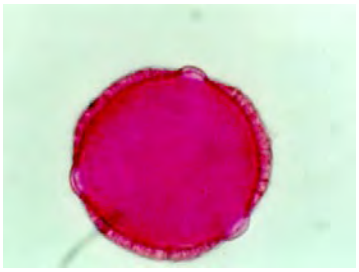
This is a good illustration of the different kinds of positions of the birch pollen and these orientations will give you a good overview of what you would expect to find in oblique as well as in particular pure views and, therefore, give a good overall understanding of the morphology of the grain but the highlights, of course, are the 3 pores with the enlarged inner wall below each pore.

308 MIC BIRCH POLLENS



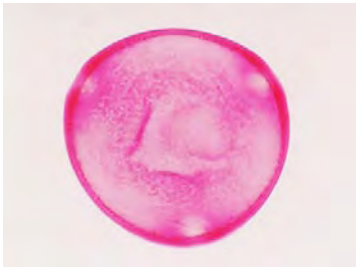
These polar views of the birch pollen illustrate clearly the 3 pores, which are found in the equatorial area of the grain and they are elevated from the surface in what we call an aspidate characteristic. Note if you will within the grain the enlarged inner wall below each of the pores.

309 MIC COMMON PRIVET



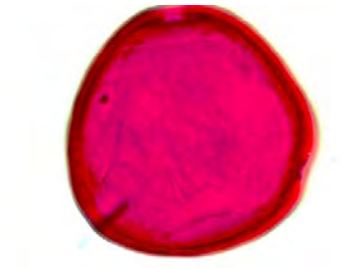
Common Privet pollen is a 3 aperture rate grain with relatively thick walls. It's about 20 to 25 microns in diameter and sometimes a little longer. So it's spheroidal to sub-spheroidal and the long furrows are not apparent in this view.

310 MIC PECAN POLLEN



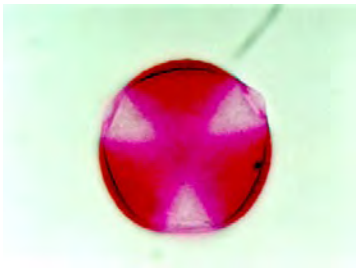
The Pecan pollen, which is very closely related to Hickory, and so the morphology is very close to the Hickory which is 3 pores, elongated pollen grain, and it is highly allergenic.

311 MIC HICKORY POLLEN - 3 PORORATE



The Hickory high bred pollen illustrated here and typical of all species is 3 pororate in a relatively spheroidal grain. It is somewhat larger than average between 30-40 microns with a fairly smooth surface.

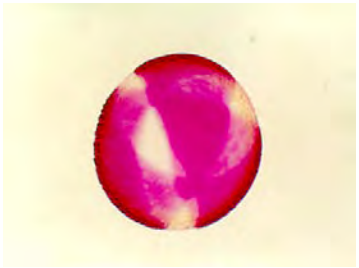
312 MIC GLANDULAR MESQUITE POLLEN



Glandular Mesquite pollen is illustrated by this polar view using a micro staining and I think it shows very well the circular form of an elongated grain that has 3 apertures, these are compound apertures with furrows that extend into the polar region at the top and then all the way along to the polar region at the bottom with about central which you can see well at about 1 o'clock the position of the individual pores in each one of the apertures.

313b MIC GLANDULAR MESQUITE - OBLIQUE POLAR VIEW

Glandular Mesquite pollen is showing an oblique polar view where you have it off centered but you can still see the 3 apertures with the 3 furrows toward the pole but it is tilted to one side.



313 MIC GLANDULAR MESQUITE POLLEN - POLAR VIEW

This is a classic polar view of the Glandular Mesquite pollen showing the 3 apertures and the fairly long furrows coming almost together at the pole.

315 MIC COTTONWOOD POLLEN

The Cottonwood pollen is a little different from what you might expect because it is related to the willows and the willows have a very discrete morphology. This is a roundish grain somewhat elongated but mostly spheroidical with a fairly thick wall that is permeated by often by 3 pores but the pores are very shallow, very irregular so often they are difficult to see. Very often in fact they may have no aperture at all being what we call inaperturate, so that if they are inaperturate that simply means that the wall has to fall apart for the pollen to emerge and there is no set spot for that emergence.

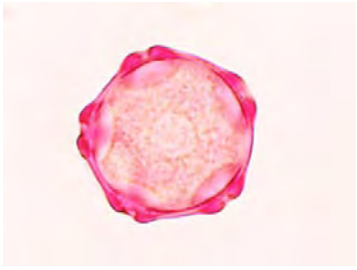
316 MIC MOUNTAIN CEDAR POLLEN

This is a good image of Mountain Cedar, which is a circular grain with a fairly irregular pore in the center and a rather thick wall. The size of the pollen is about 20 microns so it is on the smaller side.

317 MIC WHITE MULBERRY POLLEN

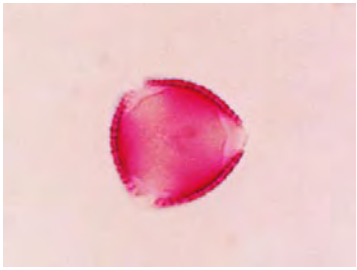
White Mulberry pollen is very small. It's about 10 to12 microns in diameter and is characterized by 2 pores one at each end and fairly round grain and below each of the pores you can see a very enlarge intine of the inner wall which is very characteristic. But the small size, thin outer wall and the 2 pores are quite distinctive for the mulberries, although they are related to hemp and others in the Cannabaceae, hops for instance.

318 MIC RED ALDER POLLEN



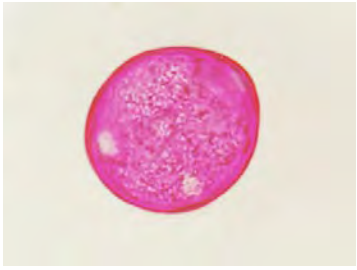
Red Alder pollen is I think very beautiful. You can see very clearly in this polar view the 5 apertures that are being representative at the equatorial region of the grain as you would go from the polar to the center part of the cell. The characteristics are 5 pores, and these pores are also surrounded by a thick wall and they protrude from the surface of the grain. The grain is about 20 to 30 microns in diameter, circular. You also note that below each of the 5 pores within the body of the grain is a slightly increased area. This is the inner wall which is typical of the Alder.

319 MIC OLIVE POLLEN



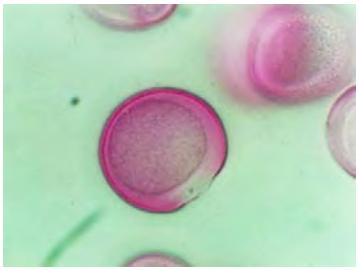
This Olive pollen looking at it from a polar view showing the 3 apertures and what appears to be a very rough or coarse outer wall. The wall is quite thick and we look at the EM to see the further details of its morphology.

320 MIC AUSTRALIAN PINE POLLEN



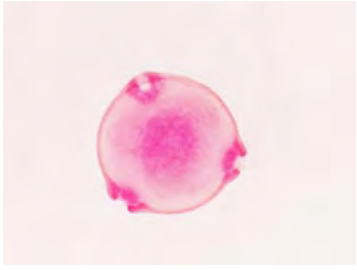
The Australian Pine pollen is sort of round, it can be a little elongated, but it is typified by 3 pores which you can see represented here on an oblique polar view and the surface of the grains rugose or too smooth.

321 MIC DATE PALM POLLEN



The Date Palm pollen is very different from the majority of the trees we have looked at. They have typically 3 apertures, sometimes 2, sometimes a few more, but very rarely if any with 1 and here is an example in the family of the Palms. The majority of the species will be like this with a single long furrow, which is rather narrow and you see it represented by this polar view to the lower right. Notice that the wall is fairly thin but you have a thickened inner wall, the lighter red, which is the intine and in the center is the protoplasm.

322 MIC PAPER BIRCH POLLEN



Paper Birch pollen is well illustrated by this polar view. It shows the 3 pores surrounded by an extrusion from the main part of the grain. Average size 20 to 30 microns in diameter and circular and, of course, it is very, very abundant in the spring.

326 MAC SCOTCH PINE NEEDLES + CONES

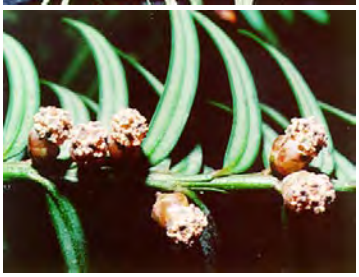
Scotch Pine introduced from Europe is widely planted in the United States and Canada and here is a branch showing the thin needles typical of the whole genus Pinus and the cone a series of male cones each section of which of course produces massive amounts of relatively non-allergenic pollen.

327 MAC SCOTCH PINE NEEDLES

This illustration of a Scotch Pine branch shows the typical needle structure of the pine and then the section through a male cone which in each one of the segments produce thousands and thousands of pollen grains that are released to the atmosphere, but they do not cause much allergy.

328 MAC JAPANESE YEW

The Japanese Yew is a small tree, which has been introduced into North America and is widely cultivated and planted around homes in zone 5 and higher. So, it is hardy in at least 2/3rds of the continent.



329 MAC JAPANESE YEW CONES

Close up view of a stem of the Japanese yew shows the typical cones. You can see in the lower cone if you look carefully a stream of pollen being shaken out of that cone. Remember this is not a flowering plant, this is a member of the Gymnosperms so it only has cones.

330 MAC JAPANESE YEW BERRIES

This is an illustration of the mature cone of the Japanese Yew that looks like a small berry. In fact it is not a berry, which is part of the fruit, but this so called yarrow is part of the cone structure, which enlarges at maturity and presents this form.

331 MAC BOX ELDER MAPLE FLOWERS

This is a close up view of the Box Elder Maple and this maple is an exception to the typical leaf. The leaf is 3 parted and doesn't look like a maple at all. The illustration here are the flowers which hang down clearly down from the stem and thus allow the pollen to be easily blown by the wind and the Box Elder is the major maple, we could say the only maple, but the major maple that is wind dispersed. The others are at least partially insect pollinated as well.

333 MAC BOX ELDER MAPLE IN SPRING

This is an illustration of the Box Elder Maple in the early spring. You see the long pending axis to the flowers, which are almost falling in the breeze here taking away the pollen. But I would point out also the illustration of the leaf, which you can see is a 3 parted leaf as it is beginning to open in the early spring.

334 MAC NORWAY MAPLE

The Norway Maple is a European species, which is widely introduced into North America along our boulevards and in our gardens. And here you see it in the spring the leaves beginning to mature and the yellowish flowers of the male and of course the readiness and maturity of the anthers to release the pollen.

335 MAC NATIVE MAPLES IN FALL

This is a great illustration in the fall of the year of our native maples. We have many species and they are not all as colorful as this but many are. They make a major proponent of the oak-hickory forest of the eastern deciduous parts of the vegetation of North America.

336 MAC BIG LEAF MAPLE LEAVES

Big Leaf Maple is one of the western North American maples but the shape of the leaf is typical of the whole genus and this is what we think of when we think of maple tree leaves. Here you see the illustration of the paired winged fruit which of course will be in itself wind dispersed on maturity.

339 MAC MAPLE FLOWERS

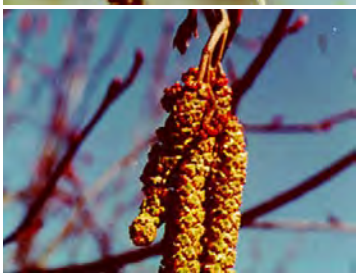
This image of maple flowers is a good illustration of the growth in the early spring before the leaves of the flowers extending the filaments of the stamen so that anther protrudes well into the air and, of course, it is the anther that will eventually break and the pollen is easily released.

342 MAC MAPLE FLOWERS MATURING

This is an example even in the early spring beginning the maturation of the fruit is the winged seeds, which of course will be dispersed by the wind. Again the long axis to the flower is typical of the maples.

343 MAC AMERICAN BEECH

The American Beech is a wonderful tree, which is native to eastern North America and can be found often in plantations in boulevards and produces its pollen in the spring.



344 MAC RED ALDER CATKINS

Red Alder is a representative of a fairly large group of species found in North America that are strongly allergenic. The centers of distribution for this kind of tree would be in the Pacific Northwest, but other species are also common in California and the Northeast.

345 MAC RED ALDER MALE INFLORESCENCE

This is an illustration of the Red Alder catkin or male inflorescence. From this inflorescence will come at maturity tens of thousands of pollen grains.

346 MAC FILBERT HAZEL FLOWER + CATKIN

The Filbert Hazel is the European equivalent of the American Hazel. It is a small tree which produce the nuts which we enjoy so much. This image is an example of the close up of the flowers. The reddish floral group on the left is the female flower and the catkin like inflorescences represent the male and produce abundant pollen, which is widely dispersed.

348 MAC RED RIVER BIRCH CATKINS

The Red River Birch is one of our numerous birches that are quite common east of the Rocky Mountains in North American where you have a high diversity of species. This particular one and is illustrated here by the catkins, or male inflorescences, that produce large and abundant amounts of allergenic pollen in the spring.

349 MAC PAPER BIRCH CATKIN

Paper Birch is a small tree common in eastern North America. Here is illustrated a part of the catkin of the male inflorescence which produces large amounts of pollen that are dispersed in the spring.

352 MAC AUSTRALIAN PINE - BEEFWOOD

The Australian Pine, or Beefwood, are mostly tall rapidly growing trees which have a characteristic weepy habit caused by the jointed stems and short internodes. They are in another way like wispy pines and you will notice that the stems are green and there are no typical leaves and that you can see the light brownish inflorescences at the tips of the branches that release pollen.

353 MAC GLANDULAR MESQUITE INFLORESCENCES

The Glandular Mesquite is a small sort of scrubby tree found in the Southwestern part of the US in the sub-family of the Mimosas. And here you see an illustration of the inflorescence in which the pollen escapes when it is formed. The pollen is both a combination of wind dispersed and facultatively dispersed because of the strong winds often in the Southwest and there is also, of course, strong insect pollination as well.

355 MAC AMERICAN CHESTNUT LEAVES

This is a photograph of what now is unfortunately a rare photograph of the American Chestnut. The trees were a grand part of our natural forests especially in the North and Central Eastern parts of the continent. Now, because of Dutch Elm disease, of course, they are reduced to just fragments. They will get to maturity, but you see this branch with the inflorescence and otherwise looking healthy but in very short order this will die off back to a vegetative state. So, the pollen can be produced in small amounts from these unusual branches that will form from time to time and so occasionally they will be found on your slides.

357 MAC LIVE OAK FRUIT

This is a photograph of a Live Oak which is a very common evergreen tree some of them getting very large and very robust, typical in the southern United States from Virginia south and to the west. In fact, the whole Live Oak group of species is typical of the southern part of the continent in California to Virginia.

358 MAC WHITE OAK LEAVES + CATKINS

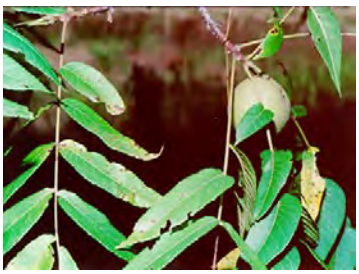
The White Oak is one of the most magnificent of the oaks native to Eastern North America it is a robust tree, which is huge branched and is magnificent in any forest and is often planted as well in parks and gardens. Here you see illustrated the mature typical oak type leaf with the male catkins each of which produces thousands and thousands of pollen grains, which are very allergenic and form much of the sensitivity to oak pollen.

360 MAC CHESTNUT OAK LEAVES + CATKINS

The various oaks in eastern North America are very common, very complex, and many of them have hybridized probably in place of evolutionary diversity of the genus Quercus. However there are species in the West and in the South that the eastern part has very many species and this happens to be one of the rather different ones. The leaf looks like a chestnut so it is called a Chestnut Oak and it is native to the Ozarks of Missouri and Arkansas and it is a small tree. It never gets much taller than about 20 feet and here you see the illustration of the leaf and of the catkins of the male inflorescence from which many, many pollen are released and spread by the wind.

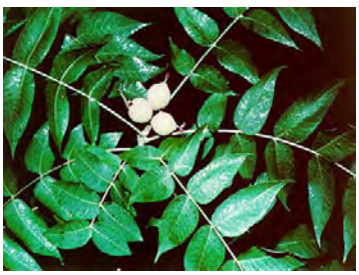
367 MAC HICKORY HYBRID LEAVES + CATKINS

This image of a Hickory hybrid shows in particular the long male catkins, which are numerous and of course it is in these catkins that the male flowers produce the abundant pollen that is dispersed by the wind.



368 MAC BLACK WALNUT LEAVES + FRUIT

The Black Walnut is one of eastern North America's trees and produces a great many fruit which is good for wildlife and, of course, for commercial production of our walnuts. The trees are often very large and quite common throughout the eastern continent.



369b MAC HICKORY HYBRID LEAVES + NUTS

The hickory hybrid has produced its fruit, and long ago allowed its pollen to be distributed in areas of the central, midwest, south, southeastern, and northeastern United States.

369 MAC WHITE WALNUT LEAVES + CATKINS

The White Walnut is a magnificent tree common in the southern parts of the eastern United States and here is an illustration of the compound leaf together with the catkin, the male inflorescence, which will produce abundant allergenic pollen.

370 MAC WHITE MULBERRY

White Mulberry trees are relatively common in weedy in eastern North America, and they are small and you can see here the inflorescence in the late spring and if you look more carefully to the anthers that are protruding from the floral axis and, of course, from the anthers will be released the many pollen into the ambient air.

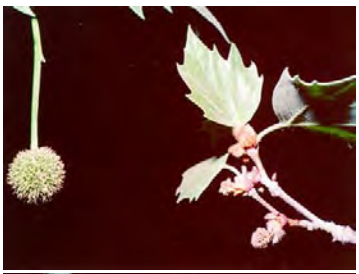
373 MAC GREEN ASH

The Green Ash is a wonderful tree, it grows very rapidly, it spreads and gives shade very, very soon after planting. It is characterized by the compound leaves or leaflets and by these winged fruit, which you see represented in the lower part of this photograph.

374 MAC OLIVE LEAVES

Olive is native to Europe and it has been widely distributed around the world and in the United States quite commonly planted in the Southwest. It is a small tree and produces abundant wide dispersed pollen although sometimes insect pollinated as well.

375 MAC AMERICAN SYCAMORE



The American Sycamore is a very valued tree in eastern North America where it is quite common. Its most distinctive feature would be the shedding of its bark annually.

376 MAC COTTONWOOD CATKINS

The Cottonwood is very common in North America not only native but highly introduced and rather a weedy tree. It is large, produces abundant pollen in the spring of the year and also somewhat later, of course, the so called cotton of the seeds which in addition to the pollen may well be allergenic.

377 MAC COASTAL WILLOW CATKINS

The Coastal Willow is common in the Southeastern U.S., and it produces these catkins, which you see at the top of the diacious plant and these will produce hundreds and thousands of pollen grains. Remember, however, that many of the willows are partially insect pollinated as well as having either facultatively or wind dispersal.

378 MAC LONG-BEAKED WILLOW INFLORESCENCES

This example of the Long-beaked Willow shows the male inflorescences coming to maturity. You can see the long stalks of the filaments tipped by the anthers and, of course, it is in these anthers that either the bees will visit to pollinate or the wind will take the pollen at least in part into the atmosphere.

380 MAC ELM FLOWERS EARLY

As you know, the elms flower very early in the spring and here is a good example no leaves on the tree which is, of course, an advantage because as these flowers mature which are made up almost entirely of stamens to produce large amount of pollen. There is no difficulty then for wind dispersal, because there are no leaves to interfere with that dispersal mechanism.

381 MAC ELM CLOSE-UP

This is a close up of a flower of the Elm which occurs very early in the tree in the spring before the leaves are apparent. The obvious advantage of this is that the pollen can be dispersed without difficulty.

383 MAC CHINESE ELM

Chinese Elm is a handsome tree that has been introduced from China and is now widely cultivated planted throughout the warmer areas of North America and this is a great advantage, because so much of our American Elm has been destroyed by Dutch Elm disease. Occasionally there are cultivars that will get into the colder areas but the plant thrives better in warmer climates.

384 MAC HACKBERRY FLOWERS

The Hackberries are small trees found commonly in eastern North America and they flower readily in the spring and produce large amounts of airborne pollen.

385 MAC HACKBERRY FLOWERS

This is an example of a Hackberry branch that was taken in the lab away from the tree to show the clear morphology of the flowers in relationship to the leaves and here you can see the flower beginning to open and they will shred large amounts of pollen.

386 MAC OREGON WHITE OAK ACORNS

In the Pacific Northwest one of the most beautiful oaks, the Oregon White Oak or the garrya oak, and here you see illustrated a few of the typical leaves of the oak morphology and the reddish fruit, the acorns, some of which have been cut in half to show the seed in the embryo.

387 MAC LIVE OAK - QUERCUS VIRGINIANA

This is a closer view of a Live Oak, the Quercus virginiana, showing the leaves and the rather elongated acorns, which of course flourish in these large trees in the southern parts of the United States.

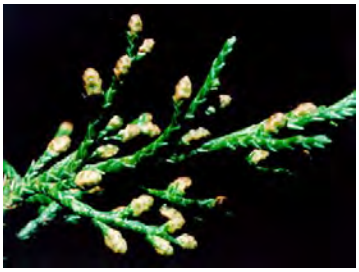
604 MAC EUROPEAN BEECH INFLORESCENCE

This is a close up photo of a European Beech showing the pendant inflorescence in which the pollen are produced and, of course, released into the atmosphere. The tree has a very smooth grayish bark.

605 MAC EASTERN RED CEDAR CONES

Eastern Red Cedar is a small tree often called Juniper in eastern North America. It produces abundant numbers of small male cones, which you can see illustrated here among the scale like green leaves and these cones produce abundant pollen in late winter and early spring months throughout the eastern part of the continent.

606 MAC EASTERN RED CEDAR CLOSE-UP



This is a close up view of the Eastern Red Cedar branch showing immature cones, which are pale brown in and amongst the leaves. Each one of these will produce large numbers of pollen and will be wind dispersed.

608 MAC CHINESE ELM FLOWERS

The Chinese Elm which we see a close up here showing the floral clusters. This happens in the fall of the year in North America, this introduced species. So this is an interesting anomaly that you have spring pollination and fall pollination.

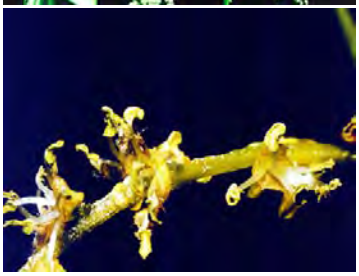
Trees

611 MAC HICKORY HYBRID LEAVES

The Hickory hybrid illustrated here does suggest the general morphology for all the hickories. A large number of species are found predominately in eastern North America where they make up a large part of the oak/hickory deciduous forests. Trees can be very large and they can be very dense and consequently produce abundant pollen in the early spring.

612 MAC SHELLBARK HICKORY CATKINS

The Shellbark Hickory of eastern North America is well represented here in the spring by the development of the male catkins and the production of the bountiful amount of pollen.



613 MAC RED OAK FLOWERS

This is a close up of the stem of the Red Oak showing the male flowers. They are made up principally of stamens. You see the filament and the anther and, of the course, the yellow anthers producing this abundant pollen.

614 MAC RED OAK LEAVES + ACORNS

The Red Oaks are a very important part of flora of eastern North America. The oak/hickory forest is predominately of oak, hickory and maples. So this is your principal major source of aeroallergens for the trees in the spring.

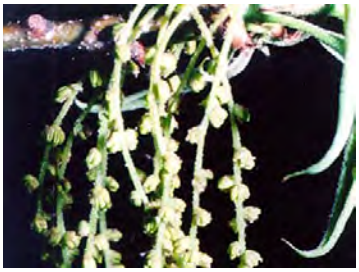
615 MAC DATE PALM TREE

This is another image of the Date Palm showing a worker actually pollinating the female and you can see the ladder and the height of the tree is about 20-30 feet.

617 MAC DATE PALM GROVE

The most commonly grown palm in the United States is the Date Palm illustrated here in cultivation in southern California. These palms and others including the coconut palm are wind pollinated even though insect pollination may also occur. Reports of allergenicity are confined to regions near these and other plantings including workers employed with the crop.

620 MAC WILLOW OAK CATKINS



The Willow Oak is a common tree in the southeastern United States, and is characterized by this narrow willow like leaf, which you see on the right side of the screen. It doesn't look like an oak, but it is one and here are the various catkins producing the male flowers and the pollen are obvious.

700 MAC EUROPEAN BEECH CATKINS

The European Beech is a beautiful tree with this sort of burnt rust color to it, to some of the leaves and to the stems and the inflorescences. It is not a very tall tree and very spread and takes up a great deal of space, but it can be found in gardens cultivated throughout eastern North America in particular. It sheds abundant pollen in the spring and you can almost see some of the stamens in the inflorescences just below the leaf and, of course, that is where the pollen will be taken away by the wind.

710 EM ELM POLLEN COMPOSITE

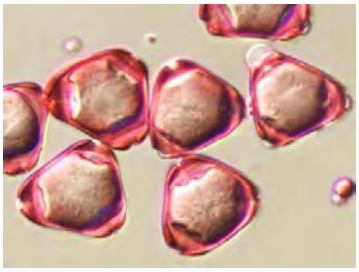
I like this image of the Box Elder Maple EM pollen because it shows so many interesting views that you are likely to see on a slide. The predominate one because, of course, the long, elongated axis of the grain will be that equatorial or side view in which you see normally 1 or 2 long furrows. But looking carefully you will see a few oblique views of the polar region. Very difficult to get exactly perpendicular but over on the upper right hand corner can you see very clearly the ends of the 3 furrows as they come toward one pole.

857 MAC ACACIA FLOWERS

The Acacias are a group of trees typical of the southwestern US and neighboring Mexico. There often is cultivation and the small size makes them attractive to have around homes.

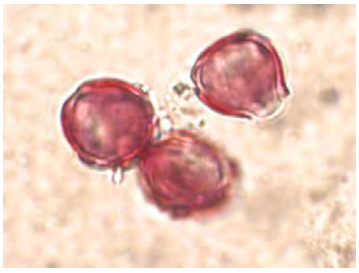
858 MAC EUCALYPTUS INFLORESCENCES

The Eucalyptus aromatic large tree is a great import from Australia where all of them are native and are common in the United States in California and Hawaii, and it is in these places, of course, that this facultative shed of typically an insect pollinated plant allows a certain amount of exposure and a certain amount of allergy to be reported by patients in those areas. The tree is a wonderful addition to the Continent from Australia, although it can become quite weedy if not kept in check.



859 MIC BLUE GUM POLLENS

The Blue Gum micro example shows a triangular form, the 3-colporate aperture and a diameter of about 30 microns in a fairly unique structure of a most interesting genus and pollen grain.



860 MIC AMERICAN CHESTNUT POLLENS

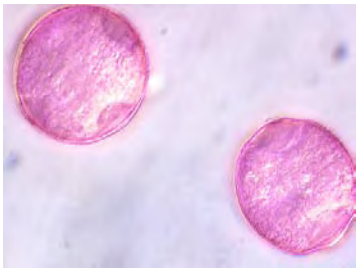
The American Chestnut pollen is quite small. It's between 15 and usually less than 20 microns in diameter. It's an elongated pollen and it has a compound aperture with 3 pores and its associated furrows which are quite long.

861 MAC MONTERREY CYPRUS TREE

The Monterrey Cyprus is a beautiful tree found in western North America. It is typical of an evergreen Gymnosperm, which means it forms cones. Cyprus are related to the cedars and the junipers, and they are found in the family Cupressaceae of the Cyprus family. They produce abundant airborne pollen and compared to other Gymnosperms are highly allergenic.

862 MIC MONTERREY CYPRUS POLLENS

The pollen of the Monterrey Cyprus is somewhat large between 30 and 40 microns in diameter, spherical in shape and with a thin outer wall but a very thick inner wall. The inner contents of the pollen which is an irregular area sometimes in a star shape in the center of the grain corresponds with the weakened outer wall which we could call a pore, an irregular pore, and it is from here that the tube emerges with the allergens. The surface of the grain is covered by excrescences, very irregular, warty like globs.



863 MIC HACKBERRY POLLEN

The Hackberry pollen is about 60 microns in diameter and tends to be one of the larger pollens of the Elm family. It is characterized by a spheroidal shape and a rather granular wall surface and usually 3, sometimes 4 pores, which can be somewhat irregularly found over the surface or in the regular equatorial zone.

864 MAC ROCKY MOUNTAIN JUNIPER

The Rocky Mountain Juniper is a very important tree so far as our allergy sources are concerned. It is found as you can imagine in the Rocky Mountains, and the scraggy areas and the rocky margins, and the tree doesn't grow very tall - but it lasts for a long time and produces very abundant pollen which is quite light. Depending on the direction of the wind, which from the Rockies is usually to the east, we find throughout much of Texas and the lower mid-continental states large amounts of this pollen having traveled hundreds and hundreds of miles to the sampling site.

865 MAC ROCKY MOUNTAIN JUNIPER BRANCH

The Rocky Mountain Juniper is a very important tree so far as our allergy sources are concerned. It is found as you can imagine in the Rocky Mountains and the scraggy areas and the rocky margins and the tree doesn't grow very tall but it lasts for a long time and produces very abundant pollen which is quite light. Depending on the direction of the wind, which from the Rockies is usually to the east, we find throughout much of Texas and the lower mid-continental states large amounts of this pollen having traveled hundreds and hundreds of miles to the sampling site.

866 MAC PECAN LEAVES + CATKINS

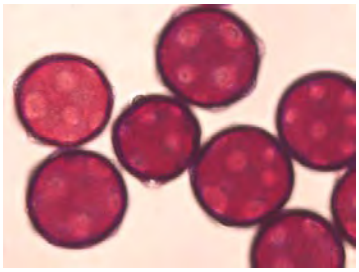
The Pecan tree is a very large plant native to Illinois and is found mostly on plantations to the south to Louisiana. The tree has numerous multi-leaflet leaves and, of course, is famous for the wonderful nut that we call enjoy.

867 MAC COMMON PRIVET

The Common Privet shrub is native to Europe and it is widely introduced into North America to form hedges and plantings around homes.

868 MAC AMERICAN SWEETGUM LEAVES + FRUIT

The American Sweetgum is a magnificent tree native to eastern North America. It grows profusely, rapidly and is widely cultivated far from its natural state. It has a very characteristic 5-pointed lobe leaf and in the fall of the year has the very hard pendant balls, which represent the compound fruit. They are very hard to get rid of when they fall on the grass.



869 MIC AMERICAN SWEETGUM POLLENS

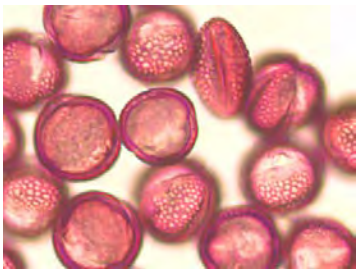
The American Sweetgum pollen is a round grain about 40 microns in diameter and throughout the entire surface are any where from 18 to 20, 22 fairly large pores and in each pore you can see the surface is covered by granules.

870 MAC CALIFORNIA SYCAMORE LEAVES

The Western California Sycamore is a wonderful tree found chiefly in California and is the counter part in the west to the large distribution of the eastern Sycamore or the American Sycamore.

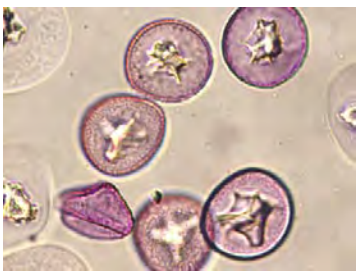
871 MAC BLACK WILLOW

The Black Willow is found in southeastern and central US. It is a relatively small tree with pendant branches and it is diacious.



872 MIC BLACK WILLOW POLLENS

The Black Willow pollen is somewhat elongate with 3 apertures and a very coarse reticulated sexine or outer wall that narrows. The grooves become smaller as you go toward the poles.



873 MIC JAPANESE YEW POLLENS

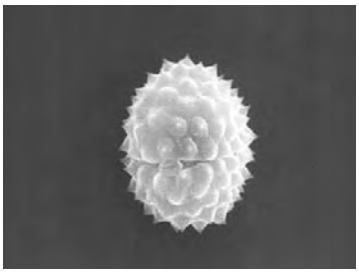
The Japanese Yew pollen very much resembles the Juniper and other members of the Cupressaceae in that it is circular about 25 microns in diameter with a thin wall and a very thick inner intine wall. A small area of the cytoplasm which is usually stellate or circular and a single large irregular pore.

Weeds

389 EM WATER HEMP POLLEN SURFACE - MARIJUANA

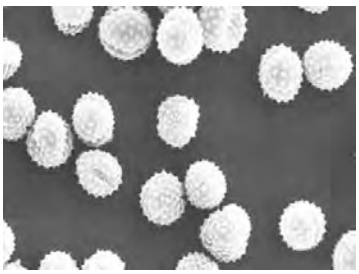
This is a fine view of the surface of the pollen Water Hemp showing the numerous pores and the sort of the warty covering of the wall inside the pore because that pore is actually closed until the pore is burst by the tube which will eventually penetrate the female stigma from the pollen.

393 EM MARSH-ELDER POLLEN



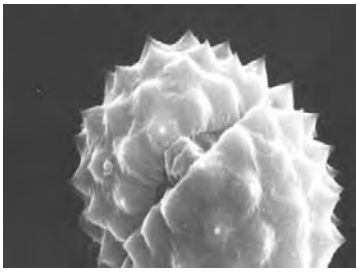
This is a SEM image of a Marsh-Elder pollen. Its spherical but somewhat flattened, what we call sub-oblate. You can see the many small spines over the entire surface and in center view, the aperture with a long furrow and right in the center of the furrow you can see the area where you have the pore.

395 EM MARSH-ELDER POLLEN COMPOSITE



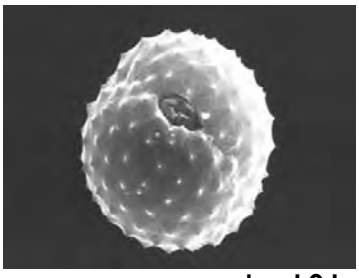
This is showing a cluster of SEM images of the Marsh-Elder. I think these are showing an excellent overview that you might mistake for something else but please exam the different positions of the grain that show a triangular form which means you are looking from the polar view down to the equatorial view of the grain or if they are quite circular or flattened, you can see the apertures looking and doing the equatorial view from the side with the poles at the 2 ends of the grain. So it is very important to examine as many pollens as you can of any particular plant so that you can understand that you are looking at the same kind of grain but different views and positions and this is a good example under SEM to study that phenomena.

396 EM MARSH-ELDER POLLEN SURFACE

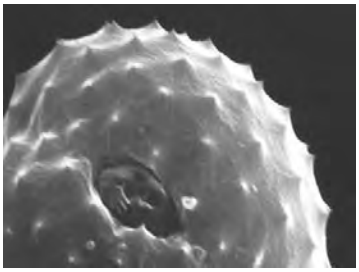


This is another image of the Marsh-Elder pollen, which shows an even closer view of the surface of the pollen and of the aperture, the long furrow, and the pore area where in fact there may be a small amount of protoplasm actually protruding in the area of the pore or that is a pore cat. That aperture is very clear. There are 3 of these pores in each grain.

401 EM DESERT RAGWEED

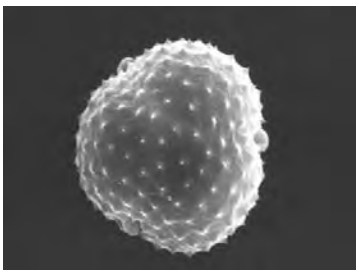


This is a very nice image of the Desert Ragweed pollen showing a single aperture, slightly elongated furrow and then a small pore in the central region and, of course, the hole surrounded by these small spines.



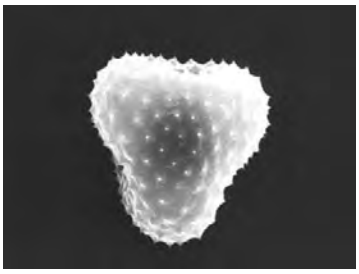
402 EM DESERT RAGWEED POLLEN SURFACE

This is an EM image of a part of the pollen grain of the Desert Ragweed showing very clearly the spine, rather small spines, all over the surface and the 1 of 3 apertures on the grain which has an elongated, shorter elongated, furrow and then in the center will be a pore from which the pollen tube emerges for pollination with the 2 sperm.



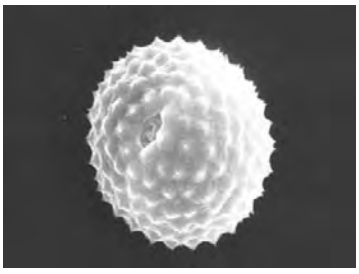
403 EM DESERT RAGWEED POLLEN

This is a very good image showing the polar view of the Desert Ragweed pollen. Along the 3 sides you can see the apertures very clearly and in fact protruding from each is a cap to the pore or part of the protoplasm which is exuding.



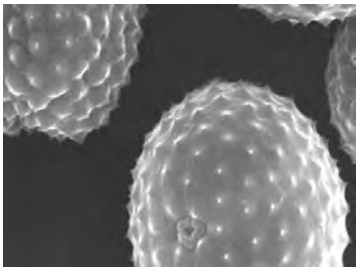
405 EM CANYON RAGWEED POLLEN - POLAR VIEW

Canyon Ragweed pollen as illustrated here with an EM image from the polar view shows the typical triangular shape of many of the Ambrosia type pollen with the 3 indention areas where the apertures exist and I think it is quite clear to see the short spines through the whole surface of the wall.



406 EM CANYON RAGWEED POLLEN

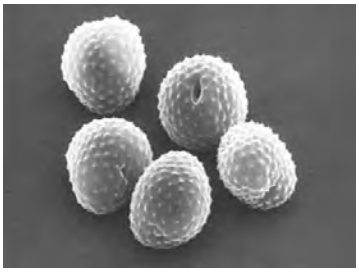
Canyon ragweed pollen is circular 15-20 microns in diameter and its typified by this small aperture which is actually a compound one in that there is outer furrow, which is fairly short and then a small pore in the center. And again, typical of all of the ragweeds, the short spines found all over the entire surface.



408 EM CANYON RAGWEED POLLEN SURFACE

Canyon ragweed pollen - another illustration SEM. This is a very good picture showing the apertures, slightly oblique, that has in fact a cap to the whole area which will be removed once the pollen tube pushes out from that pore area and then, of course, the image of the spines over the entire surface.

409 EM CANYON RAGWEED POLLENS

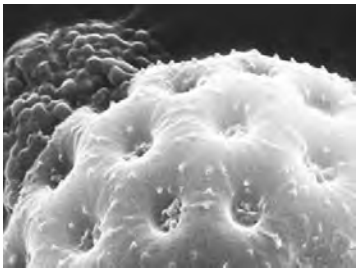


This is a great illustration of a clump of Canyon Ragweed pollen because I think it so clearly shows the different images of the pollen grains depending on the position so that you can see in the top center for instance an equatorial view where the spheroid shape of the pollen is very obvious and you can see the aperture which is a compound aperture made up of a short furrow and a tiny pore inside and then it is obviously well dispersed short spines throughout the surface. I should note that this particular species of ragweed has also been known in the genus Franseria so that many of the textbooks will have the genus Ambrosia separate from Franseria. Don't' be confused because the 2 genera are the same and they were separated technically for insufficient reasons. So everything that you see is Franseria should be into the genus Ambrosia and so that there is 1 ragweed genus.

411 EM LAMB'S QUARTERS POLLEN

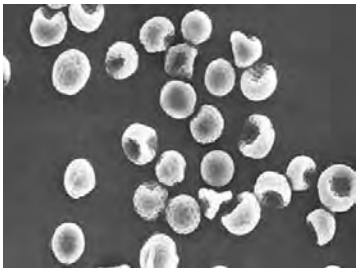
Lamb's Quarters pollen is spherical about 30 to 35 microns in diameter and throughout the surface these many pores scattered evenly. The pollen is occasionally found in the atmosphere but it is typical of a large group, the Chenopod group, that it is difficult to distinguish. During the months of June, July and August you will find them throughout North America.

412 EM LAMB'S QUARTERS POLLEN SURFACE



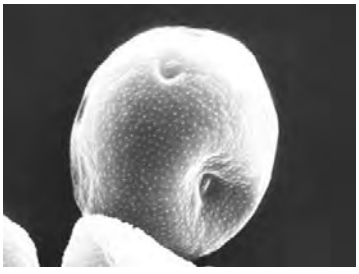
This is an excellent close up view of the SEM wall of Lamb's Quarters pollen. It's a great view of the many pores, which are somewhat sunken here over the surface of the pollen.

413 EM LAMB'S QUARTERS POLLEN COMPOSITE

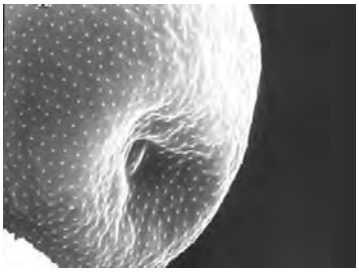


This is an overview of the Lamb's Quarters pollen that you would find in your slide if you had a good aero sample and you can see the round grains with the many pores over the surface.

414 EM ENGLISH PLANTAIN POLLEN

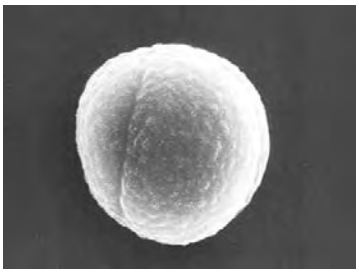


This is a SEM image of English Plantain pollen with at least 4 of about half a dozen pores that would be found on each grain and a rather rough surface of the wall.



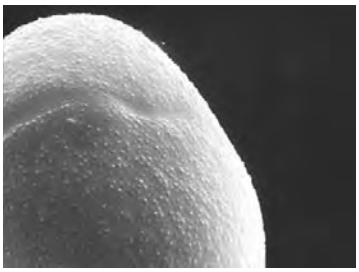
415 EM ENGLISH PLANTAIN POLLEN PORE

This is a good image of a close up view of the English Plantain pollen showing the 1 pore of about half a dozen, and you can see that it is well inundated on the surface and the wall has a series of just small warts or bumps along the surface.



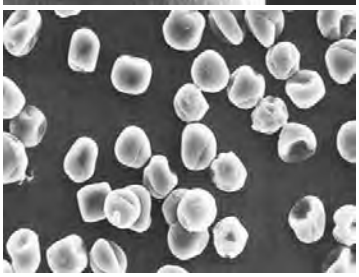
417 EM YELLOW DOCK POLLEN

This is a SEM grain representation of the Yellow Dock. One of the main characteristics is that it is round, somewhat larger, reaching 30 microns in diameter than a typical weed and what stands in this morphology is the very long furrow and there will be 3 of these furrows in each grain and in the center, that you cannot see well at all, is a small pore. Then you will notice that the surface is rather bumpy but they do not have spines like so many of the aster group.



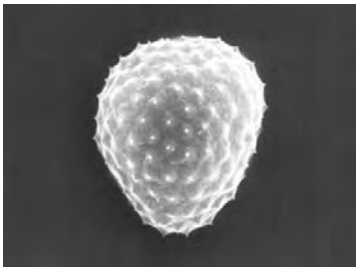
418 EM YELLOW DOCK POLLEN SURFACE

This is a SEM picture of the Yellow Dock pollen showing part of the wall, which has this bumpy aspect and then the upper portion of the long furrow over the surface.



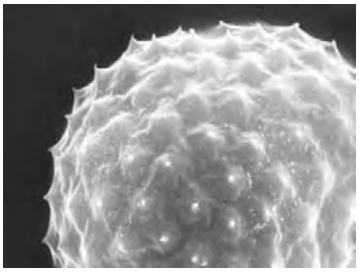
419 EM YELLOW DOCK POLLEN COMPOSITE

This is a photograph of the Yellow Dock pollen in mass and I think you can see very clearly the somewhat spherical to the elongated form and especially the long individual furrows which there will be 3 per grain.



420 EM RABBITBUSH POLLEN

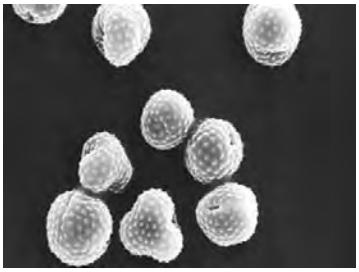
Here is a Rabbit Bush EM image which shows the typical roundish form of the pollen which resembles Ambrosia and all its morphology, the short spines and they are not visible here, 3 typical apertures if you would be looking down from a standard polar view.



421 EM RABBITBUSH POLLEN SURFACE

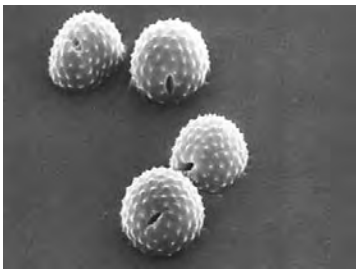
This is a Rabbitbush EM pollen showing the surface with small spines and typical of the Ambrosia type pollen.

422 EM RABBITBUSH POLLEN CLUSTER



Here is a cluster of the Rabbitbush pollen showing a number of positions but I think it is quite clear that you have the 3 apertures in each grain and that you have relatively long furrows in the spines over the whole surface. These resemble the Ambrosia pollen.

423 EM RABBITBUSH POLLENS

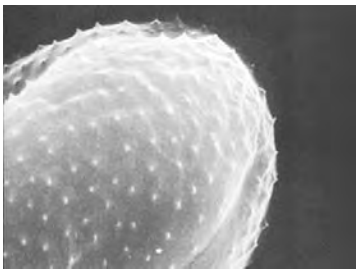


Here is an excellent example of the 4 pollen grains of the Rabbitbush. They very much resemble the Ambrosia pollen because of the aperture form and, of course, the small spines found over the whole surface.

425 EM SAGEBRUSH POLLEN

This SEM is an excellent image of the Sagebrush pollen which shows elongated nature of the grain from an equatorial view looking at the equator and you see the 2 long furrows and right in the center of each furrow, just obvious I think a little bit on the upper one, is the small pore with some protrusion there and the tiny spines that are found not too densely over the entire surface.

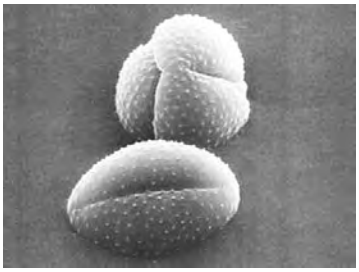
426 EM SAGEBRUSH POLLEN SURFACE



This is an excellent post view of the Sagebrush pollen using EM and here again you see these widely spaced tiny spines and the ends on each side of the 2 long furrows.

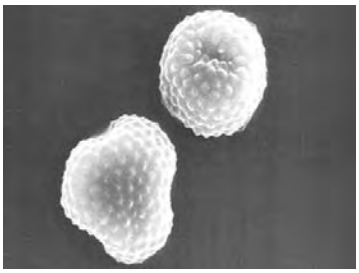
427 EM SAGEBRUSH POLLEN COMPOSITE

Sagebrush pollen under EM and here I think is an excellent series of different images of the pollen in that you can see a single furrow, or 2 long furrows in these elongated grains. But again with the lower magnification even under EM it is difficult to see the tiny spines that are found throughout the surface. This is an excellent view to discern the more or less oblique polar view in which the grain actually looks circular but remember you are only seeing the diameter of the pollen looking from the top or the near top whereas almost all of the others we are looking from the side.



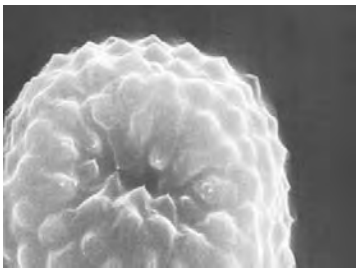
428 EM SAGEBRUSH POLLENS

This EM image of the Sagebrush pollen is I think an excellent one showing the almost the 2 extremes of the positions and the views that you are likely to see when examining this pollen. In the lower is, of course, is what we call the equatorial view which is the side view showing the single long furrow with the tiny pore the right in the center of that axis and there will be, of course, 2 furrows on the side that you can't see and then slightly oblique but clearly showing the polar axis in which the 3 furrows are coming together at the polar region and then, of course both grains with the widely scattered fine rather delicate spines.



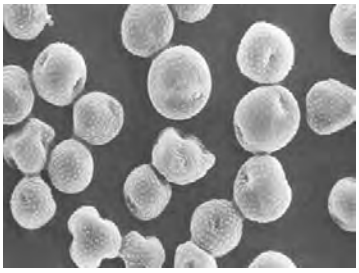
429 EM COCKLEBUR POLLENS

Here are 2 pollen grains of the Cocklebur, which are widely dispersed by the wind. The characteristics are quite clear of this aster group of pollen in that you have the short spines over the whole surface and you have the grain, another triangular shape if you are looking at it from the pole, and you see the 3 indentations which represent the so called aperture areas, the areas where you have a short furrow and a round pore what we call a complex aperture. The grain at the top shows one of these where you can see within between all the spines a fairly elongated but short furrow and right in the very center an irregular shape pore.



430 EM COCKLEBUR POLLEN SURFACE

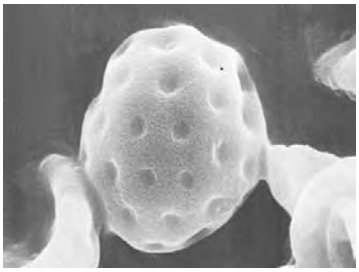
This is EM of a pollen of the Cocklebur showing part of the grain and focusing in on an aperture which shows a longish furrow in and around all the spines and then in the very center, the pore portion of that aperture and it is a complex or compound area in which the pollen tube emerges upon germination.



431 EM COCKLEBUR POLLEN COMPOSITE

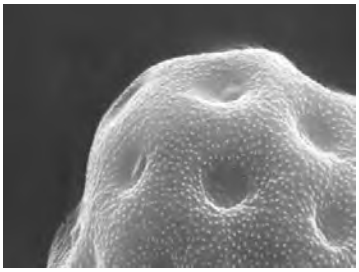
This is an excellent view of an overall numerous Cockleburs that you would find on your slide and here you can see the bumps which represent small spines over the surface of the grain, which are spherical, and then anywhere from 15-20 microns in diameter and depending upon the view you will see 1, 2 or maybe even 3 of the apertures that are found in each grain. Two are quite obvious with the short furrows and then in the center of each furrow you would find a small pore. But there are 3 and you can see in the lower left hand side looking down from the pole of the grain the 3 aperture regions.

432 EM REDROOT POLLEN



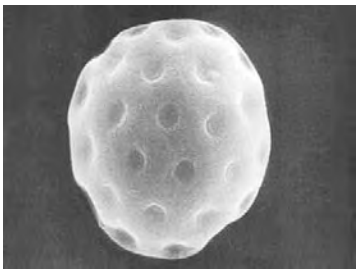
Here is an EM image of the pollen Redroot Pigweed. This shows clearly the multi-aspect of the pores throughout the surface of the grain and a relatively round medium size pollen.

433 EM PIGWEED POLLLEN SURFACE



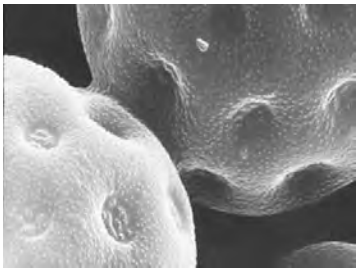
This is a close up view EM showing the wall and the pores of the Pigweed pollen and gives a very good image of the surface of that grain.

435 EM CARELESS WEED POLLEN



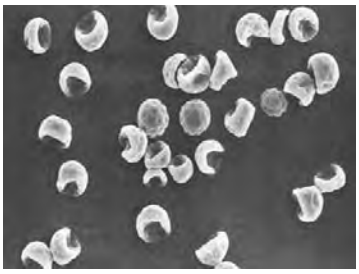
This is a good example of Careless Weed pollen taken with the SEM showing the 3 dimensional of the whole grain and clearly the spherical shape and the many pores spread over the whole surface are clear indications of this type of pollen.

436 EM CARELESS WEED POLLEN SURFACE



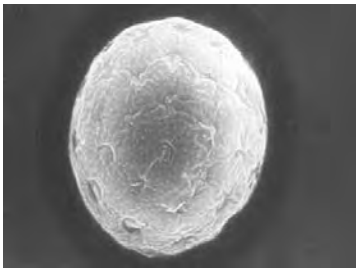
This close up of the Careless Weed pollen shows very clearly the pores over the surface of a fairly bumpy, kind of warty like surface. From each one of the pores will emerge the pollen tube containing the sperm which will, of course, after pollination fertilize the egg so that any one of those pores will be used by the pollen grain for the emission of the tube.

437 EM CARELESS WEED COMPOSITE

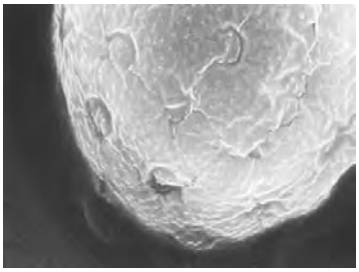


This cluster of Careless Weed pollen taken with the SEM shows especially in the center a circular form of the grain and you can see clearly the many pores over the surface. Again as an artifact there are many of the grains have collapsed but you might see this on any slide.

438 EM ALLSCALE POLLEN

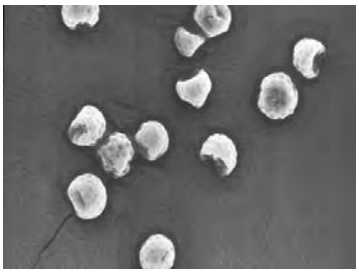


This is standard electron micrograph of an Allscale pollen and you can see hear the very clear 3 dimensional aspect of this spherical pollen grain with the many pores scattered over the pollen surface. You can see details of the cell wall which is sort of reticulated and with some warts or bumps along the surface.



439 EM ALLSCALE SURFACE

This is an example of a close up view of the Allscale SEM pollen grain. Here you can see very clearly the pores with the plugs over the pores and on the surface of the wall the small bumps or protrusions and somewhat the ridges that you find throughout the pollen grain.

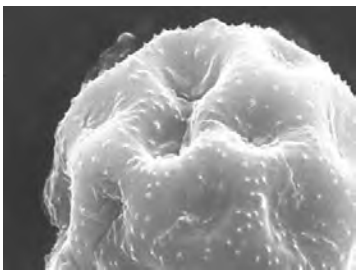


440 EM ALLSCALE

This is a view of a cluster of Allscale pollen taken with the SEM. You can barely see the pores on the surface but they are there and you can see the round form of the pollen grain, although under SEM there has been a slight distortion because of the preparation. But this is the kind of image you would view in your slides.

441 EM RUSSIAN THISTLE POLLEN

Russian Thistle pollen is shown by this EM. Again shows you more or less its spherical shape with many of these rather indented pores throughout the surface probably because of the SEM preparation. So you may not see that kind of morphology on a micro prepared slide.

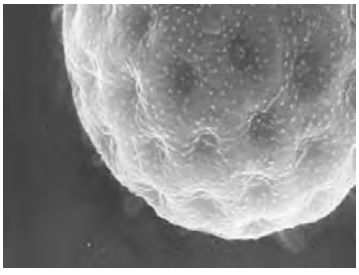


442 EM RUSSIAN THISTLE POLLEN SURFACE

This is a section of a pollen of Russian Thistle which shows the artifact of the indented pores. Normally they would of course be out to the surface.

445 EM FIREBUSH POLLEN

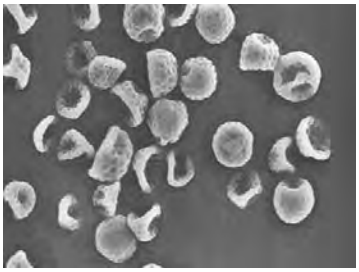
This is a good example of a SEM of the Firebush pollen showing the spherical shape in 3 dimensions and the scattering of the very numerous pores over the entire surface of the grain.



446 EM FIREBUSH POLLEN SURFACE

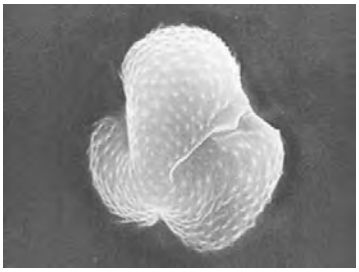
This SEM of the Firebush pollen shows a close up of the many pores on one end of the grain and the small warty protrusions along the wall.

447 EM FIREBUSH POLLEN COMPOSITE



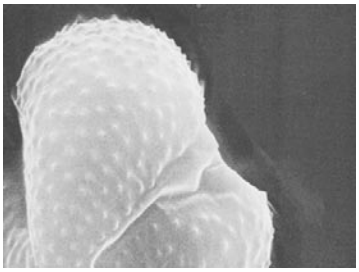
This is a cluster of the Firebush plant pollen showing what it would look like on a slide with the fairly round grains and the many pores over the surface typical of the Chenopod type of pollen grain and many of these groups are very difficult to distinguished from one type of plant to another. They all look rather similar.

449 EM WESTERN MUGWORT POLLEN



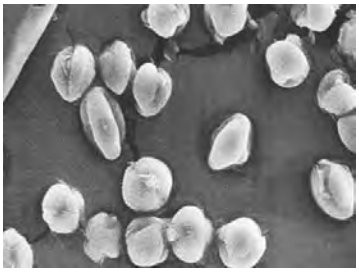
This SEM image of the Western Mugwort pollen clearly shows the 3 apertures with the long furrows in each and gives a real detail of the wall showing that in fact there are spines present though they are very small.

450 EM WESTERN MUGWORT POLLEN SURFACE



This is a good close up image of the Western Mugwort pollen showing the fine or small spines along the surface of the wall, the ends of two furrows. This whole grain is about the size of the typical asteroid type, 15 to 20-25 microns in diameter, and like any of these would be found in the summer months or early fall.

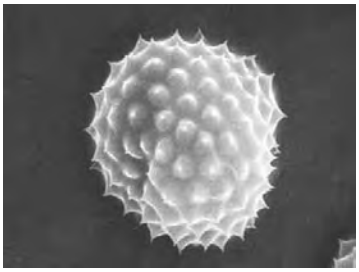
452 EM WESTERN MUGWORT POLLEN COMPOSITE



The Western Mugwort in view here shows many different views of the same species. Some are more elongate than you would typically find in the Ambrosia type pollen with the longer furrows. But 3 apertures, fairly elongated furrows, and very tiny spines along the wall are present.

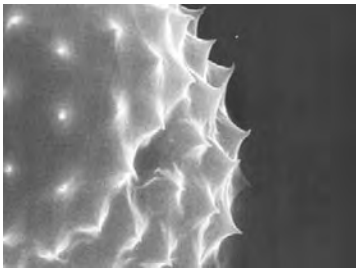
453 EM SHORT RAGWEED POLLENS

Here is a clustering using EM of the Short Ragweed pollen illustrating I think the very different views that you should be aware of and that you will see, of course, on any slides and that is looking at either 2, 1 or sometimes 3 apertures with the different shapes depending on the view. For instance, on the lower left is an equatorial view showing 2 apertures. One of course would be found on the part you are not seeing that wall structure. But you notice they are somewhat flattened, they are round but just a little flattened and that is quite typical of the Ambrosias. In different views then the polar view toward the top you will see grains that are more rectangular and these are scattered in this view and those are from a polar view. So the two views that give you the best identification would one strictly from the pole and another from an equatorial or side view.



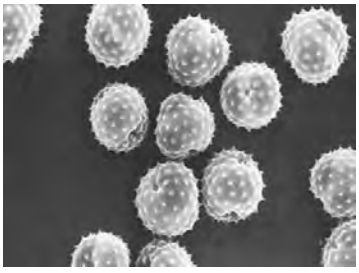
454 EM SHORT RAGWWED POLLEN

Short Ragweed EM of the whole grain showing you the spines over the entire surface and a single aperture.



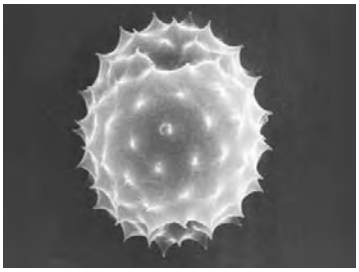
455 EM SHORT RAGWEED POLLEN SURFACE

Short Ragweed pollen EM close up which shows the spines on the wall and the single aperture of three that you will find on any one of these grains.



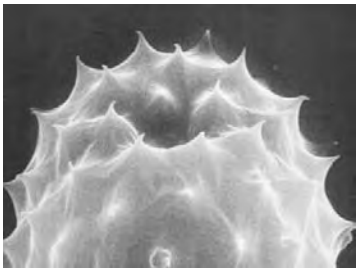
457 EM GIANT RAGWEED POLLEN COMPOSITE

This is a great illustration using EM to show the different positions of the Giant Ragweed pollen in which you see the 1, 2 or sometimes 3 apertures but they are all there even if they are not in view and of course over the surface the many small spines. I should emphasize that the 16 or 17 species of ragweed that exist in North America so far as we know all cross-react. So if you are sensitive to one you will be sensitive to them all or at least the vast majority of our population.



458 EM GIANT RAGWEED POLLEN

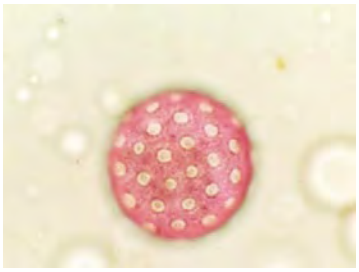
This is an image of Giant Ragweed in EM pollen. You can see 2 apertures. The one at the top is quite clear. You can see certainly the pore and at the base there is actually another pore and the whole spherical grain 15 to 20 microns in diameter, of course, covered on the service by the small spines.



459 EM GIANT RAGWEED POLLEN SURFACE

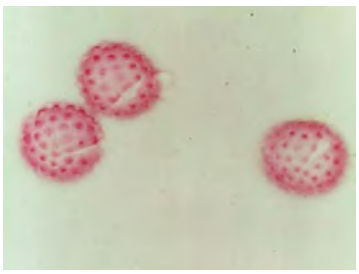
This is a close up of a Giant Ragweed pollen which shows very clearly the short spines found over the entire wall surface of the grain and in this instance, the pit as it were, which is the basis of course of the aperture both the short furrow and the pore. Giant Ragweeds are probably the most profuse aeroallergen found in North America. This is probably one of the most dangerous of our pollen grains so far as causing allergies are concerned in the months of August, September and part of October.

461 MIC ALLSCALE POLLEN



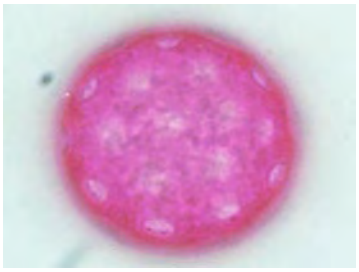
Allscale produces abundant pollen which is wind dispersed. The pollen are very round, they are permeated by a whole series of holes, maybe as many as 50 of these pores scattered evenly over the surface. The grain is about 20 to 30 microns in diameter. It is very typical of a form found in western North America called a Chenopod type of pollen.

462 MIC MARSH-ELDER POLLEN



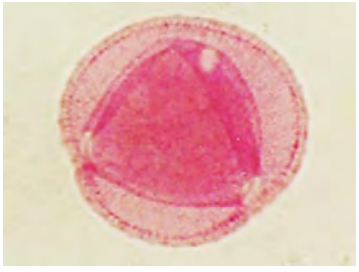
The Marsh-elder pollen is typical of the Aster type of pollen as you can see the roughness of the surface of the grain and the really small spines. This pollen is circular about 15-20 microns in diameter. It is found in the late summer and the fall throughout particularly in eastern North America. This is extremely similar to the pollen of Ragweed and difficult to distinguish on slides and one feature I might note for you that might help and that is the fairly long furrow compared to the shorter furrow of the ragweeds.

463 MIC CARELESS WEED POLLEN



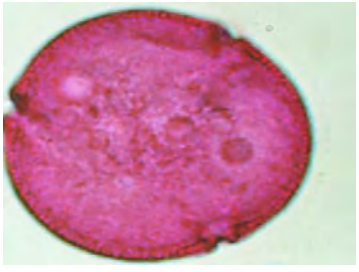
Careless Weed pollen is spherical permeated by these many pores over the surface. It is typical of the Chenopod type of morphology. It is widely produced and is a source of allergic reactions.

464 MIC COCKLEWEED POLLEN

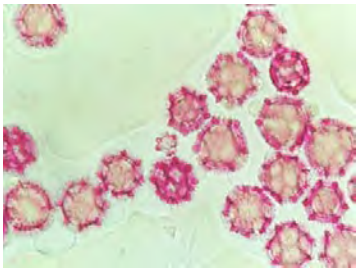


This is a Cocklebur weed pollen which is found commonly in North America. It is in the class or group of pollen known as the Aster group and is characterized by fairly short or small spines over the surface of the wall which are hard to see in this shot but they are there and characterized by 3 apertures or complex furrow pore areas. You can see in the lower part 2 fairly clearly and you can't see the one because of the oblique position of the grain at the top. Another characteristic of the Cocklebur pollen is an extremely thick wall which is here light in color with the protoplasm in the center.

465 MIC YELLOW DOCK POLLEN

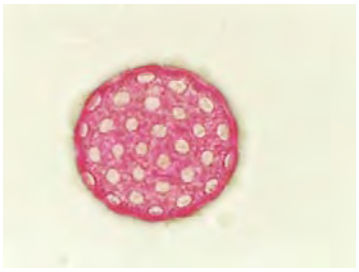


The Yellow Dock pollen is a large pollen for many of the weeds and will reach up to 30-40 microns in diameter. It has the typical 3 apertures represented by a long furrow and a pore in each one of the apertures. Relatively round although somewhat tending to be sub-spherical. These grains are found occasionally and not in great quantities in the summer months.



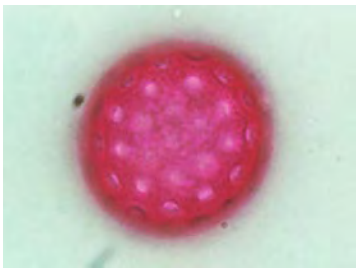
466 MIC DANDELION POLLEN

Dandelion pollen is quite unusual among the Aster group. It is a distinct class of spiny grains and you can see from this cluster that it is most unusual. There are 3 apertures with short furrows and pores in each but they have these pits that make the grain quite distinct. There are other grains like this. One that you will all know would be the Weedy Chicory, the purple flowered plant that you find along the roadsides so commonly.



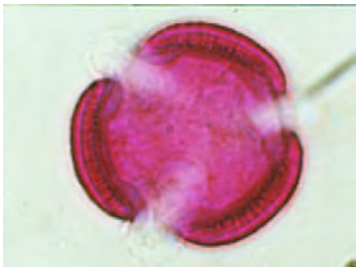
468 MIC FIREBUSH POLLEN

Firebush pollen is typical of the Chenopod group or genera that are found in North America and especially in the West. As you can see it is very spheroidal and made up of many, many pores over the surface. This particular group has perhaps the largest number of pores up to 80 in any single pollen grain.



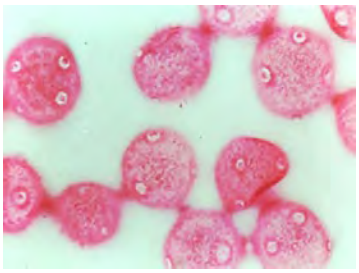
469 MIC LAMB'S QUARTERS POLLEN

Lamb's Quarters pollen is typical of the Chenopod group, spheroidal grains about 20-30 microns in diameter with these many pores over the entire surface.



470 MIC WESTERN MUGWORT POLLEN

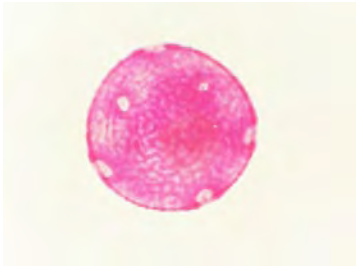
Western Mugwort pollen though it doesn't look too typical of the Aster group it is certainly within that area, but this light microscope image you will not see clearly the small spines that over the surface of the pollen, but they are there as you will see with the EM. Typical, however, are the 3 apertures, which are clear here from a polar view, the very thick wall between the apertures and spherical shape.



471 MIC ENGLISH PLANTAIN POLLEN CLUSTER

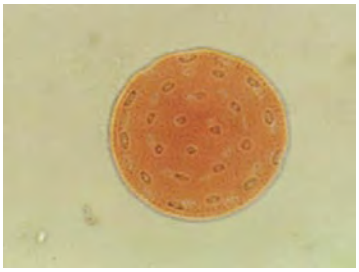
Here is an image of a cluster of English Plantain pollen grains and you will notice that they are spheroidal. They are about 25 to 30 microns in diameter and again as we have seen with many of the weeds, a number of pores over the surface. But here they are limited. The average number would be any where between 6 and 10 pores. So this would be diagnostic to separate the plantains from the Chenopod type pollen that we have already discussed.

472 MIC ENGLISH PLANTAIN POLLEN



This is an English Plantain spheroidal grain with about 6-10 pores on the surface spread rather irregularly. These grains will be found on aero samples taken in May and June generally in North America.

473 MIC PIGWEED POLLEN

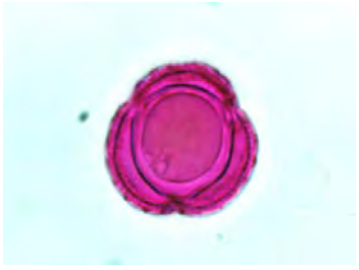


Pigweed pollen as illustrated here shows the typical spheroidal form with the wall surface permeated by up to 50 pores. This is very typical of the Chenopod type in its related family within the Amaranthaceae.

474 MIC PIGWEED POLLEN

The Pigweed pollen as illustrated here shows the typical spheroidal form with the wall surface permeated by up to 50 pores. This is very typical of the Chenopod type in this related family, in the Amaranthaceae.

475 MIC RABBITBUSH POLLEN

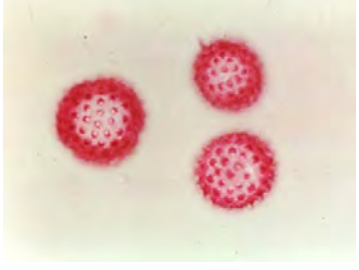


Rabbitbush pollen is typical of the Aster group in that there are very, very thick walls between 3 apertures. It is fairly round and about 15 to 20 microns in diameter. The pollen is shed in abundance where the plant is found commonly any where from December to February.

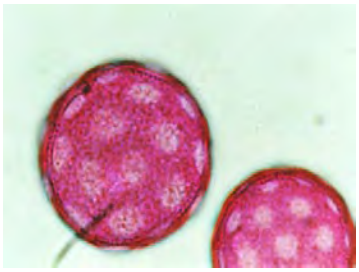
476 MIC GIANT RAGWEED POLLEN

Giant Ragweed pollen is extremely common in eastern North America in August and September and sometimes into October. It is a typical Aster-Ambrosia type, of course, with small spines throughout the surface and it is very difficult in this image to see the 3 apertures.

477 MIC WESTEN RAGWEED POLLENS

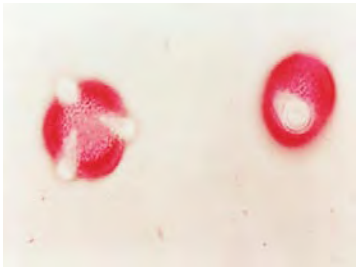


This microscopic image of Western Ragweed pollen is typical of all of the other Ambrosias and the Aster group with short spines. It has the 3 apertures and these are small grain 15 to 20 microns in diameter.



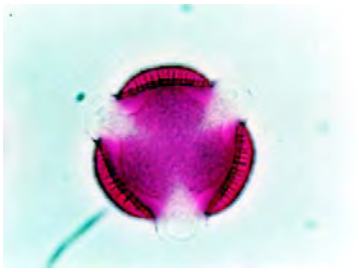
478 MIC RUSSIAN THISTLE

Russian Thistle pollen is typical of the Chenopod group of weeds in that you have a spherical average size grain which has a relatively smooth surface, at least no spines that we are use to in the Aster groups and with many evenly dispersed pores over the entire surface.



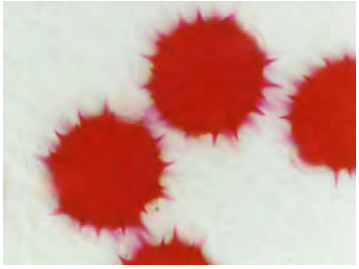
479 MIC SAGEBRUSH POLLEN

Sagebrush pollen although in the Aster group is somewhat different from the typical in that the spines are hardly visible in micro, you cannot see them very well on the surface of the wall of the pollen because they are so small. Another feature is that they actually have fairly broad and long furrows and although not visible here from a polar view, its difficult to see it, the grain is actually elongated.



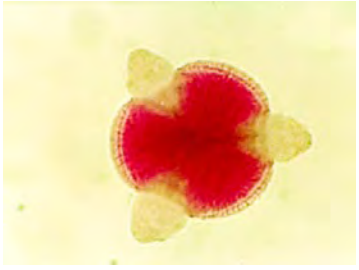
480 MIC SAGEBRUSH POLLEN

This micro image of the Sagebrush pollen shows, I think, quite clearly the 3 apertures typical of the Aster group in which you see the pore and the ends of the furrow from the polar end of the grain and also the very thick wall of the pollen and, of course, the absence of the obvious appearance of these tiny spines that are found on that wall.



481 MIC SUNFLOWER POLLEN

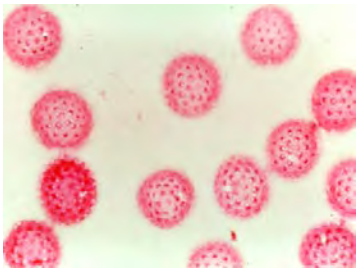
Pollen of the common Sunflower is much larger than the typical Ambrosia type spiny grain and you can see that the spines are very long. So you've got large grain with long spines and although this is typically entomophilous in those areas where it is widely cultivated for example there can certainly be an amount of pollen distributed by the air facultatively and it does cross-react with other Asteraceae.



482 MIC SAGEBRUSH POLLEN

This is a really interesting example of Sagebrush pollen in which you see the staining of the fuchsin, which we use to give color to the pollen grain, but also in preparation to illustrate that each of the 3 apertures can extrude the contents of the protoplasm, which carry the sperm to the female part of the flower. The illustration here is that they can all act in that capacity but that in reality only one will be the base from which the extrusion of the pollen tube will actually take place.

483 MIC SHORT RAGWEED POLLENS



This is a nice clustering of the Short Ragweed showing again the many positions that you might find the grain in, but remember the overall characteristics of the typical Aster Ambrosia pollen that is to say 3 apertures, the short, the whole surface covered with short spines and spherical shape about 15-20 microns in diameter.

485 MAC ROUGH MARSH-ELDER ANTHERS

This is a very close up of the Rough Marsh-elder flowers showing the yellowish anthers that produce abundant pollen for dispersal in the air. Remember that pollen of the Marsh-elders is very similar to the pollen of Ragweed and they can be distinguished with some difficulty.

486 MAC ROUGH MARSH-ELDER INFLORESCENCES

This is an image of the Rough Marsh-elder. You can see the inflorescences at the top of the plant and if you look carefully you can see the yellowish anthers that produce the pollen in abundance and of course dispersed very readily into the atmosphere.

487 MAC POVERTY WEED

The Poverty Weed is an herbaceous that is relatively common from California to the central part of the United States say to Nebraska.

488 MIC GOLDENROD GROUP

Goldenrod is a common weed in North America to be found along any roadsides or waste fields throughout the continent. It has a very distinctive upper growth of 2 to 3 feet with the herb topped by a yellow inflorescence. The pollen is typically insect pollinated but on occasion because of the density of the populations and close exposure to the plants especially in windy weather there can be an exposure to the facultatively wind dispersed pollen.

491 MAC COCKLEBUR

Cocklebur is a common weed found in North America. It is a weedy annual and can be found in many waste or meadows, along the roadsides, any place where weeds generally are found.

492 MAC COCKLEBUR STAMENS

This is a close up shot of the Cocklebur weed, which is found in waste places throughout North America. Here you can see the illustration of the stamenate heads, which are the male heads, generally in clusters along the branches.

493 MAC COCKLEBUR HEADS

This is an example of flowers in clusters or heads of the Cocklebur a weed found throughout North America. In some of these you can see the very small stamens protruding from these clusters, which of course is the source of the pollen for dispersal.

496 MAC TUMBLEWEED

Tumbleweed is a common Amaranth found in western North America and produces abundant chenopod type pollen.

498 MAC REDROOT - ROUGH PIGWEED

The Redroot, or rough pigweed, is common in tropical America and has been introduced into North America and can be found in essentially any waste areas from California to the East Coast.

502 MAC HOPS

Hops are occasionally found in North America, They are herbaceous vines and they can be found in waste places along with any other kind of weeds. They do produce a pollen that is airborne but is infrequently found on samples. But it is small and not unlike the pollen of marijuana. It is almost impossible to distinguish.

504 MAC REDROOT PIGWEED

The Redroot Pigweed, when it matures, can extend for 2-3 feet in height. It is a plant that was introduced from tropical America and is widespread in North America and is a source of a good deal of our pollen from the Amaranthus group, which is closely related to the chenopod family.

509 MAC WEED HABITAT

This is an excellent habitat view of the multiplicity or biodiversity that you find in that kind of habitat where weeds thrive. Because I can see at least half a dozen different species, all of them important in producing abundant pollen, and therefore, very important as aeroallergens. This is in western America and you find many kinds of chenopods and aligned species in such a habitat setting.

511 MAC GIANT RAGWEED PLANTS

The Giant Ragweed in eastern North America certainly lives up to its name for I have seen plants that are a small seed in April germinate and by late August in the Mississippi River Valley be 26 feet tall with a woody base that is 6-7 inches in diameter and I have seen dozens of these trees together. They really do look like trees and it forms an absolute forest and what you are seeing here is part of the tip of one of those gigantic herbs turned trees in which millions, if not billions, of pollen grains are released into the atmosphere and the upper Mississippi Valley is in fact a haze in August and parts of September due in large part to the massive amount of grains from the Giant Ragweed. So it is a real problem in eastern North America and wherever there is a bounty of water, these will grow into giants.

515 MAC GIANT RAGWEED ANTHERS

This is an illustration of a small branch of a Giant Ragweed where you will see the male inflorescences. Each one of these is made up of dozens and dozens of male flowers producing, of course, the pollen and that is so abundant in the atmosphere in eastern North America.

519 MAC SHORT RAGWEED ANTHERS

The Short Ragweed as implied by the name is in fact a low herb, an annual herb, native to North America. It can be found in many of the waste places, abandoned fields and patches throughout the continent.

520 MAC WESTERN MUGWORT

The Western Mugwort is a very widespread herb, which is very common in western North America in dry open places. The flower clusters are white and the plant is often known as White Sage.

523 MAC ORACH

Orach is an herbaceous plant common in western America in the coastal flats and inland areas. It is found from California to the East Coast in spotted areas in eastern North America.

525 MAC ORACH INFLORESCENCES

This image shows the upper part of the small herb, which can be 2 to 3 feet tall of Orach. Here the inflorescences have immature flowers but they will produce bountiful amounts of pollen from their mature anthers.

526 MAC WEDGE SCALE

Whitescale is an herb found commonly in western North America in saline and other alkaline areas and in disturbed hillsides generally.

527 MAC WEDGE SCALE INFLORESCENCES

This is a close up image of the Wedge Scale. Along the stems you can see the floral clusters that produce the anthers and ultimately the pollen that is widely distributed in eastern North America.

528 MIC LAMB'S QUARTERS

Lamb's Quarters is a common weed in North America. It could be found in almost any waste field, along roadsides, wherever you might go. Distinguishing features are that it is about 2 feet or so high and has the flowers in whitish clusters towards the ends of the branches.

529 MAC LAMB'S QUARTERS INFLORESCENCES

Lamb's Quarters is a common weed in North America it could be found essentially anywhere where you would expect to find weedy plants along roadsides and waste fields and the like. This photo shows the white flowers but also emerging from these flower clusters are the yellow anthers that, of course, disperse the pollen. This does not shed a large amount of pollen. It is considered in the chenopod group and probably a smaller amount of pollen than you might anticipate.

530 MAC FIREBUSH INFLORESCENCES

Firebush is a herbaceous weed which is European in origin though it is escaped from cultivation in North American and can be found in waste places throughout North America. What is interesting about this upper part of the inflorescence is that you can see the stamens protruding from the plant and, of course, from here you get the production of the pollen and the dispersal of pollen.

531 MAC FIREBUSH INFLORESCENCES

This is a photograph of a part of a stem of the Firebush weed. This form is reddish as you can see and is widely used in cultivated gardens in both Europe and North America. In some of the inflorescences you can see the flowers and the pollen, of course, is produced in the anthers that are just emerging from these flowers. Mostly wind dispersed but there are reports that the plant is also partially insect pollinated.

532 MAC FIREBUSH - BURNING BUSH

The Firebush, or Burning Bush, is an herb found in western North America and other parts of North America in any wasteland. It is an escape from cultivation and it is naturalized from Europe.

533 MAC GLASSWORT

Glasswort is an herbaceous weed found through western North America and it is originally from Europe. It is found in the saline sinks of the Great Basin and occasionally into eastern North America.

536 MAC AMERICAN SEEPWEED

American Seepweed is a common herb of about 3 or 4 feet tall sometimes with a woody base that is found in saline soils and coastlines especially in western North America.

538 MAC THREE-SEEDED MERCURY

This is a close up image showing the flowers of the Three-seeded Mercury, and they are just coming into maturity and will produce small numbers of wind-dispersed pollen, which can be quite allergenic.

539 MAC ENGLISH PLANTAIN

Here is an example of 3 floral stalks from the English Plantain, the weed that was introduced from Europe, and produces an abundant amount of pollen and the flowers that you just see forming at the top of these inflorescences.

541 MAC SEASIDE PLANTAIN INFLOURESCENCE

The Seaside Plantain inflorescence is illustrated here show the formation of the stamens, which are maturing out from the head of the inflorescence so that they can be easily carried away by the wind.

542 MAC SEASIDE PLANTAIN

The Seaside Plantain herb is a succulent plant that is found along the seacoasts, as you might imagine, and in this saline habitat. Inflorescences at the top of the plant, of course, produce the flowers that release the pollen.

543 MAC BRACKED PLANTAIN

The Bracked Plantain is a small herb which is found on coastal areas, and is a source of some but not a great deal of pollen and for the pollen image we look under the Common Plantain.

544 MAC SHEEP SORREL

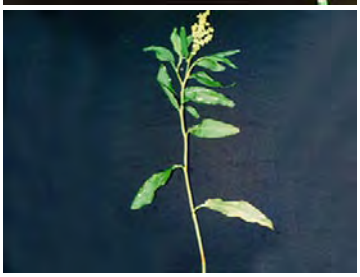
Sheep Sorrel is a low perennial herb, which is widely distributed in North America, having come from Europe where it is a very common weed.

546 MAC SHEEP SORREL INFLORESCENCES

This illustrates the compound inflorescences of the Sheep Sorrel, which produce relatively abundant amount of allergenic pollen in the different weedy areas that it is found it. It is a plant introduced from Europe.

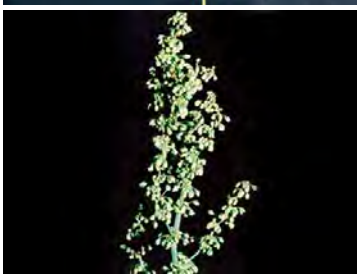
547 MAC SWAMP DOCK

The Swamp Dock is a small herbaceous perennial, which is found in the weedy areas like North America.



548 MAC SWAMP DOCK FLOWERS

This slide shows the flowers of the Swamp Dock which is a common herbaceous weed found throughout North America.



549 MAC YELLOW DOCK FLOWERS

This is a photograph of the upper portion of Yellow Dock, which shows the flowers of this herbaceous weed found throughout North America.

550 MAC MEADOW-RUE

Meadow-rue is a cultivated plant in North America of European origin. It does produce pollen that is airborne but infrequently and occasionally it could be found because it is in so many gardens. The herb is about up to 5 or 6 feet tall and very attractive with these whitish pendant flowers.

551 MAC MEADOW-RUE FLOWERS

This is a close up shot showing the flowers of the Meadow-rue which is a widely cultivated plant in North America of European origin and produces small amounts of airborne pollen which may or may not be allergenic.

553 MAC FALSE NETTLE

The False Nettle is an herb, which is non-stinging and is found on the edges of forests, sometimes in the forest, and some disturbed areas in eastern North America.

554 MAC RICHWEED

Richweed or Clearweed is a small herbaceous and succulent plant found in southern areas commonly on walls or old walls and old pathways you will find it common and it produces, given the size of the plant, very abundant allergenic pollen.

555 MAC RICHWEED - CLEARWEED

Richweed, or Clearweed, is a fairly uncommon plant found in very specific habitats in most parts of eastern North America but most common in the South. The plant is found on old walls or pathways, in other rather abandoned regions. The plant produces abundant pollen given its size, as it is very small, anywhere from June until October even November.

556 MAC WOOD NETTLE

The Wood Nettle is another typical nettle species found in less disturbed areas in the forests and woods of eastern North America. It does not got the stinging component and in this slide you can see the flowers that produce large numbers of small pollen grains.

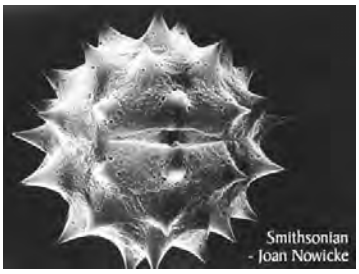
558 MAC STINGING NETTLE

This is a view of the Stinging Nettle. Something to be avoided. The leaves definitely give you a histamine reaction, a rash, and sting. The pollen is airborne. The plant is something that is very common in the northern part of North America and is an introduced weed from Europe.

559 MAC STINGING NETTLE PLANT

The Stinging Nettle is a plant to avoid or you will know whether you have touched it. It definitely will cause a stinging reaction and you will have rash and hurt for a short period of time at least, but the plant is easily come across because it is found in weedy and disturbed areas around the forests and in the woods of eastern North America in particular and the pollen is wind dispersed and is shed in abundance and will cause an allergic reaction. The pollen is very small 10 to 15 microns in diameter.

564 EM SANTA MARIA FEVERFEW POLLEN



Stanta Maria Feverfew pollen is a small grain 15 to 20 microns in diameter with very long spines in relationship to the total diameter of the grain. You will note in this slide a central aperture, which is fairly short with a furrow and then a central pore. The whole surface is permeated by tiny pores, and these are quite diagnostic.

632 MAC ROUGH MARSH-ELDER

Rough Marsh-elders are common in eastern North America and extending to the Rocky Mountains. They are a very large source of pollen and it is airborne and looks very similar to ragweed and is found flowering at the same period of time. So it is difficult to distinguish the pollen of both.

635 MAC THREE-SEEDED MERCURY

Three-seeded Mercury is a small herbaceous weed found in eastern parts of North America that produces wind-dispersed pollen.

637 MAC ENGLISH PLANTAIN CLOSE-UP

Here is a close up view of the English Plantain weed that is introduced from Europe and I think what is evident of this inflorescence is the formation of the stamens coming out of this cluster of flowers and, of course, the stamens will produce the pollen.

638 MAC ENGLISH PLANTAIN

The English Plantain is a weedy herb that has been introduced from Europe and is very common in North America. It is probably the most frequent source of the airborne pollen of plantains on the continent.

640 MAC COMMON PLANTAIN

The Common Plantain as the name suggests is, of course, common in North America and can be found along roadsides or any disturbed areas. It produces relatively frequent amounts of pollen and the illustration of that pollen can be found under English Plantain.

641 MAC RUSSIAN THISTLE STEM

Russian Thistle is an import from Eurasia and it is very common in the western states in sort of waste places, places that have a long dry period and it is commonly known as one of the tumbleweeds which is a generic term for the plants that dry and are moved around by the weed all over the western deserts and basins. And the plant can be very much branched can reach 6-7 feet and is covered by spiny ends to the branches. So it is a plant to be really avoided.

643 MAC MARIJUANA

Marijuana is a weedy herb that is found in native areas of northern India and Nepal and is widely dispersed throughout the world as a part of our weedy vegetation. Here you can see it in the background where in fact you have other weeds associated in a waste area.

644 MAC MARIJUANA PLANT

This is a close up view of the upper portions of marijuana plant showing the greenish yellow flowers that are now in maturity.

645 MIC MARIJUANA POLLEN (HEMP)

Marijuana pollen is readily airborne, very light and very small grain which is only 15 or so microns in diameter with a very thin wall so it has a great deal of buoyancy. So wherever the weed is found in the introduced state along the roadsides, you will find it in the atmosphere. For instance in South Dakota we reported a few years ago that 9% of the pollen in the ambient air throughout the year, of course this is in the summer months, was made up of marijuana pollen.

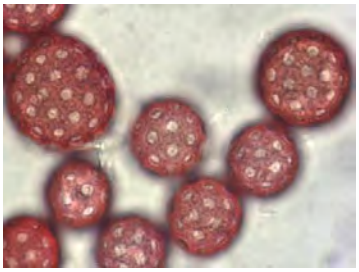
803 MAC ALLSCALE

Allscale is a plant found in western North America and is very common in saline and alkaline sinks. The plant can get as large as two feet and would be called a sub-shrub.

804 MAC BEET PLANTS

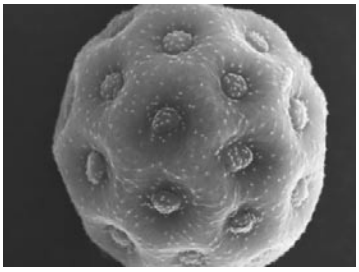
Beet plants are herbaceous perennials and they are often grow in cultivated fields and, therefore, you can find them as a source of pollen. So I think they should be considered in any broad view of airborne pollens such as this.

805 MIC BEET POLLEN



Beet pollen is wind dispersed in large amounts and is an extremely small grain for this chenopod type of morphology. The grain only reaches 14 or 15 microns in diameter. It too has the many pores scattered over the surface and can be easily distinguished from all other type of chenopods because of the small size of the round grain.

806 EM BEET POLLEN



The SEM image of the Beet pollen again shows the morphology with typical pores scattered over the surface, the small size of the grain.

807 MAC CARELESS WEED

Careless Weed is a plant found in waste places particularly from southern California to the central part of the United States.

808 MAC DANDELION PLANTS

Dandelions are a common weed in North America and the yellow distinctive flower is well known to everyone. The reason for including the dandelion though it is typically insect pollinated is that, of course, children playing in a field where there are many, many dandelions can, of course, be sensitized or cross-react to other members of the Aster family and thus reaction to this exposure to the pollen in this way.

809 EM DANDELION

Dandelion SEM view shows the unique features of the apertures and the pits found all along the surface of the spiny grain. It is a unique kind of grain probably found nowhere else in the flowering plants.

810 MAC SANTA MARIA FEVERFEW PLANT

Santa Maria Feverfew is a newly recognized weed as a source of pollen allergens in the United States. The plant is extremely common in the Gulf Coast region and is a very aggressive weed of waste fields, along roadside, railway and anywhere there is an exposed area in the southern states between Texas and Florida.

811 MIC SANTA MARIA FEVERFEW POLLEN CLUSTER

This is a cluster of Santa Maria Feverfew pollen. You should note that the pollen may be released in small clusters because of a sticky sugar on the surface, and they are partly insect pollinated as well as wind dispersed, especially along the Gulf Coast where the winds are very strong even these large clusters can be dispersed and are dispersed. This is interesting because you can observe the small size 15 to 20 microns of these spherical grains with the long spines in relationship to a pollen grain of grass which is much larger but would reach 30 to 40 microns in diameter with a smooth surface.

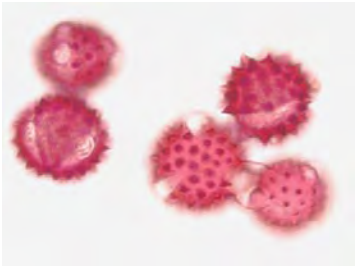
812 EM SANTA MARIA FEVERFEW POLLEN

This slide shows a small cluster of the Santa Maria Feverfew pollen, and I think you can see clearly the small size 15 to 20 microns of a spherical grain with long spines. What is interesting here is that beside the pollen of the Feverfew to the right you will see a ragweed pollen. The somewhat larger pollen with a shorter spines which is quite characteristic of the ragweed and is a means of separating the two groups.

813 MIC GLASSWORT POLLEN

The Glasswort pollen is typical of the chenopod pollen group. It is wind dispersed and is spherical with many pores and about 20 to 25 microns in diameter. The Glassworts can be found pollinating in the western parts of North America during the summer months between June and August.

814 MIC GOLDENROD POLLEN



The pollen of Goldenrod is typical of the Asteraceae group of pollens in that you have long spines, 3 apertures and some cross-reaction with other members of the family.

815 MAC WATER HEMP PLANT

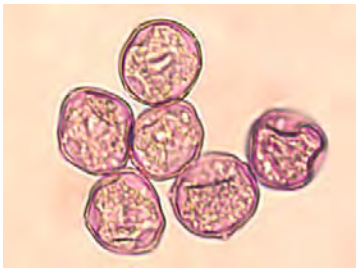
Water Hemp is a relatively common weed found in western North America and it sheds abundant wind dispersed pollen.

816 MIC MEADOW-RUE POLLEN

Meadow-rue pollen is small and its spherical 15 to 20 microns in diameter. The apertures, they're usual pores, are spread 6 to 8 of them around the pollen grains. So, it makes a fairly unique type of grain to be found in the atmosphere.

817 MIC THREE-SEEDED MERCURY POLLEN

Three-Seeded Mercury pollen is very small 10 to 12 microns in diameter. The grains are spherical and 3 pororate so they have 3 pores around the equatorial zone of the grain. So they are very small, they are very difficult to see in the collections and are rarely identified but they are allergenic and important to know the distribution of these grains.



818 MIC STINGING NETTLE POLLEN

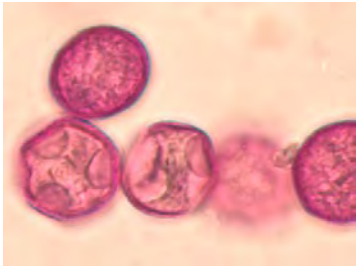
Stinging Nettle pollen is very small 10 to15 microns in diameter. Its round and it has anywhere from 2 to 4 pores around the equatorial area of the pollen grain. It is airborne and it is allergenic. The majority of the pollen will be released in the early summer.

819 MIC ORACH POLLEN

Orach pollen is typical of the chenopod type, which means that it is spheroid, 20 to 30 microns in diameter, and the whole surface of the grain is covered by evenly spaced pores.

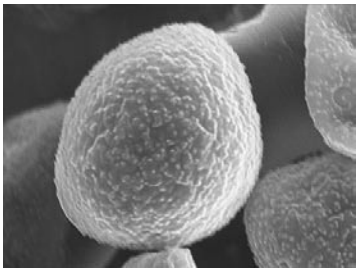
820 MAC WALL PELLITORY

The Wall Pellitory is a small herb, which as the name suggests can be found on walls or other parts of our environment where the plant can grow. It can grow essentially in any weedy areas typically in the more southern area of the United States where many of the pellitories have been introduced from southern Europe.



821 MIC PELLITORY POLLEN

The pollen of Pellitories is difficulty to distinguish but it is very small, round and has 2 to 4 pores and very often is missed on slides if you don't look very carefully because of thin wall, poor staining it is difficult to pull them out.



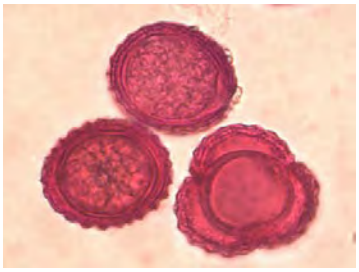
822 EM WALL PELLITORY

Here is a SEM image of the Wall Pellitory, which shows the very small size of the grain and rather rough surface, thin wall and anywhere from 2 to 4 pores.

823 MAC RABBITBUSH PLANT

The Rabbitbush is a plant found in Arizona and neighboring New Mexico. It is a perennial with a woody base and is commonly found in the arroyos and canyons and other dry areas in the Southwest and it flowers in the winter.

824 MIC POVERTY WEED POLLENS



The Poverty Weed pollen is typical of the Ambrosia type in that it is circular, 15-20 microns in diameter and has the 3 typical apertures and short spines that you would find in that type of grain.

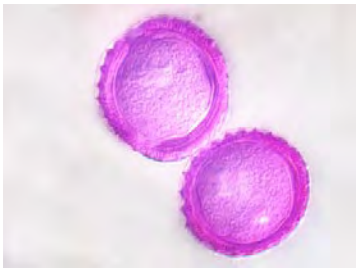
825 MAC CANYON RAGWEED

The Canyon Ragweed herb is a spreading perennial sometime woody at the base, which is found in waste places and hillsides from California and Arizona.

826 MAC DESERT RAGWEED

The Desert Ragweed or Burro-weed is a common shrubbery perennial found in the deserts from California to Arizona and Utah. It produces abundant pollen where the plant populations are dense.

827 MIC DESERT RAGWEED POLLEN



The Desert Ragweed pollen is typical of the Ambrosia type pollen in that it is a spherical, smallish grain with 3 apertures and the surface covered with spines.

828 MIC WESTERN RAGWEED

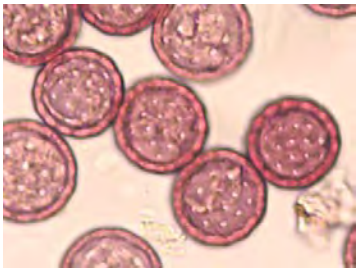
Western Ragweed is a common low perennial in southern United States and in the central part of the continent. It produces abundant pollen as, of course, the ragweeds are well known for.

829 MIC RICHWEED - CLEARWEED POLLEN

Richweed, or Clearweed, pollen is very small. It measures about 12 microns in diameter. It's spherical and it has anywhere from 2 to 4 pores usually 3.

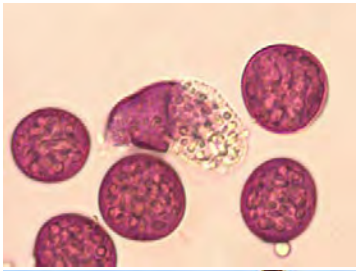
830 MAC SAGEBRUSH PLANT

The Sagebrushes are common herbs in all of western North American in the desert, sunny dessert, dry areas, saline marshes and the like. They are a very common source of pollen because of the density of the populations of the Sagebrush.



831 MIC AMERICAN SEEPWEED POLLENS

American Seepweed pollen is typical of the chenopod group in that you have spherical grain, average size with many pores scattered over the surface. This particular group of plants produces only modest amounts of pollen and even though some of the pollen is wind dispersed, much of it is entomophilous and by that I mean that the pollen is dispersed by ants, butterflies and other insects so that you would not expect to find too much of the Seepweed in the atmosphere even where the populations are dense.



832 MIC SHEEP SORREL POLLENS

Sheep Sorrel pollen is average size. It's an elongated pollen and it has typically 3 apertures.

833 MAC SUNFLOWER PLANTS

The Common Sunflower is a large annual, native to eastern North America, and is now distributed throughout the continent and in other areas of the world as well. There are a number of giant cultivars that are found in commerce for their oil and, of course, the edible seeds.

834 MIC TUMBLEWEED POLLEN

Tumbleweed pollen, which is commonly found in aerosampling in western North America, is typical of the Chenopod group in that it is spherical, smooth surface generally, and with many pores found over the surface. Amaranthus is in a family that is closely related to the Chenopodiaceae. This genus shares the same type of pollen with the entire family Chenopodiaceae.

835 MIC WEDGE SCALE POLLENS

Wedge Scale pollen is typical of the Chenopod group in that it is average size, spherical with many pores over the surface, and it is commonly shed and becomes a major part of the aeroallergen flora.

BURKARD AIR SAMPLER

The Burkard air sampler is the premier volumetric environmental device inuse today throughout North America by certified members of the American Academy of Allergy, Asthma and Immunology. Although there are other means of collecting air samples, the authors believe that the durability and precision of the Burkard product makes it the unit of choice when assessing airborne mold spore and pollen levels.

SITE SELECTION

Your selection site should be in a building that is 3-5 stories off the ground, that has no obstructions, and in which you have a 110-volt power source. What you want is an area that has good air flow that is going to give you good representation of what is in your regional area every single day. The Burkard air sampler itself is a pretty simple device. You have a wind vane in the back. In the front, there is an opening orifice, where the air is sampled, and you have the whole device with the tripod legs. You also have the machine itself that will, or the top portion, that will spin around. The locking device is what holds your heads in place, and then the opening where the air gets sampled - down in there. In the daily operation, there are two different types of heads that are available: a 24-hour head and a 7-day head.

CALIBRATION

Calibration of the Burkard air sampler is done very simply. You need to plug the machine in and let it run for about 30 minutes to insure that the motor is up to speed. Each morning, do a visual inspection to make sure that there is no debris blocking the opening orifice, and then you also want to make sure that it is clean inside. There is an O-ring up here, which is made of rubber. Make certain it is still viable, and it's free from any cracks or cuts or anything like that, because you want to make sure that you get a nice tight seal. Put the head down into place, and you lock the arm in place, and using an air flow meter, you want to place it over the opening orifice down here - making sure that it is seated tightly. Then read the amount of air that is being aspirated. What you are looking for is a rate of 10 liters of air per minute. That's ideal.

If it needs to be adjusted either up or down, inside the machine there is a set screw on the opening thing you can either adjust it in or out - depending on which way you need the flow rate to go. After you adjust it, return the head back to the seated position, lock the arm in place, and then recheck the calibration. It is a good idea that this is done at least once a week to insure that the motor is not losing its efficiency, and that nothing else is blocking the machine, so that you are getting a constant flow rate.

DAILY MAINTAINENANCE

Daily maintenance of the machine is pretty simple. Every day that you come up and replace the slide, you should look down inside the machine and give it a visual inspection to make sure that there is no debris, insects, or any other obstructive particles such as leaf parts, and things like that. You also want to check the opening orifice, to make sure that there are no bugs that have gotten in there, or leaves, paper, or anything else that could have flown across the orifice and then been collected by the vacuum that is being created. You also want to make sure that your head sampling is moving properly - that it easily moves with both the 24 and the 48 hour heads. When you place your head back into the seated position, locking on does hold it and does keep a nice tight seal and that your wind vane and the machine does move within the direction of the wind.

SAMPLING HEADS (24 HOUR HEAD PREPARATION)

The Burkard air sampler comes with two different types of heads. There is a 24- hour head, which is this one right here, which in this laboratory we use Monday through Thursday. Then on Friday morning, the 7-day head gets placed down there for the 3-day collection over the weekend, and then slides are prepared on Monday morning. When you come up and want to replace the slide, the slide will be in this position here. All you do is take the daily slide off, place it there, take a new fresh slide, which has your silicon-like grease on it, and slide it back up into place. After loosening your locking nut, slide the slide holder into the seated position and retighten the locking nut. You want to make sure that the locking nut is taunt, but not over tight, and that the clock has been rewound each time that you want to use it. After it is in this position, you slide it back down into the slot, locking back down, and take your slide. You are done for the day of the 24-hour head.

SAMPLING HEADS (7 DAY HEAD PREPARATION)

The 7-day head has a continuous drum. There's an entire strip of melanex tape that goes all the way around with the clock and locking nut there. Once it is locked in, it is lined up with the arrow on the right slash on there that when it is placed into the machine the air will start sampling where the green line is right there and over a 7 day period it will be collected in a clockwise position. So again this is the same thing, make sure that it is lined up on the arrow, drop it into the machine, put your locking nut down and the machine is ready to go for 7 days.

DO'S AND DON'TS

A couple of do's and don'ts for using a Burkard air sampler: You want to be sure that your locking arm is swinging freely, and that it is easy to open and close, but you want to make sure that it is going keep your head locked down in place so that you are aspirating just through this opening down here at 10 liters per minute. And you can adjust that over here, with a set-screw and nut to adjust your arm.

When removing your head, you want to make sure that when you pull the head out, you pull it straight out, that you don't angle it or anything like that, because you don't want anything to touch the sampling site. You want to make sure that the adhesive that is on there, and the sample you have collected, is going to be undisturbed until you put a microscope cover slip on it. And the same is also true when you are replacing the head. You want to come at it at exactly a 90° angle, put it in the slot, and to let it just fall down in there - don't force it. If it doesn't drop down easily, then there is something wrong and you need to re-examine the unit.

When you use a 24-hour head, it is very easy to get the slide holder hitting the edge of that when you are sliding it into place, which in turn could run the slide holder up so you are not getting a 24 hour sample. You will end up getting a short sample. Also, with the locking nut over here, there are times that you will forget to tighten your locking nut, and if the locking nut is not tightened down on to the clock, the slide and the slide holder will not move. So, what will happen is you will just end up collecting one sample in the 2 ml by 14 ml area. So, you have to make sure that you hold slide holder down at the bottom position and again tighten the locking nut just tautly.

So, when you turn it like that, that it is tight, but the clock is still ticking. You also want to make sure that when you are winding the clock, you don't over wind it and break the spring. Just wind it enough such that when you start feeling some positive pressure. And again you want to inspect the rubber ring up here. You want to look for any kind of cracks, dry rot; that the thing had not become broken or you are not getting a good solid seal. If it is broke, or if it is cracked, what is going to happen is you are going to end up getting air being sucked in around the top of the head - which is not going to give you a good selection sample over your open orifice. So, again when you slide the 24 hour head down, you want to line it up on the slotted area, and now gently slide it down into place, bringing your locking handle over, lock it in place, and then make sure that your wind vane each day is free, and that it can move within the direction of the wind.

SLIDE PREPARATION INTRODUCTION

In this portion, we are going to go over the preparation of slides for both the 24- hour sampling and the 7-day sampling.

With the 7-day sampling head, you have your locking nut, the drum itself which has a red notch, 2 black notches, and a green notch. You have your clock and this is the locking nut apparatus, and this is also the place where the clock itself will be wound. It uses the old key method. The key is placed in there, the clock is wound counter clockwise, and you wind until you start feeling some positive resistance. You don't want to over wind it, or get it too tight, because that could cause the spring to break or the clock not to work properly. So, you want to give it a little play.

DRUM PREPARATION (7 DAY HEAD)

Preparing the drum itself is rather simple. You place the drum on the drum holder, taking some double-sided tape, like the tape between the 2 black marks on the drum itself. Using a blade, cut off the excess tape. Using your melanex tape, place the edge of the tape directly in the center of the double stick tape, pressing down so that it is firmly held in place. Binding the melanex tape around the drum until it comes into contact, again with the double stick tape. You want to just put some pressure on it to make it taunt so that there are no gaps, twists or anything like that. So, you want a nice even sample. Run it past there, pressing down again, where the double stick tape is, and using your cutting device, cut straight across the tape and the tape is removed.

Now, at this portion here, you have the melanex tape completely spread across your 7-day drum.

CLOCK WINDING

Before you place the drum on the clock head, you want to make sure that the clock is wound using the key that fits into the slot. Now, you want to insure that the clock is not over wound, as that could break the spring or cause the clock to malfunction. So, what you want is some good resistance like that on the clock.

7 DAY SLIDE REMOVAL

The seven-day slide preparation is done rather easily. Once you remove your head from the machine, you bring it to your laboratory and remove the locking nut, insuring that nothing has come into contact with your sampled area. Placing the head apart using the plastic cutting board that was supplied by Burkard. I'm going to lay this out. What you want to do is come back to your double stick area, gently place the tip of the cutting device underneath the double stick tape and removing the tape insuring that you do not come in contact with the sampled area. Again the green notch on the drum itself is where the sample started. So, this is day 1 working around and at the end of the tape it is going to be day 7. Fastening the end of the tape, you pull it off, and now finding the beginning of the sample, wind that up with the 1st notch on the cutting block - which would be here, and laying this out. Now, the block is separated into 7 sections. So it is 1, 2, 3, 4, 5, 6, 7. So insuring that the end of the sample is at the end of the tape.

Coming back, what you want to do is make little notches at the groove notch, here, and your tape continues to lay flat. Mark each one of the sections, which is a 24-hour sample. Now, with a scissors you come back and cut at each notch interval, and again insuring that you do not come in contact with the top of the adhesive.

7 DAY SLIDE PREPARATION

Once you have your seven samples, what you do then is grab your microscope slides, and lay your slides out. What you want to do at this point now is properly label the slides. Label them with the date. You have to use a 10% solution of Gravenol and mount the melanex tape under the microscope slides. That is done by using a dropper; and what you want to do is create a nice even stream. I'm grabbing the air sample. You want to make sure that you do not touch the center portion where the sample was collected. Using a rolling type thing, you want to have the tape start on the Gravenol and gently roll it down into place. You want to try to eliminate any type of air bubbles that will be created down there at that point there. At this point, you can leave it set for an hour to make sure that it is going to dry before you stain it. You can reposition the slides to make sure that the melanex tape is positioned squarely under the microscope slides, so that when it is stained, and you put your cover slip on there, you will have adequate room on the outside that you can seal it up and preserve the slide for your archive.

So, the slide should be placed on an angle for a minimum of an hour to mount the Gravenol to dry the melanex tape to the microscope slide itself.

24 HOUR SLIDE PREPARATION

In preparing the 24-hour slides, what you would like to do is measure your melanex tape at 5.5 cm. Using a ruler, go ahead and mark your places on the tape itself. Cut your tape, and insure that you are cutting it at a 90 degree angle.

Once your tape has been cut, take your slides, lay them out, again taking a 10% Gravenol solution, and place a small bead of the solution under the microscope slide. Grasping the slide and measuring roughly less than a centimeter from the edge of the slide, gently roll the melanex tape under the slide, insuring that you are getting proper adhesion and that the entire melanex tape that the Gravenol is going to cover the entire bottom of the slide, so it is going to adhere the slide to the tape.

So, again using the edge of the tape, start it about a centimeter from the edge of the slide, centering the melanex tape under the slide. At this portion here, the slides will need to dry for 24 hours. Once the slide has dried and you are preparing to use the slide for your 24-hour sampling head, you would label the slide. Then you would come back with your silicone grease. Again, you could use an artist's brush or use your finger to gently adhere some grease on there. Taking a Chem Wipe and gently, but evenly, spreading the grease over the slide creating a very thin uniform layer of the silicone grease. At this portion here, the slide is now ready to be placed in the 24-hour head.

In placing it in a 24-hour head, using the date at the top of the slide, the slide should be placed on the head in the same way each day. In this laboratory, we put the date at the top of the slide. So, if we want to check what time of the day that we are seeing certain pollens or molds, we can calculate the amount of, or the time that the sample was attached to the slide. We can use the date that that is going to be zero time down to the 24-hour time.

Again, making sure that the slide holder is all the way at the bottom, or the seated position, making sure that the clock has been wound properly and reseating the locking nut, insuring that you do not over tighten it. But it is just taunt enough to keep the drum tight on to the clock, and at this portion here, the drum will then be dropped down into the sampler itself, the locking handle put into place, and it will begin collecting a sample.

APPLYING ADHESIVE

Now this portion here, you have the melanex tape lightly spread across your 7-day drum. In applying the adhesive, there are many different ways that you can use to apply the adhesive. You can use a soft bristled artist brush, or you can use your finger, and ideally you want to start at the beginning and just start dabbing some on in place. What you want to do is get yourself a nice even thin layer of the grease solution. Once it has been completely applied, you want to take a couple of pieces of Chem Wipe, which is a lint free material, and just lightly wipe over the drum - wiping any excess grease that you are using and with that you have yourself a very thin, uniform layer of grease. At this point here, the drum can be placed back onto the clock, using the locking set screw, placing it back on to the head. Before it is locked into position you, want to line the red notch up with the arrow on the head itself. Lock the nut into place, and now the drum is ready for sampling. It is ready to be dropped into the machine.

STAINING

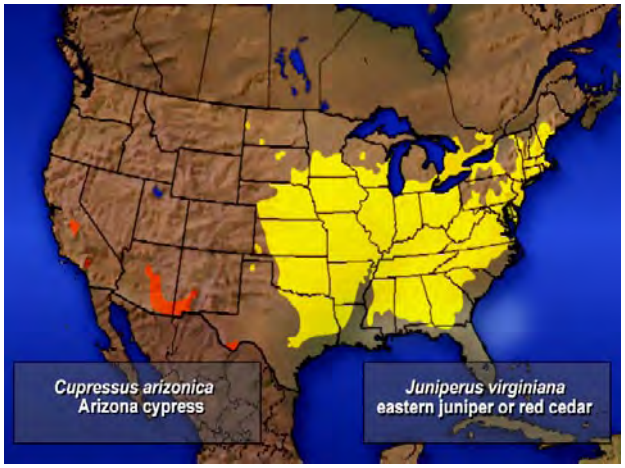
Once you have your sample on your slide and properly labeled, what you do then is use a couple of pieces of tissue paper. You have heated your stain up, so it is liquefied; what you would like to do is place 2-3 drops evenly across the slide. Working rapidly to make sure that it doesn't become solid, you place a 22 x 60 microscope cover slip over the slide, and gently tap down to remove any excess air bubbles to insure that you are getting proper unification of the stain itself. Try not to move the cover slip at all. All you want to do is just place a bit of positive pressure down on top, because you do not want to move the sample that you have already collected. So, once this is done you have a good even staining solution going. What you do then is take a couple of pieces of Chem-Whipe and gently blot the edges of the sample area, removing any excess stain that is present. Again, you would like to work rapidly to make sure that you will be able to remove the excess stain before the staining solution re-solidifies. Again, doing a visual on it to make sure that you do not have any air bubbles trapped underneath. In this position, wipe off the excess stain that's around the edges, and the slide can be then sealed with fingernail polish. At this point right here, it's ready to be read.

SUMMARY

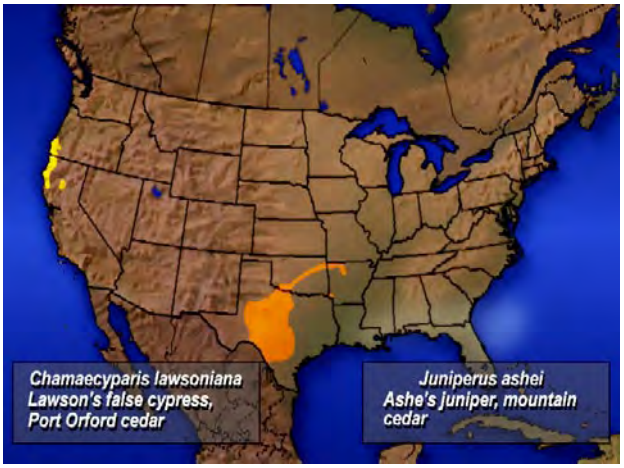
Just some general comments about preparing your slides: You want to make sure that once you have a sample collected that the top of the slide does not come in contact with anything other than the stain and the cover slip because you want to make sure that the integrity of the sample that you have collected is true. When you prepare your slide you want to make sure that you are not adding excess amounts of gravenol when you are doing this. This is probably going to take a little bit of time for you to become familiar with. How much you should add, how little you should add or the best technique that you can use to create a nice uniform surface for the gravenol and for the melanex tape to adhere to the slide as once you start looking at it over through a microscope if it is mounted properly then you are going to have a nice even flow and you won't be doing a lot of focusing up and down. You also get rid of a lot of the air bubbles that are there and things like this.

Once the melanex tape has been properly adhered to the slide and you start adding your silicone grease or your luber seal whichever one you choose or medium of your choice, that again it will be a technique that you are going to learn over time so it's a good idea to practice a few times making sure that you are going to get a thin layer of luber seal or of the glycerin or silicone jelly that we use. Um, and what you would like to do is once you got the grease on the melanex tape, is just take a piece of Chem-Wipe or something with a little bit of alcohol on it or some type of a solvent and just wipe the excess grease off the corner of the melanex tape. So when you come back and you put your data on there you have a nice clean surface and after you stain and put your cover slip down there and blotted off the excess stain. Again it is a good idea to take a couple of slides and some stain and practice your technique because everyone will prepare a slide a little bit differently and you will need to find the technique that is properly best you and your laboratory.

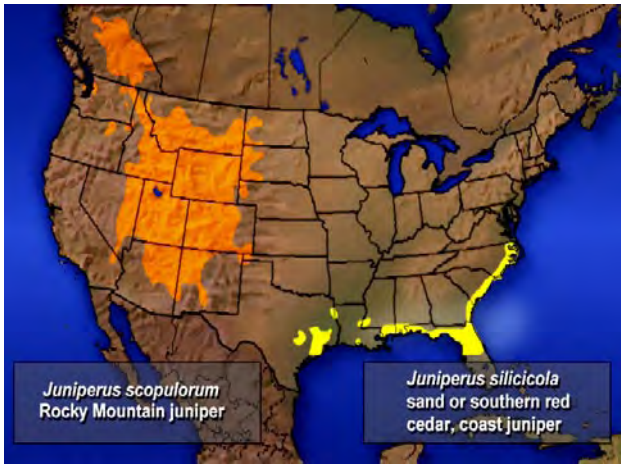
Once the slide has been stained, the cover slip has been down, the excess stain has been removed from the outside of it again you can seal it up with fingernail polish and you can use it for an archive. The slide should be good for 3-4 years at this position there.



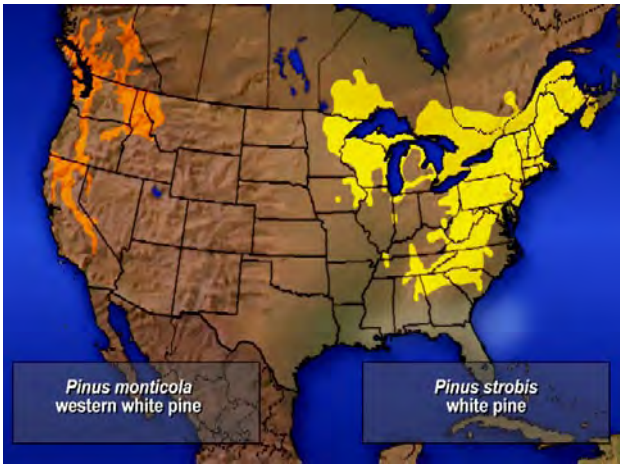
Arizona Cypress — Eastern Juniper or Red Cedar



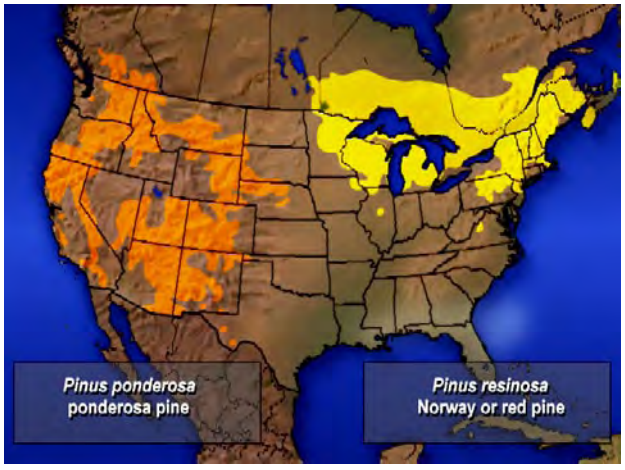
False Cypress or Port Orford Cedar — Mountain Cedar



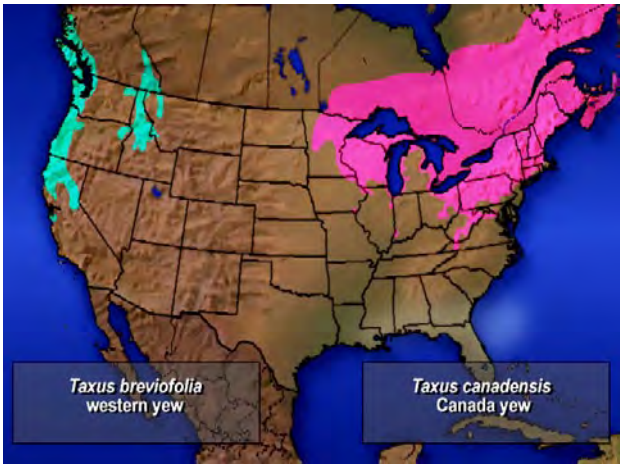
Rocky Mountain Juniper — Southern Red Cedar or Coast Juniper



Western White Pine — White Pine

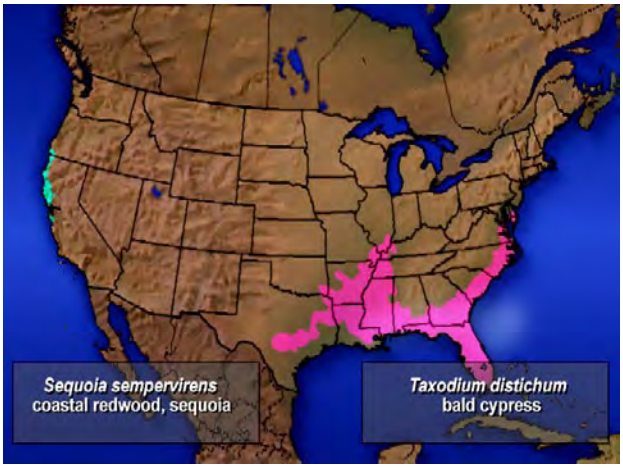


Ponderosa Pine — Norway Pine or Red Pine

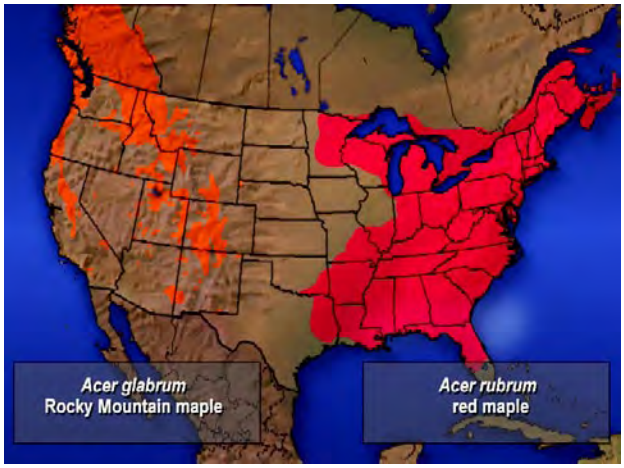


Western Yew — Canada Yew

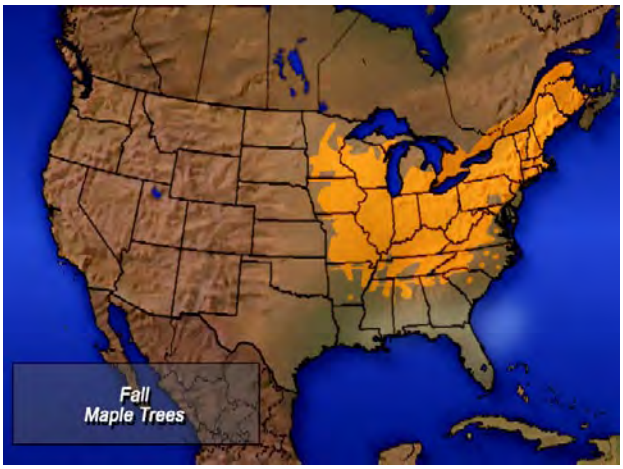
Distribution Maps



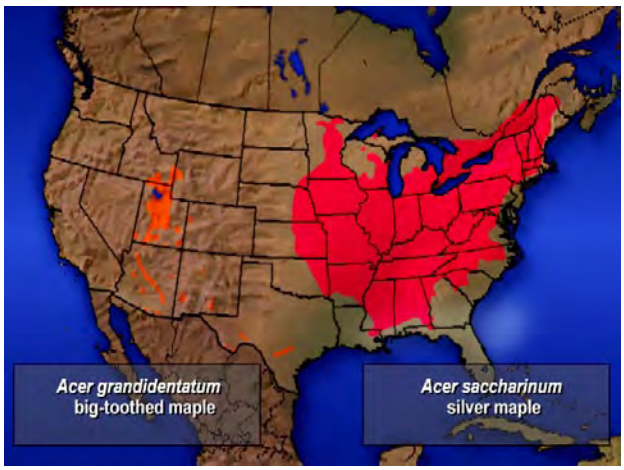
Coastal Redwood Bald Cypress



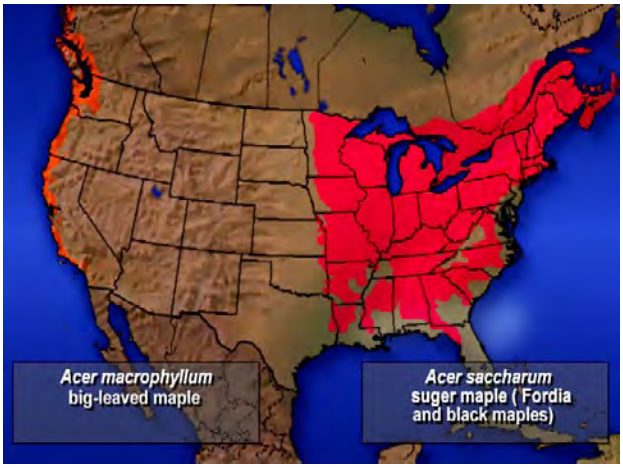
Rocky Mountain Maple Red Maple



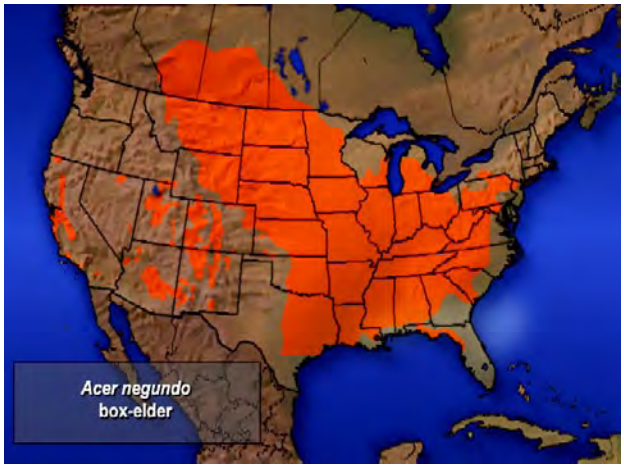
Fall Maples



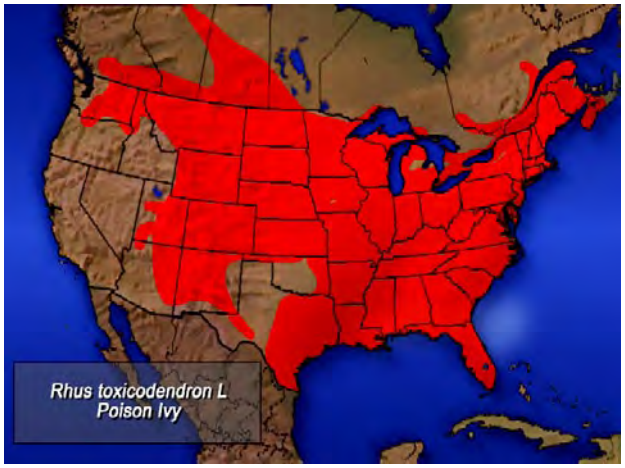
Big-toothed Maple Silver Maple



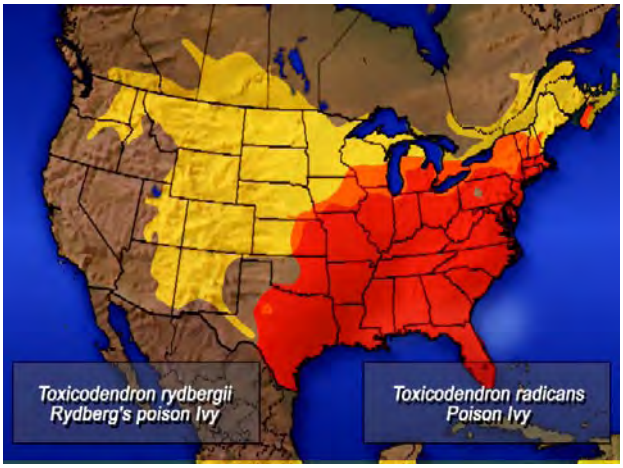
Big-leaved Maple Sugar Maple



Box-elder

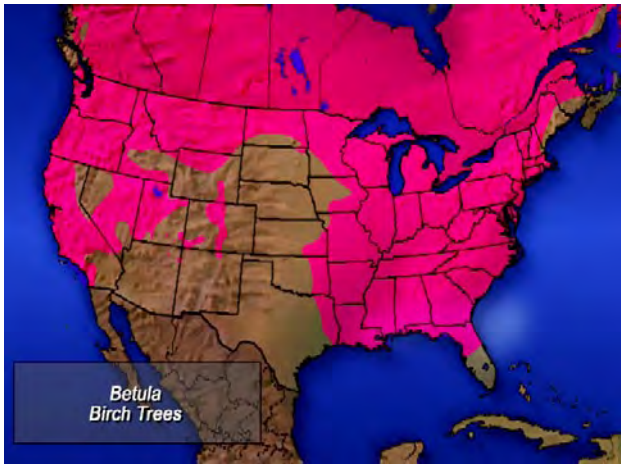


Poison Ivy



Rydberg's Poison Ivy

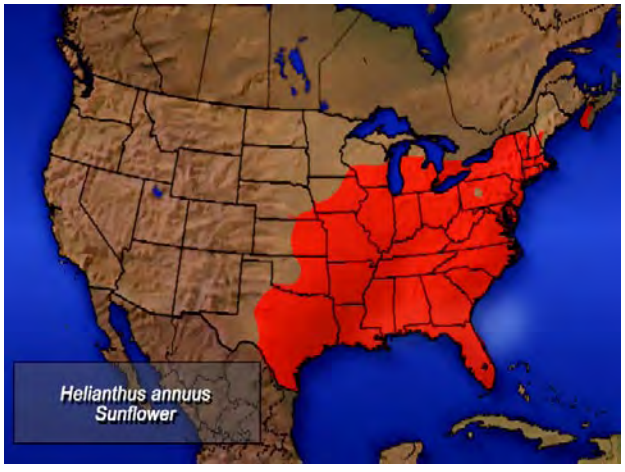
Poison Ivy



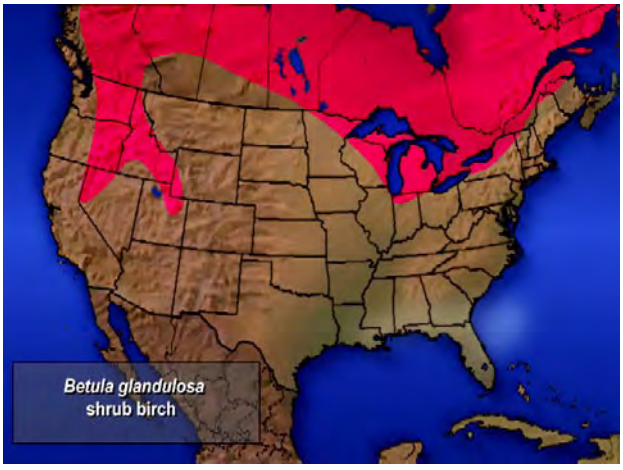
Birch Family

Red Alder

River Birch or Red Birch



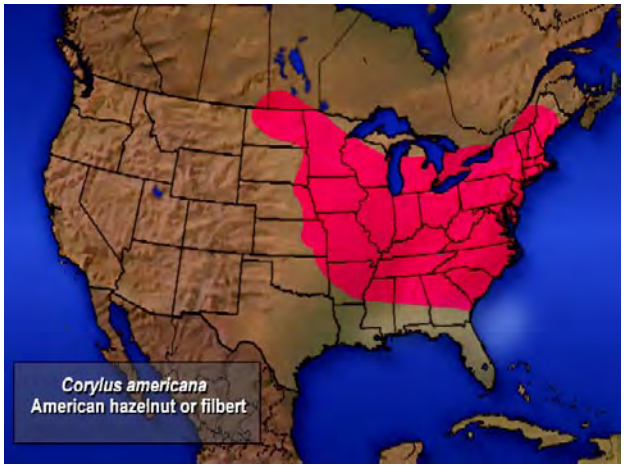
Sunflower



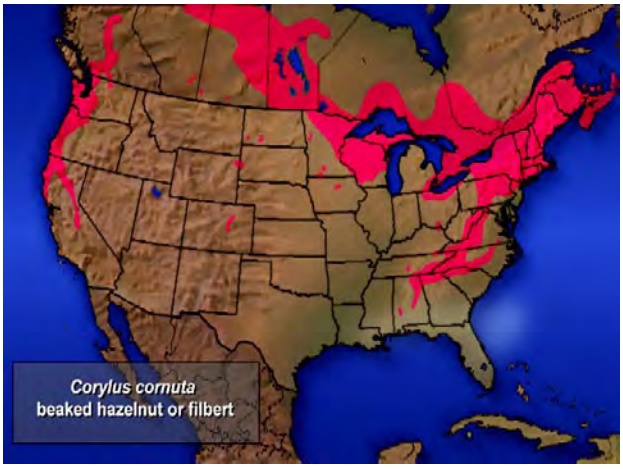
Shrub Birch

Distribution Maps

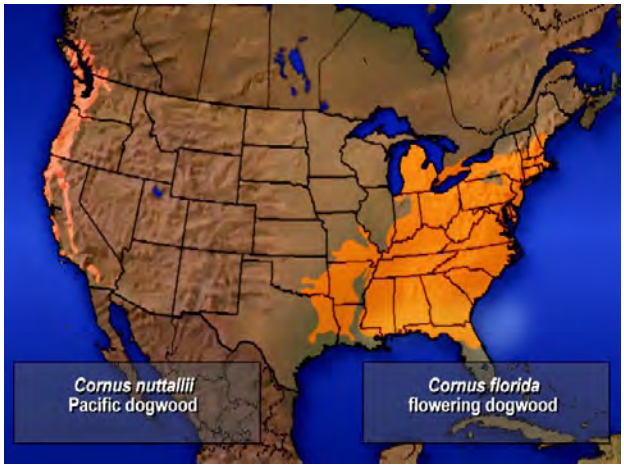
Paper Birch



Hazelnut or Filbert

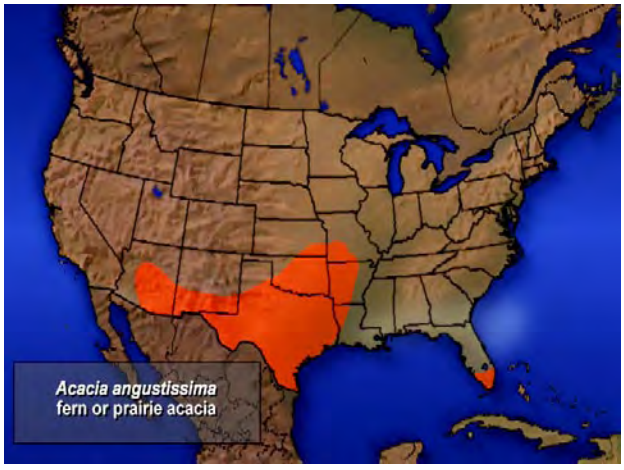


Beaked Hazelnut or Filbert



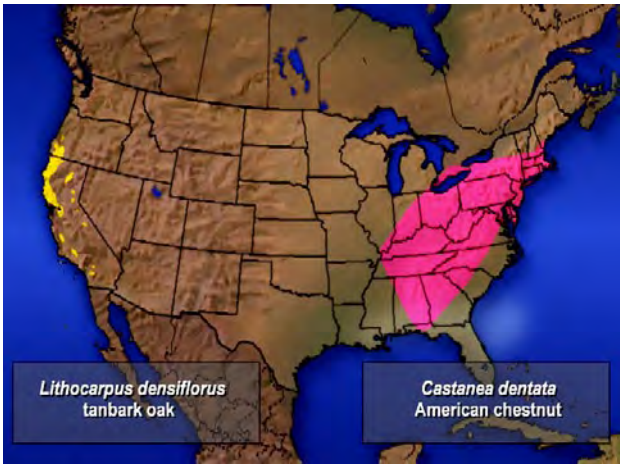
Pacific Dogwood Flowering Dogwood

Ozark White Cedar



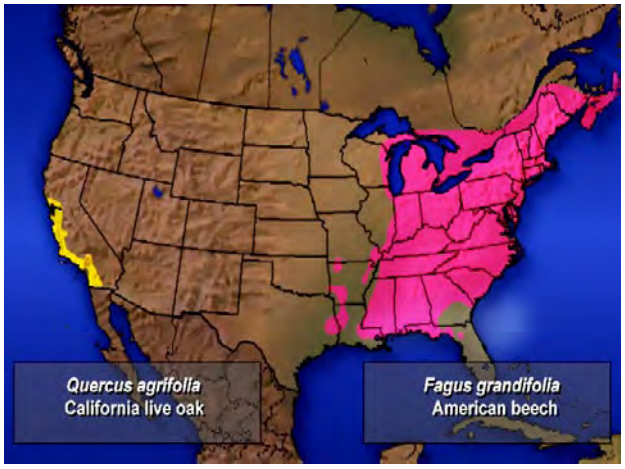
Fern Acacia or Prairie Acacia

Glandular Mesquite



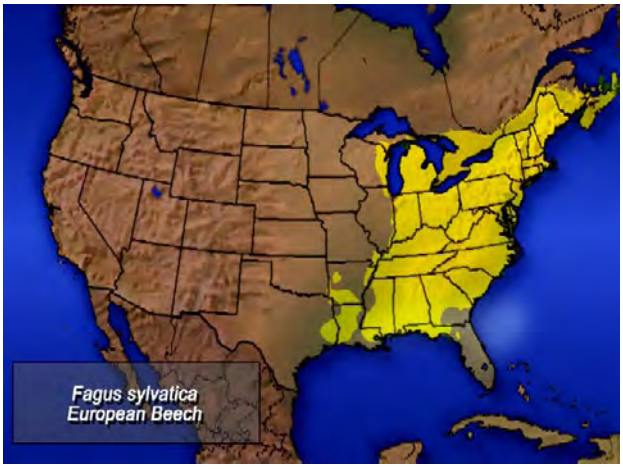
Tanbark Oak

American Chestnut

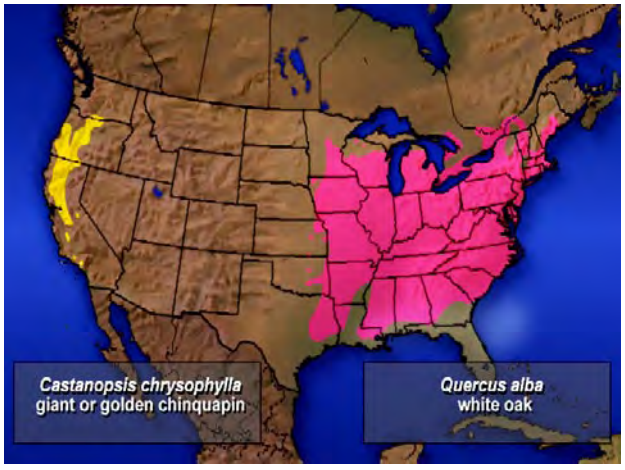


California Live Oak

American Beech

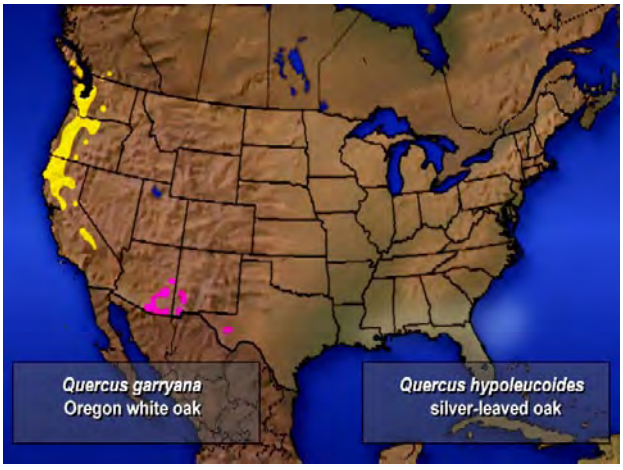


European Beech



Giant or Golden Chinquapin

White Oak

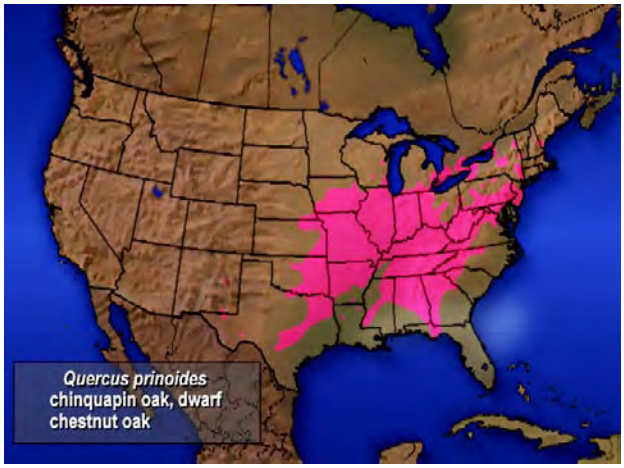


Oregon White Oak

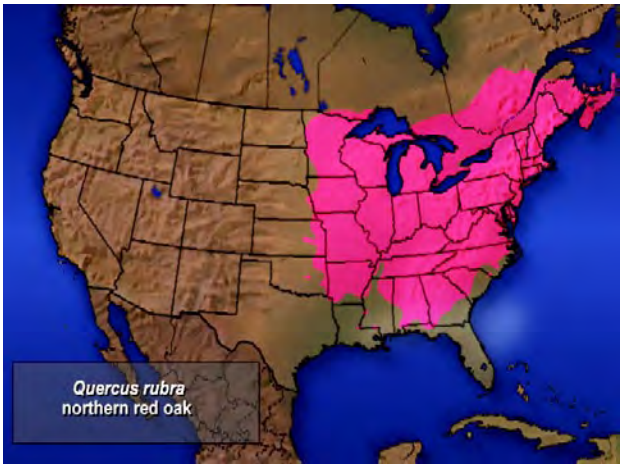
Silver-leaved Oak

Distribution Maps

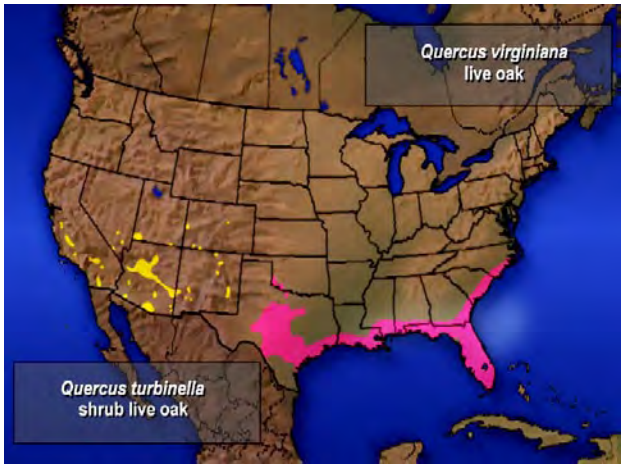
Willow Oak



Dwarf Chestnut Oak
or Chinquapin Oak



Northern Red Oak



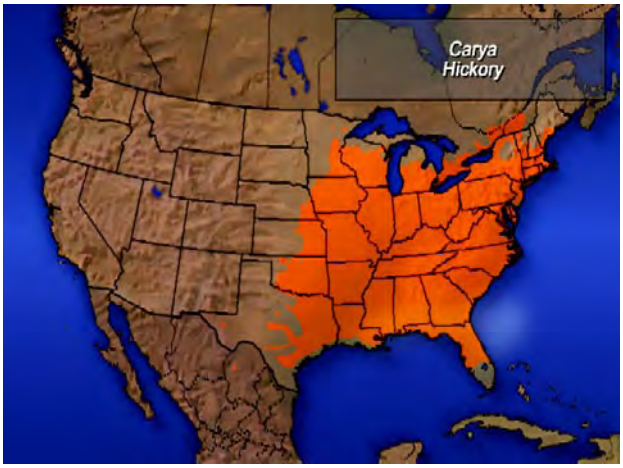
Shrub Live Oak

Live Oak

Silk-tassel Bush

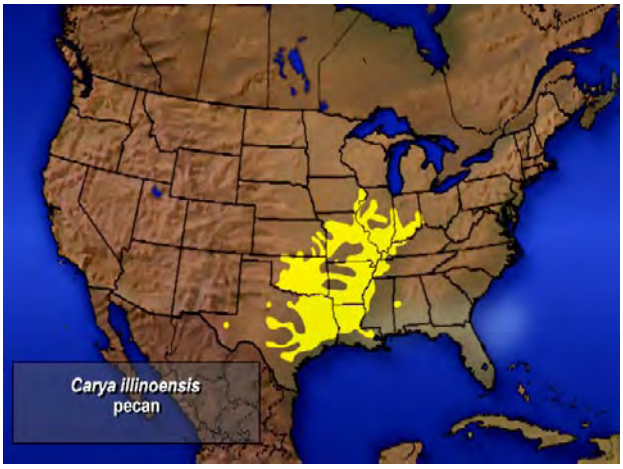
Waxy-leaved
Silk-tassel

Sweet Gum



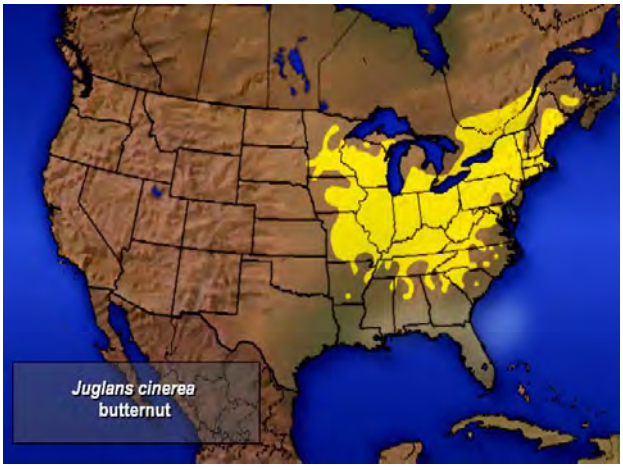
Hickory

Bitternut Hickory



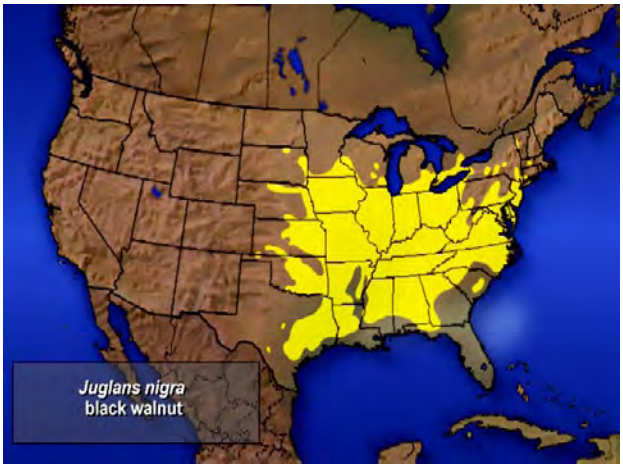
Pecan

Shagbark Hickory

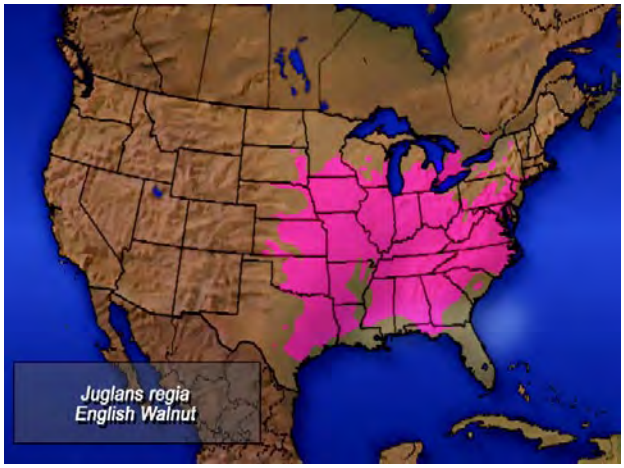


Butternut

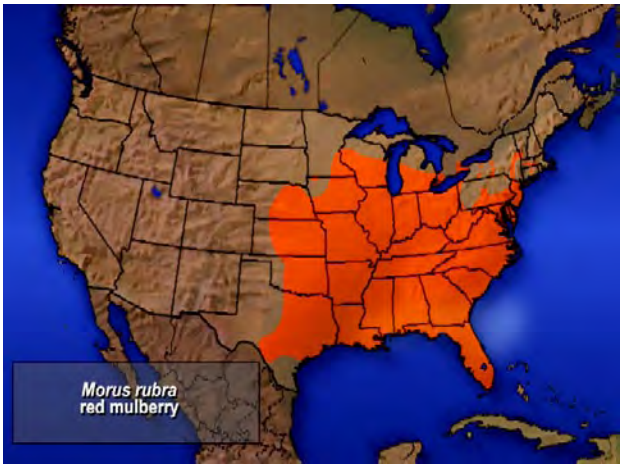
Distribution Maps



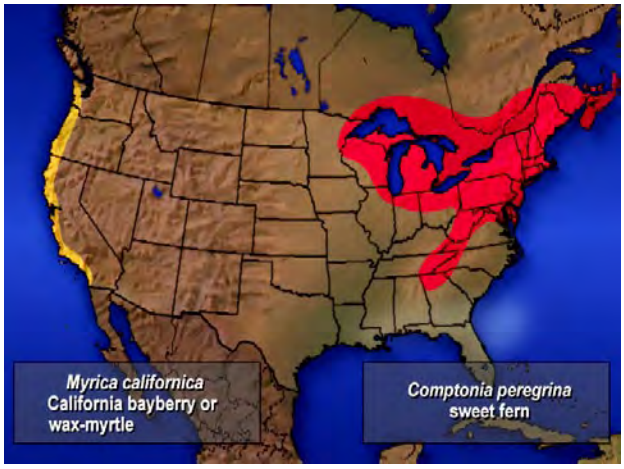
Black Walnut



English Walnut



Red Mulberry

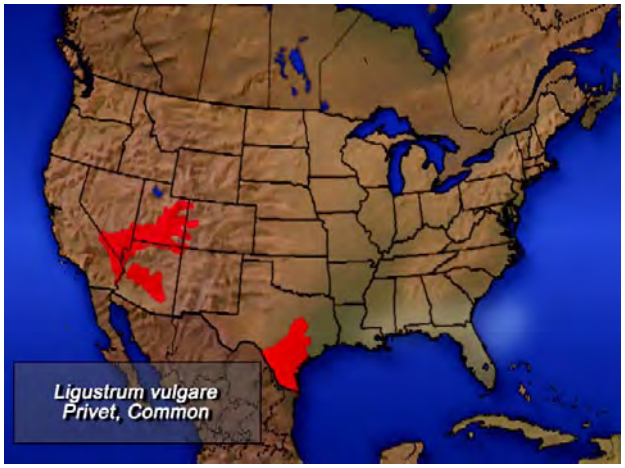


Wax-myrtle or California Bayberry

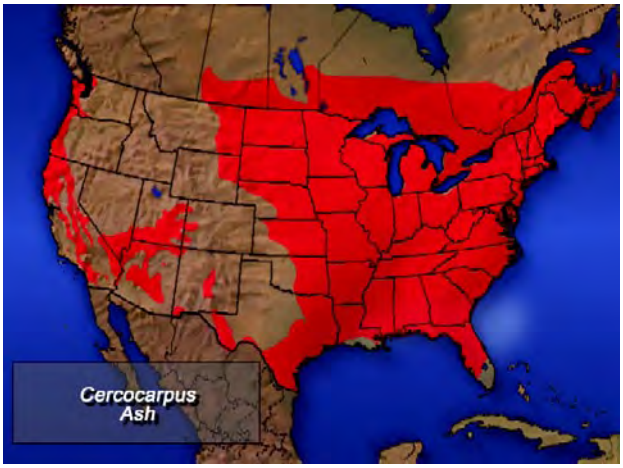
Sweet Fern

Southern Bayberry
or
Southern Wax-myrtle

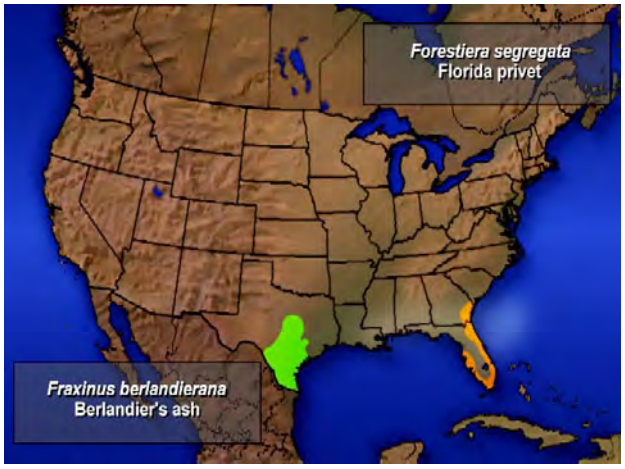
Northern Bayberry



Common Privet

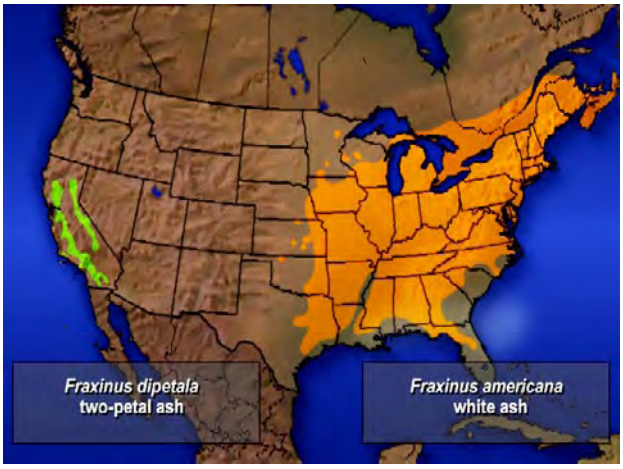


Ash



Berlandier's Ash

Florida Privet



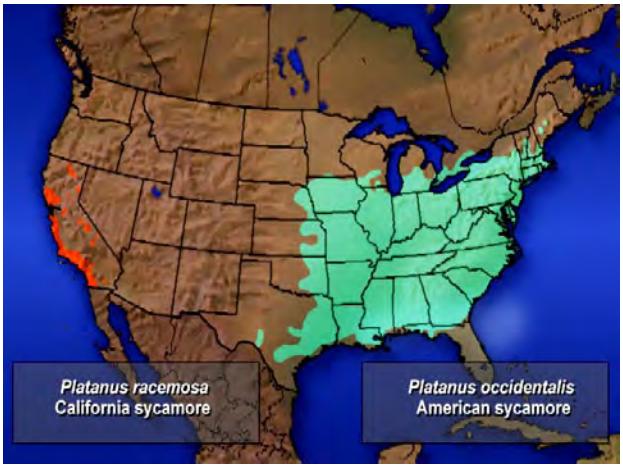
Two-petal Ash

White Ash

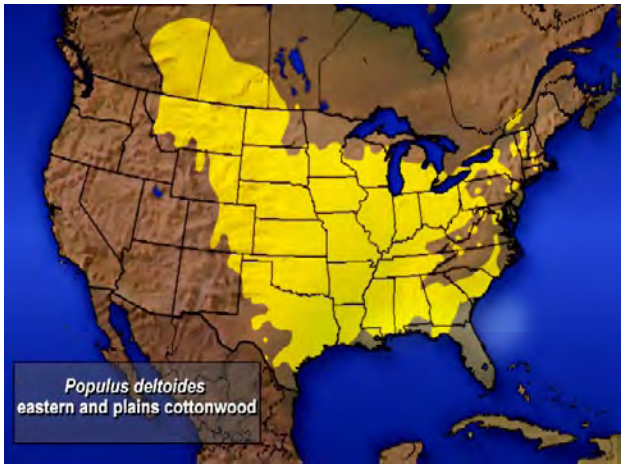
Fragrant Ash

Carolina Ash

Green Ash

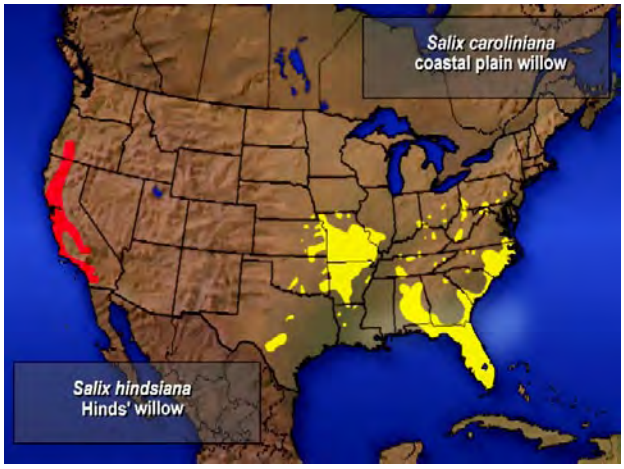


California Sycamore American Sycamore

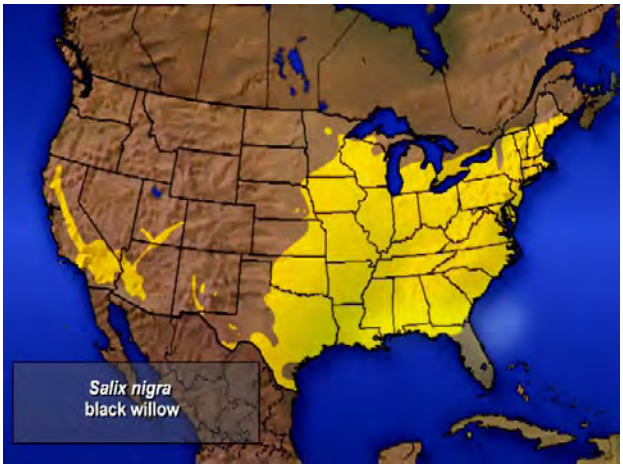


Eastern and
Plains Cottonwood

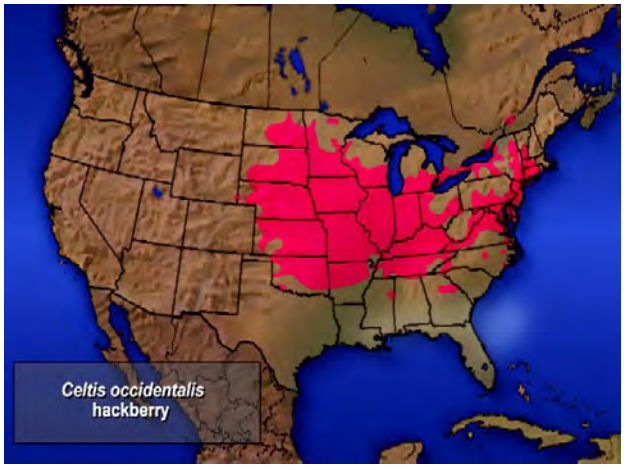
Long-beaked Willow



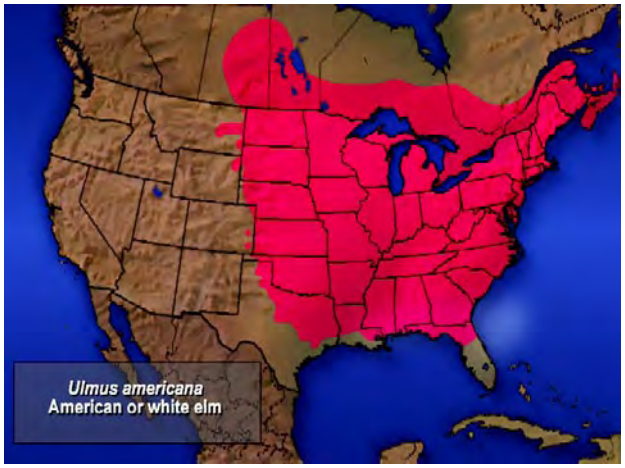
Hind's Willow Coastal Plain Willow



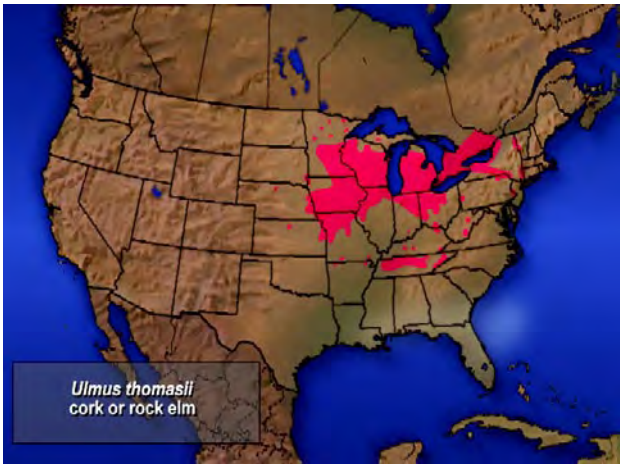
Black Willow



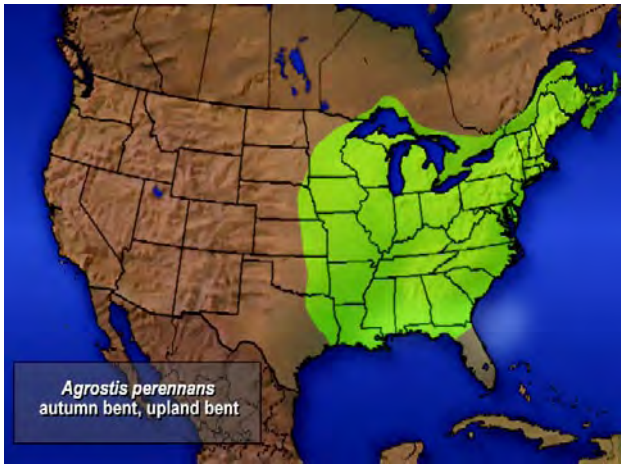
Hackberry



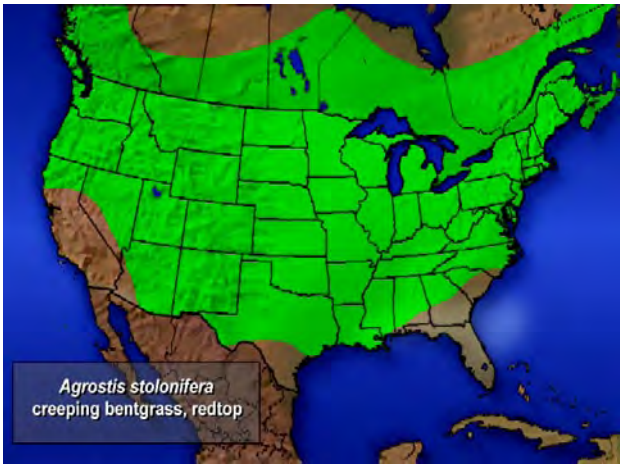
American or White Elm



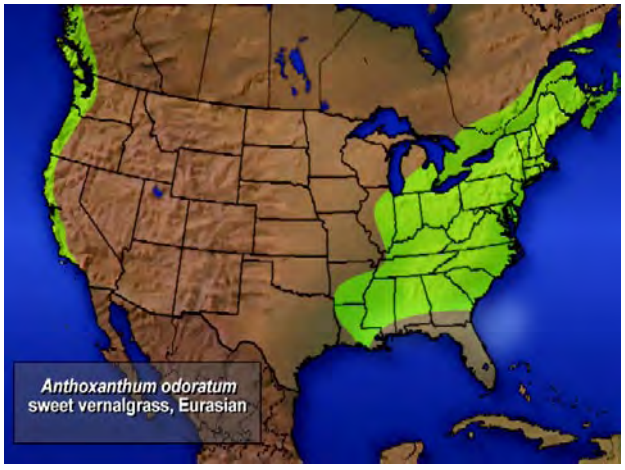
Cork or Rock Elm



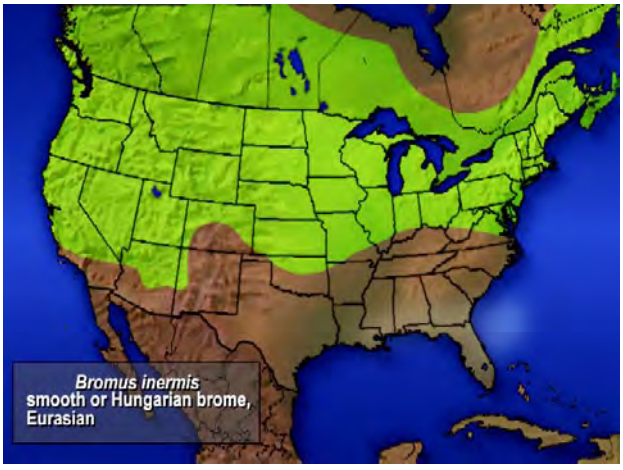
Autumn Bent or Upland Bent



Redtop or Creeping Bentgrass

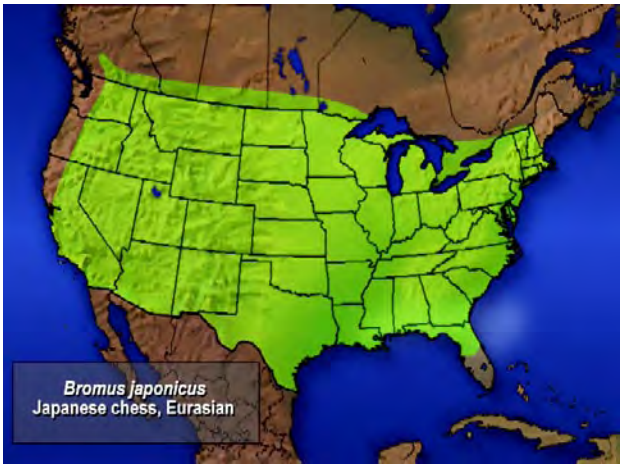


Sweet Vernal Grass

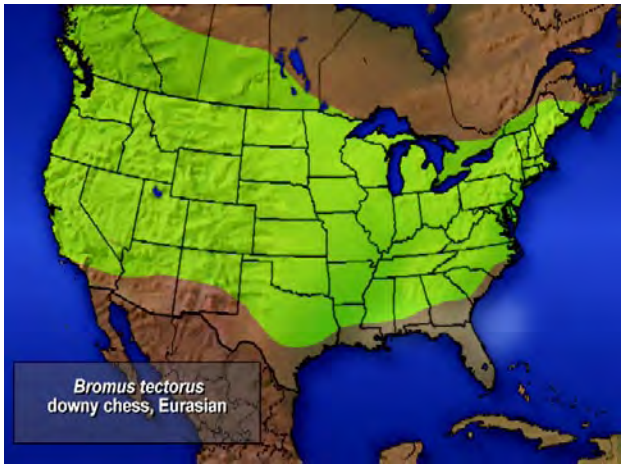


Smooth Brome or Hungarian Brome

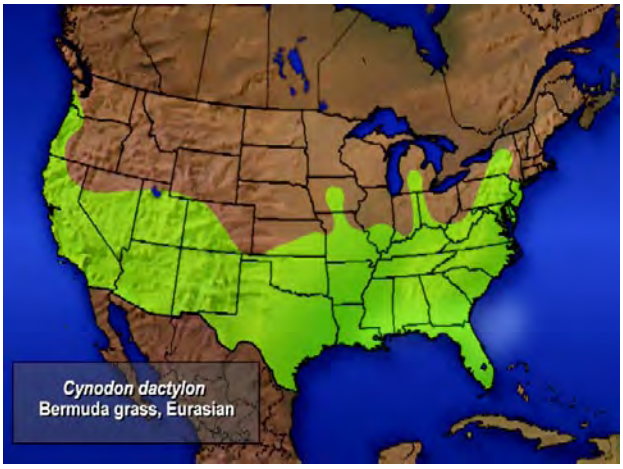
Distribution Maps



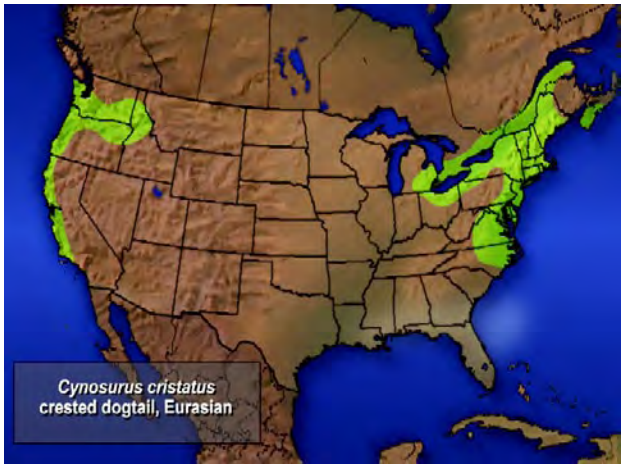
Japanese Chess



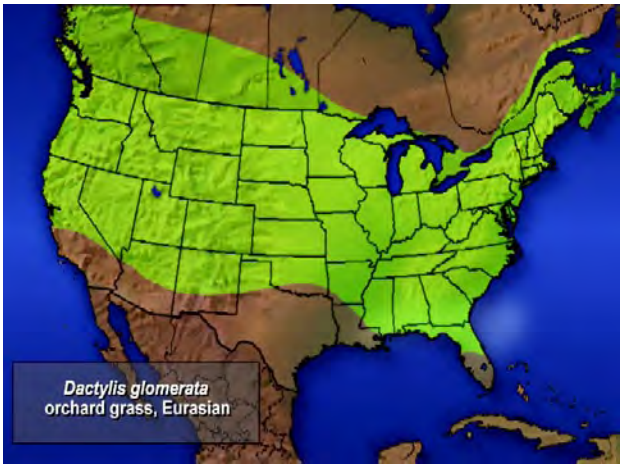
Downy Chess



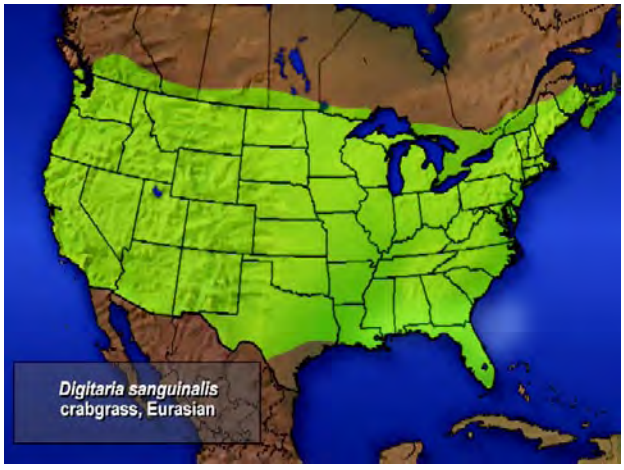
Bermuda Grass



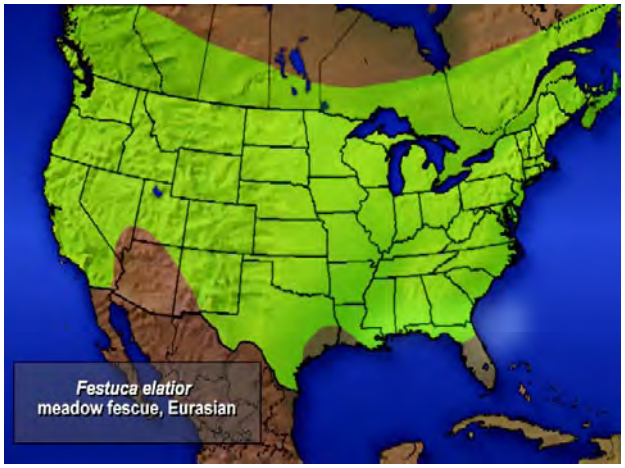
Crested Dogtail



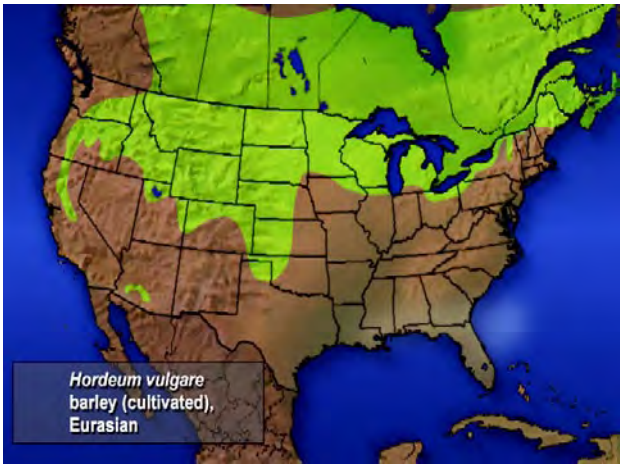
Orchard Grass



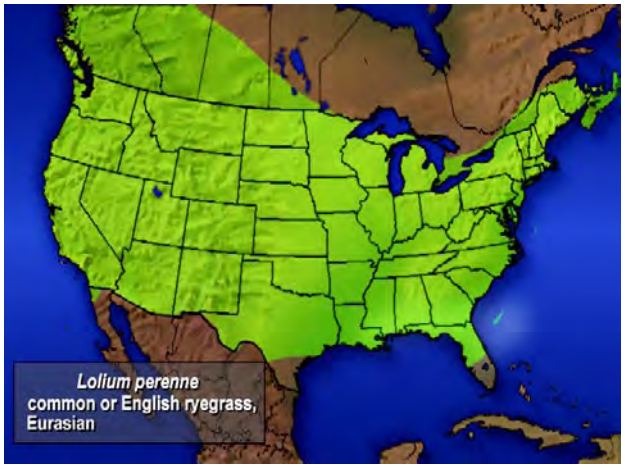
Crabgrass



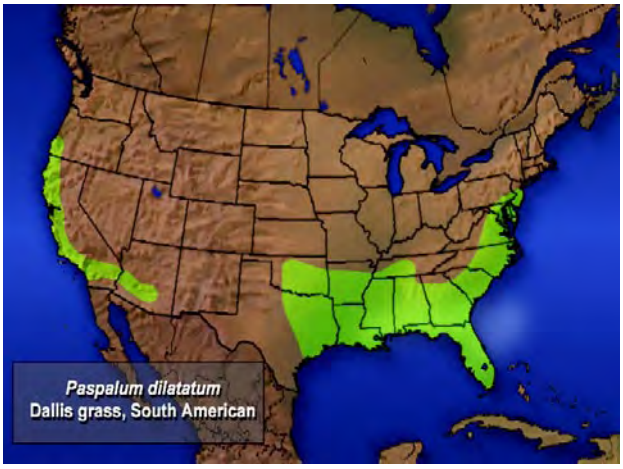
Meadow Fescue



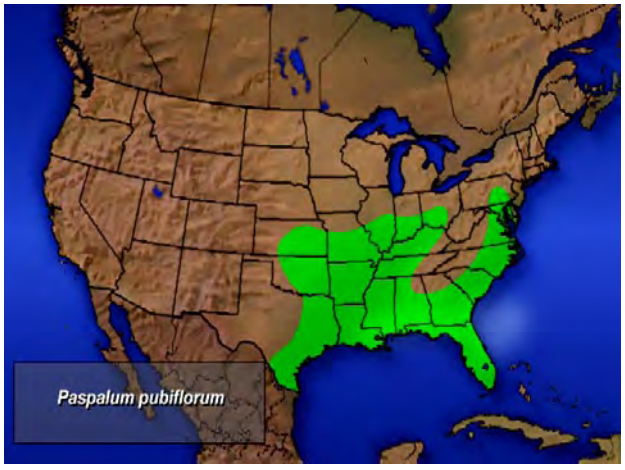
Barley



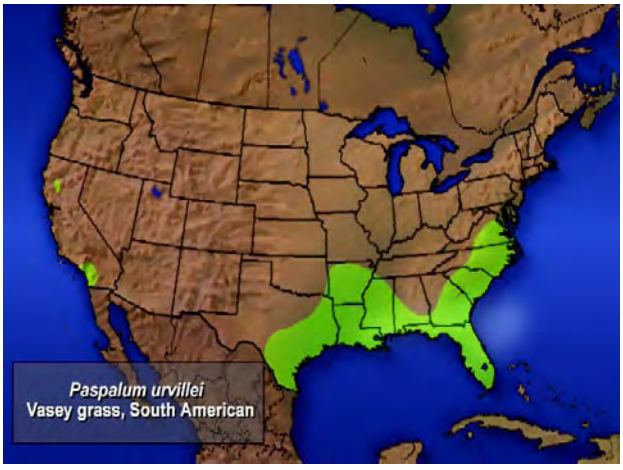
Ryegrass



Dallis Grass

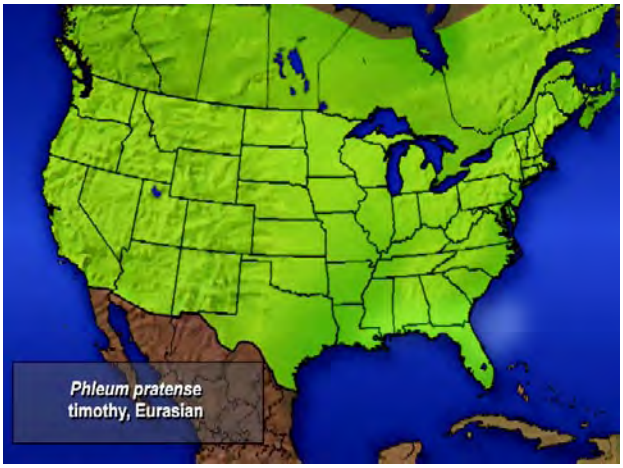


Hairyseed Paspalum

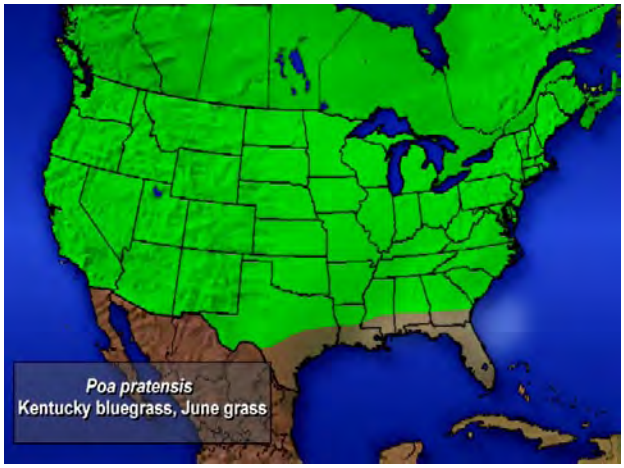


Vasey Grass

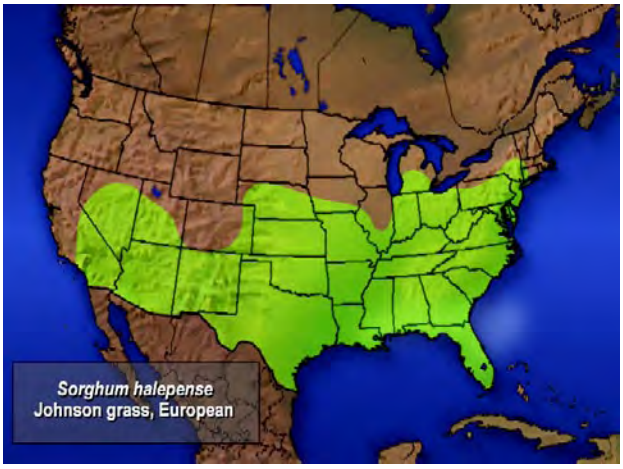
Distribution Maps



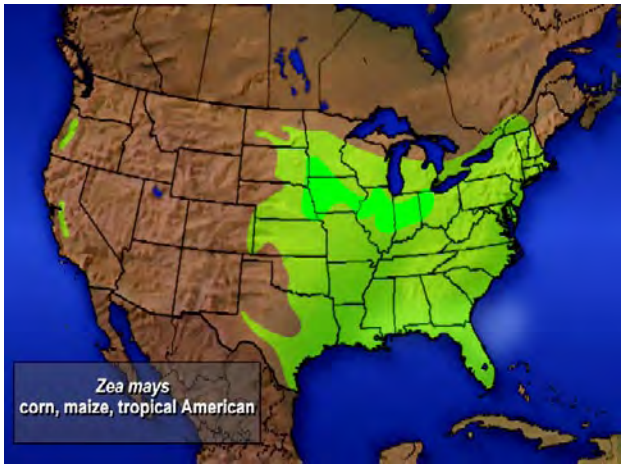
Timothy



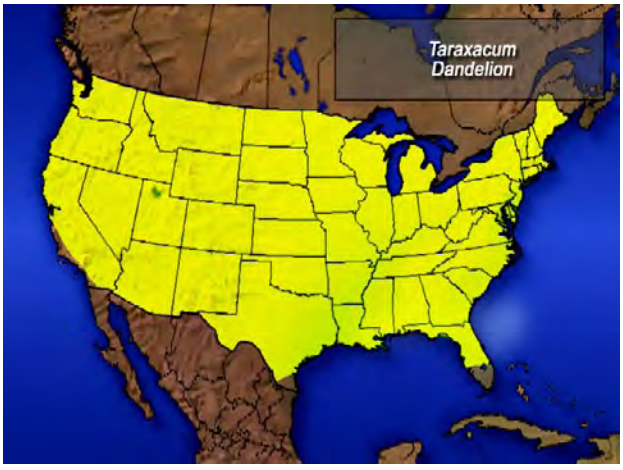
Kentucky Bluegrass
or June Grass



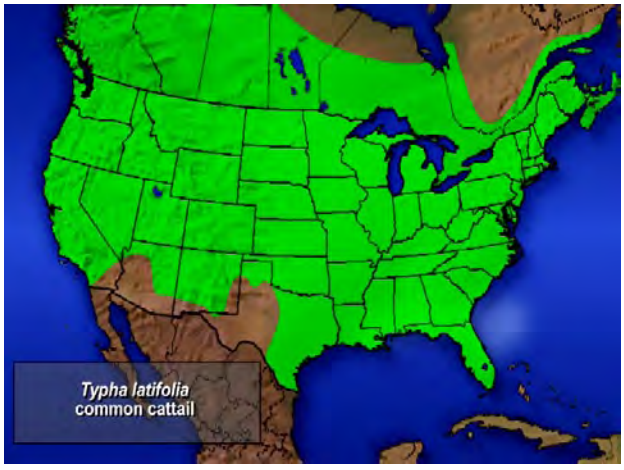
Johnson Grass



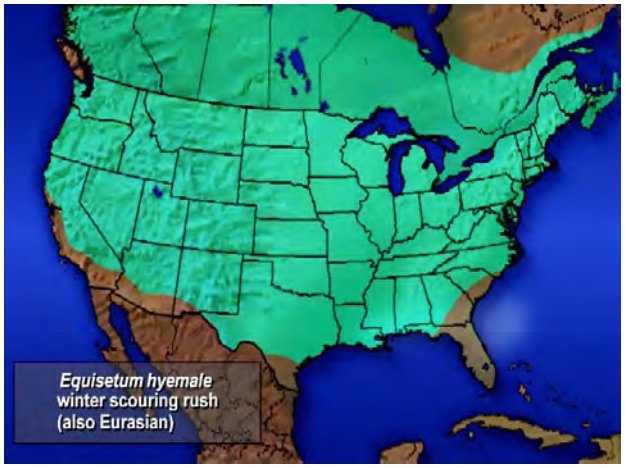
Corn or Maize



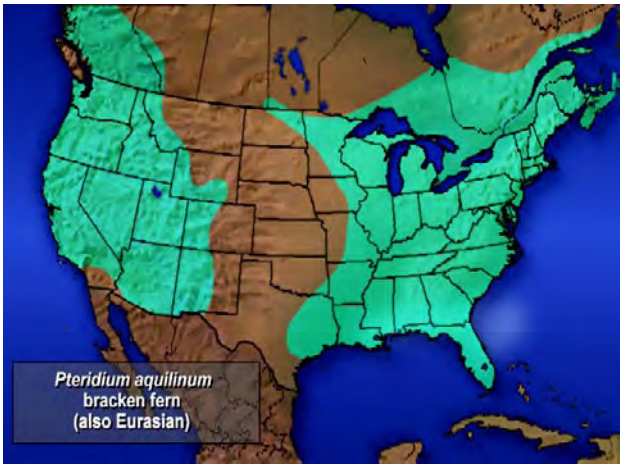
Dandelion



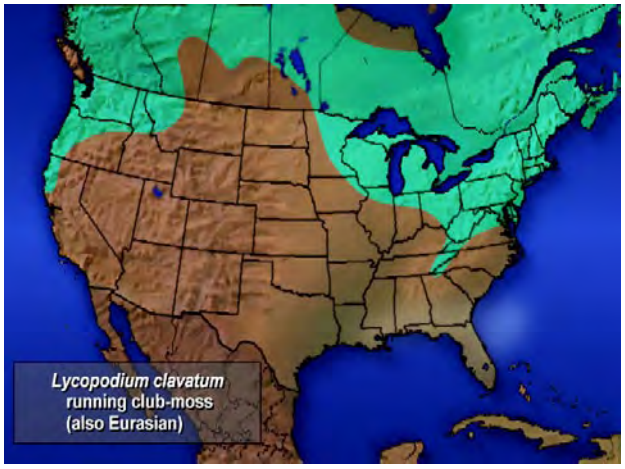
Common Cattail



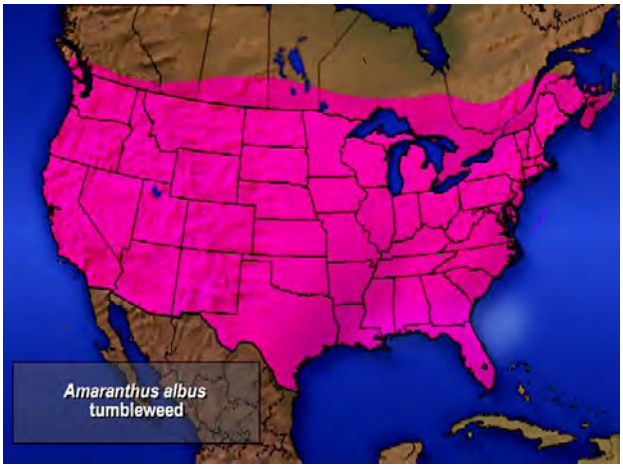
Winter Scouring Rush



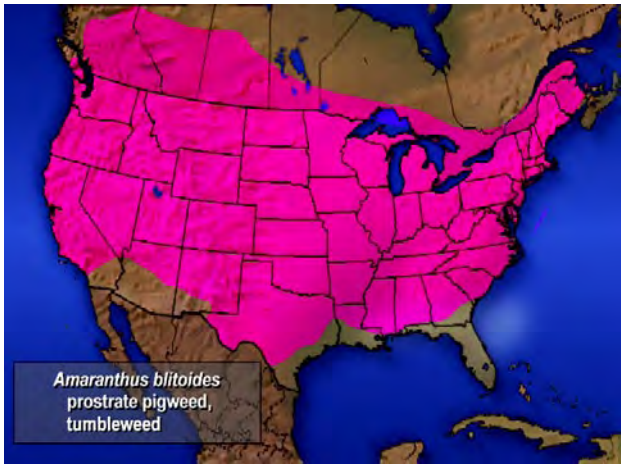
Bracken Fern



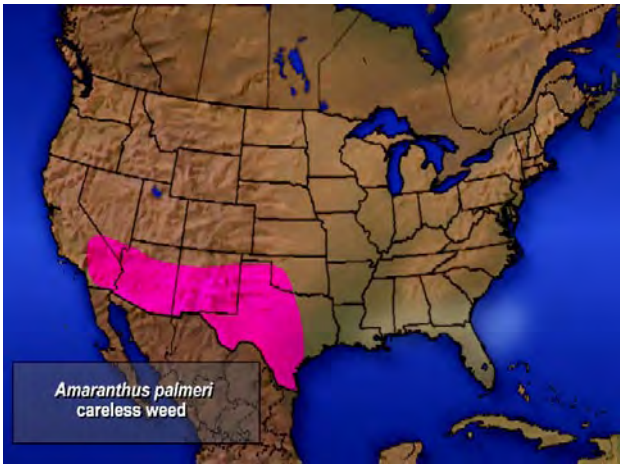
Running Club-moss



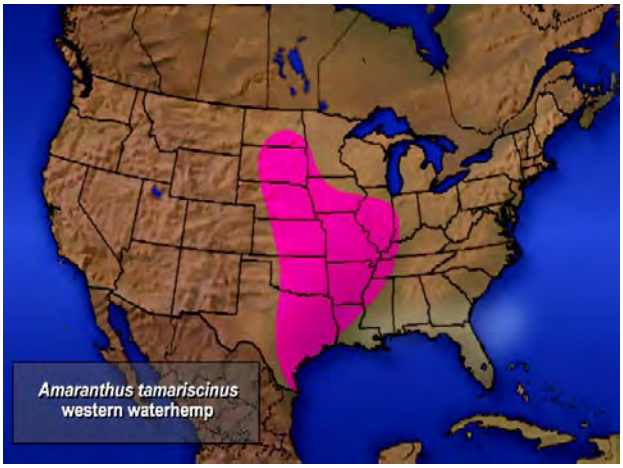
Tumbleweed



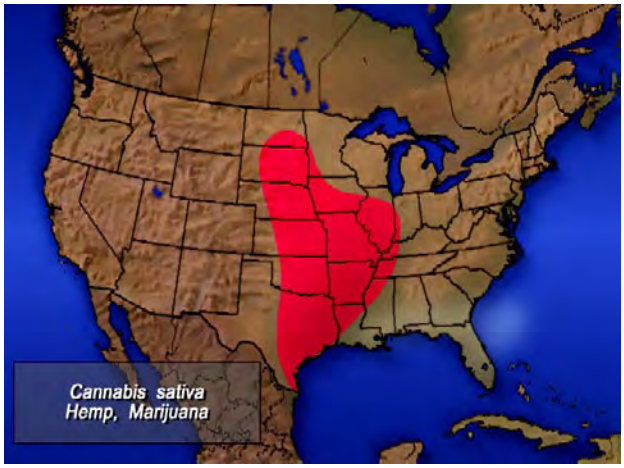
Prostrate Pigweed, Tumbleweed



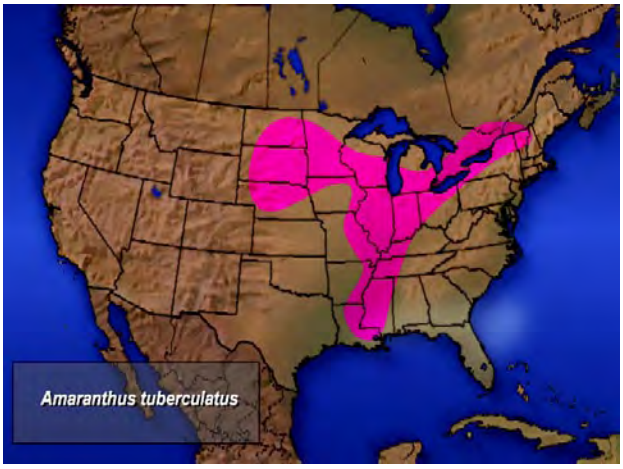
Careless Weed



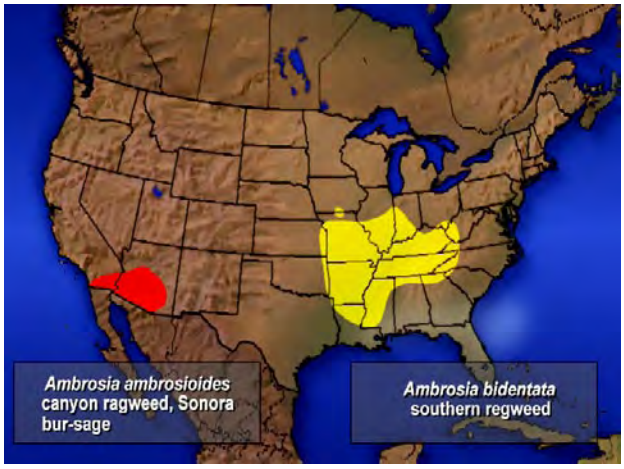
Western Waterhemp



Hemp, Marijuana

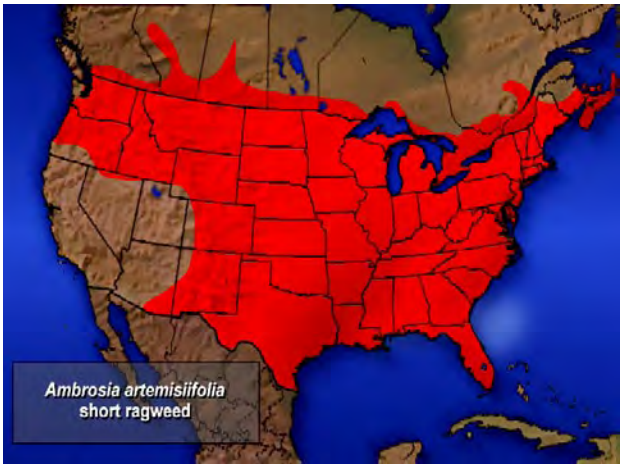


Water-hemp (Amaranthus tuberculatus)



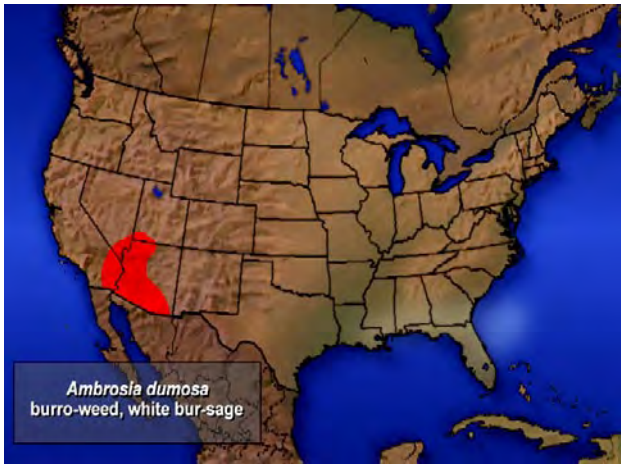
Canyon Ragweed or Sonora bur-sage

Southern Ragweed

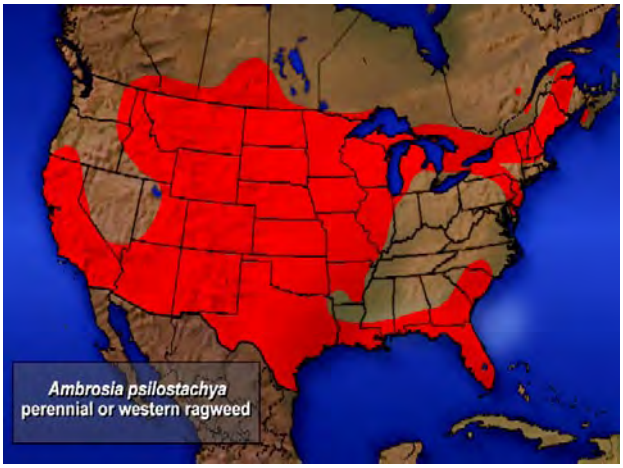


Short Ragweed

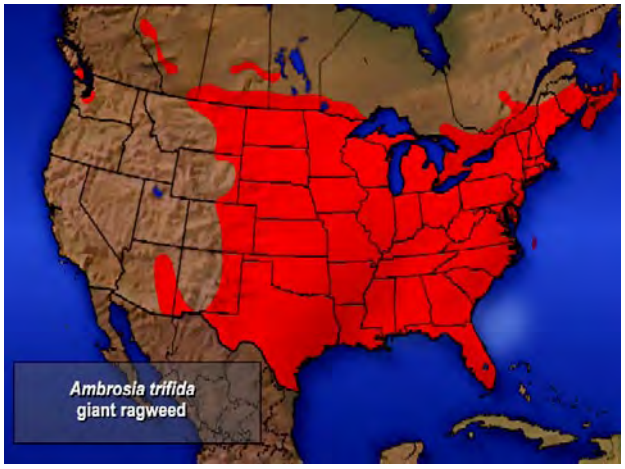
Arizona bur-sage



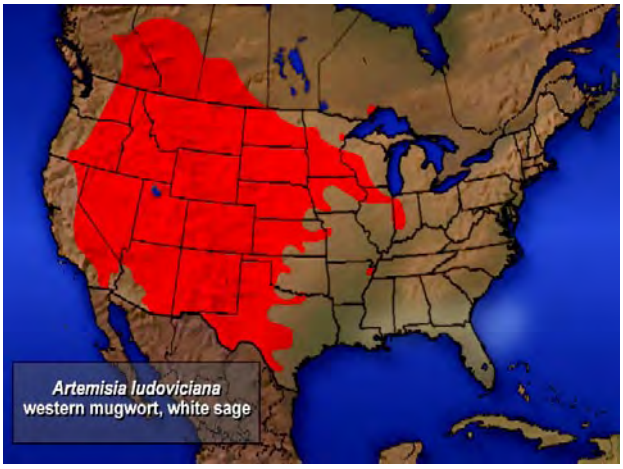
Burro-weed or White bur-sage



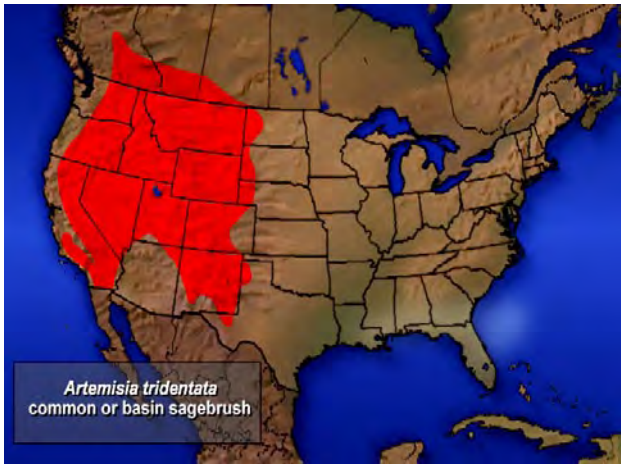
Western Ragweed or Perennial Ragweed



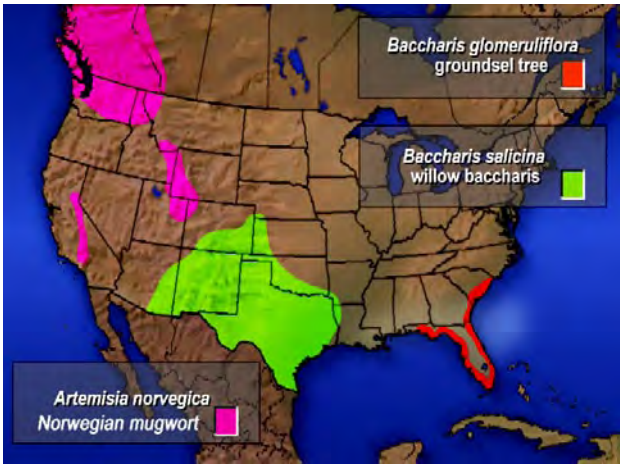
Giant Ragweed



Western Mugwort or White Sage

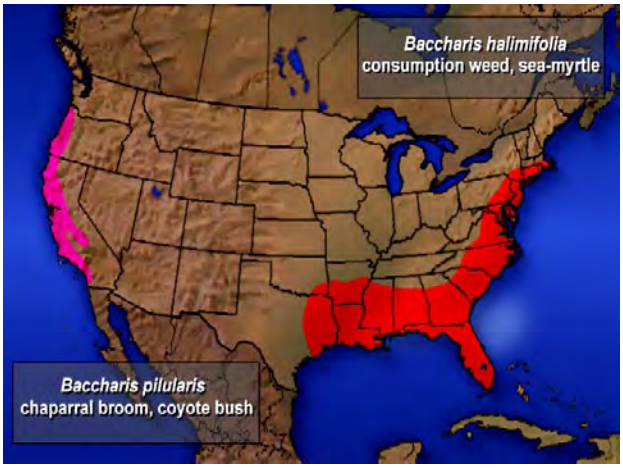


Common or Basin Sagebrush



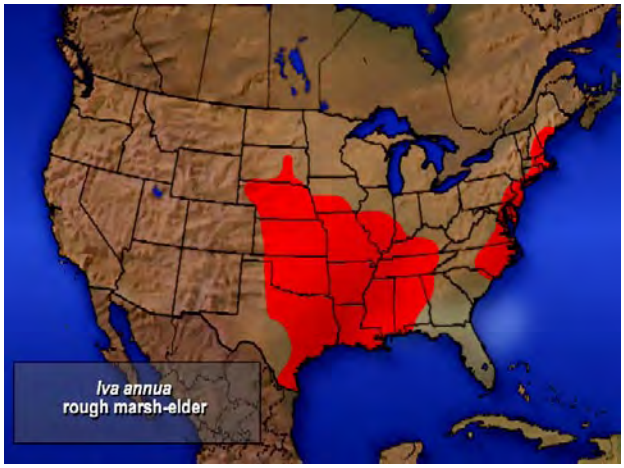
Norwegian mugwort

Groundsel tree & Willow



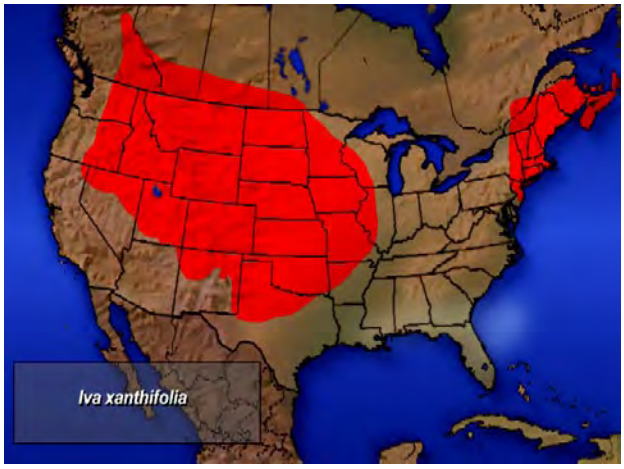
Chapparral Broom or Coyote Bush

Consumption Weed, Sea-mrytle

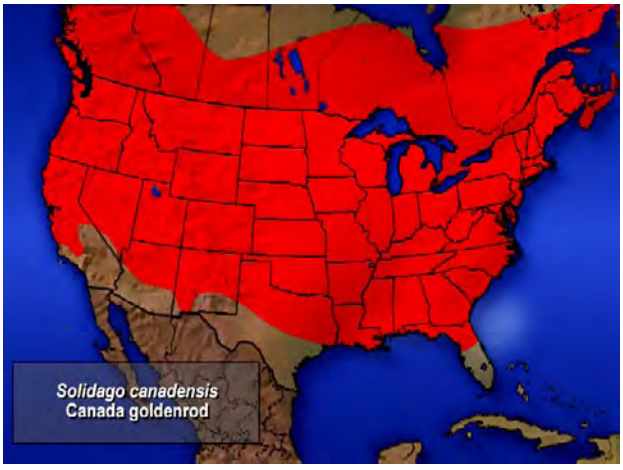


Rough Marsh-elder

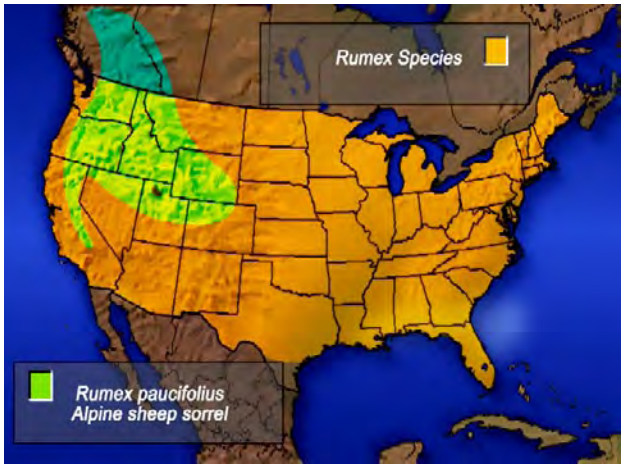
Poverty Weed



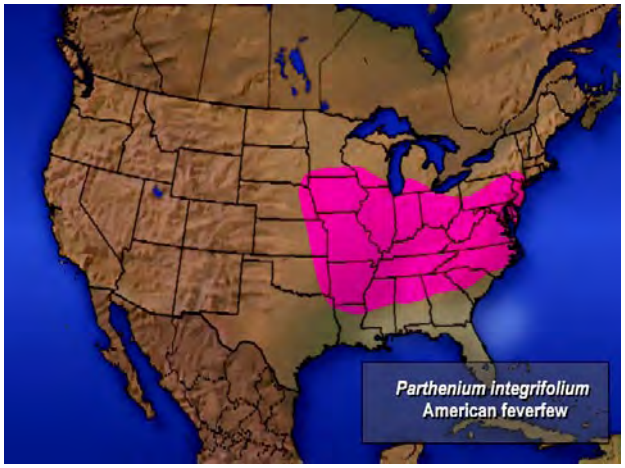
Giant Sumpweed



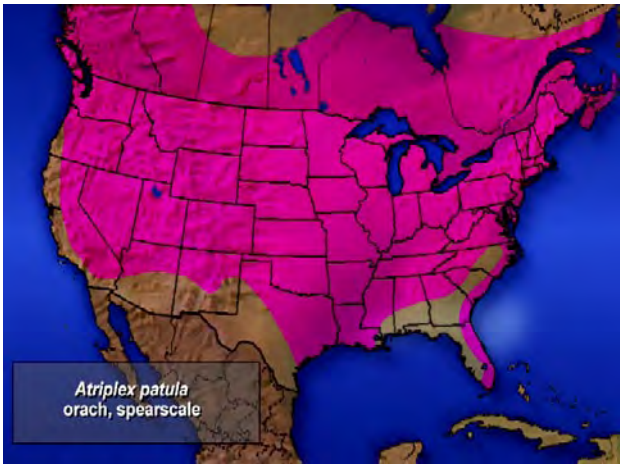
Canada Goldenrod



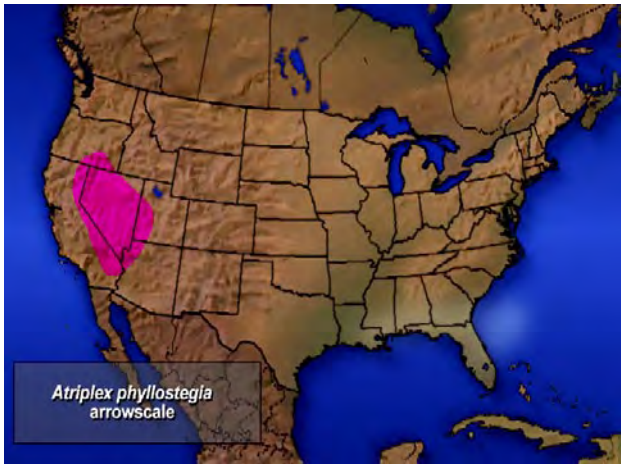
Sheep Sorrel



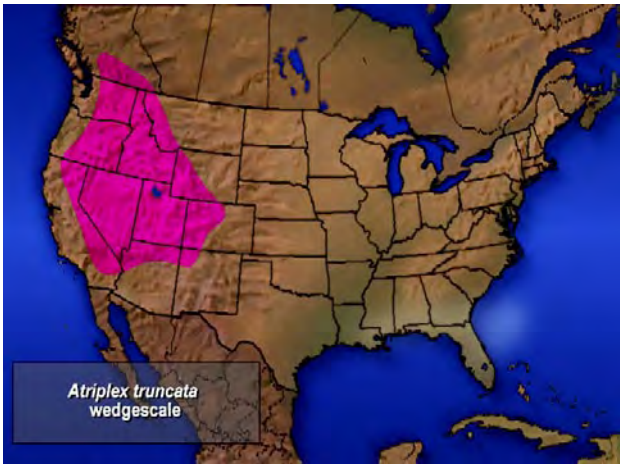
American Feverfew



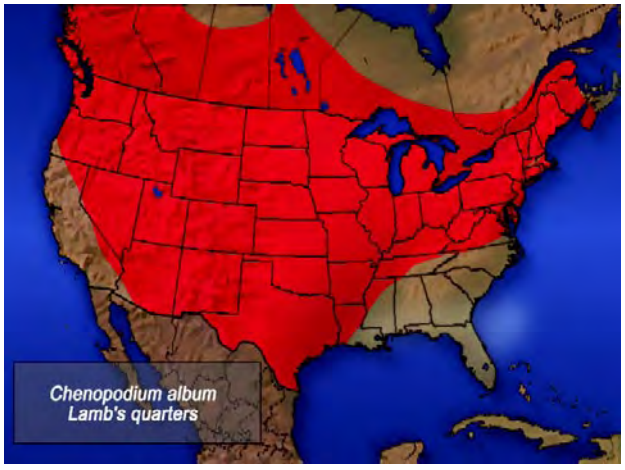
Orach, Spearscale



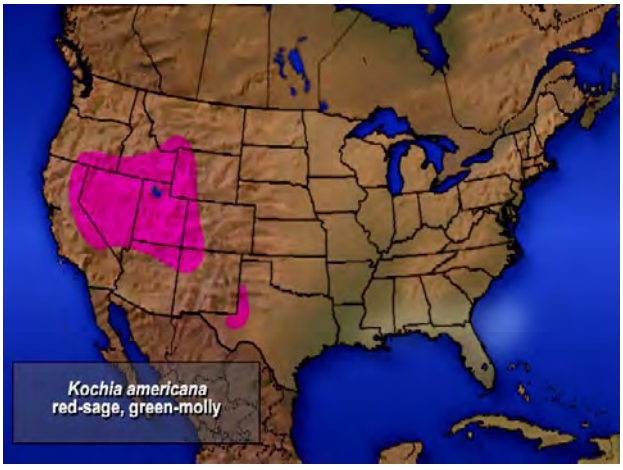
Arrowscale



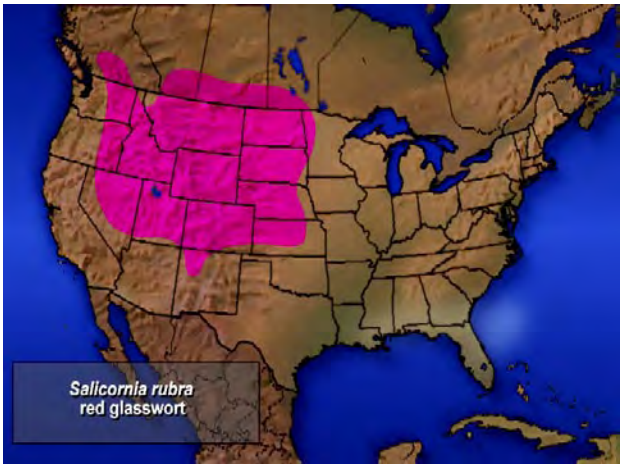
Wedgescale



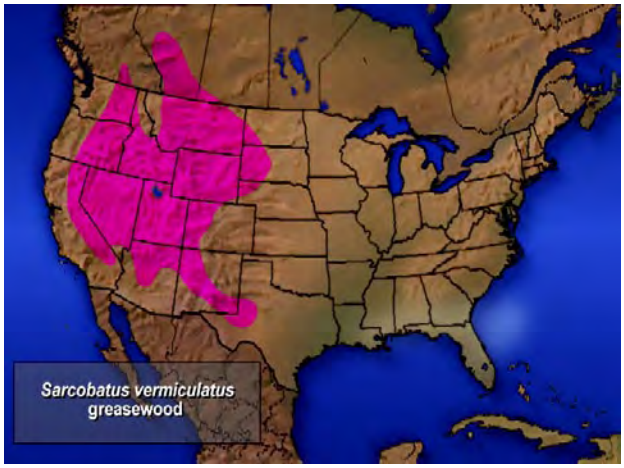
Lamb's quarters



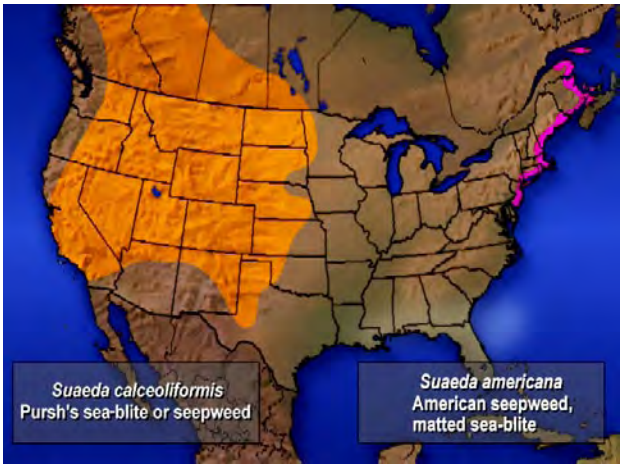
Red-sage,
Green-molly



Red Glasswort

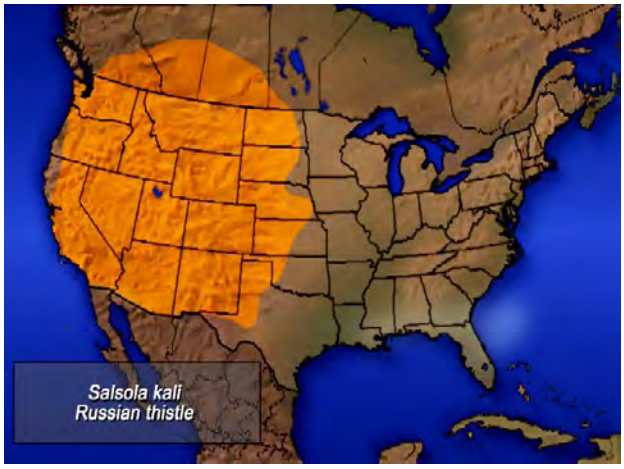


Greasewood

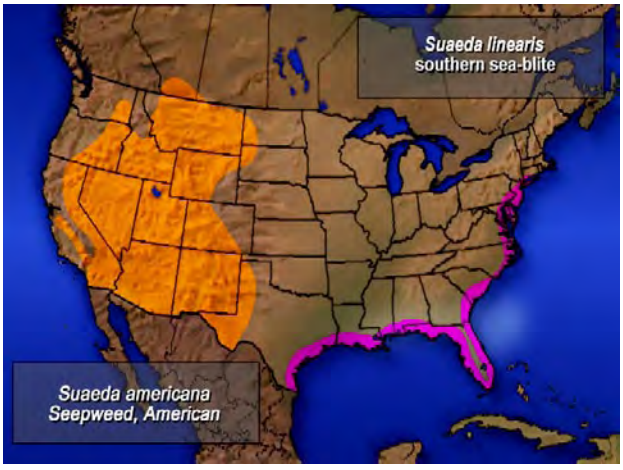


Seepweed or Pursh's Sea-blite

American Seepweed or Matted Sea-blite



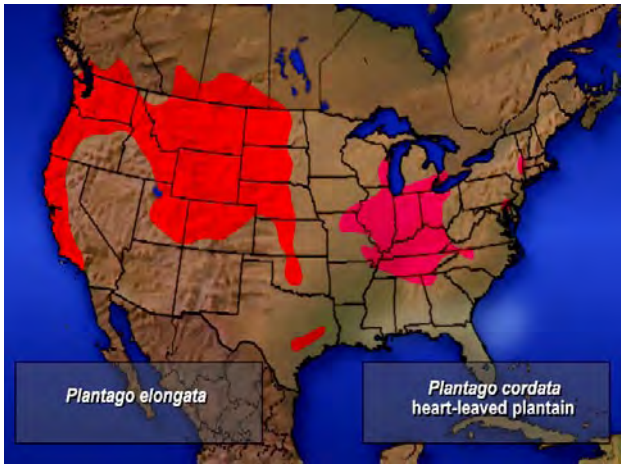
Russian Thistle



Seepweed, American

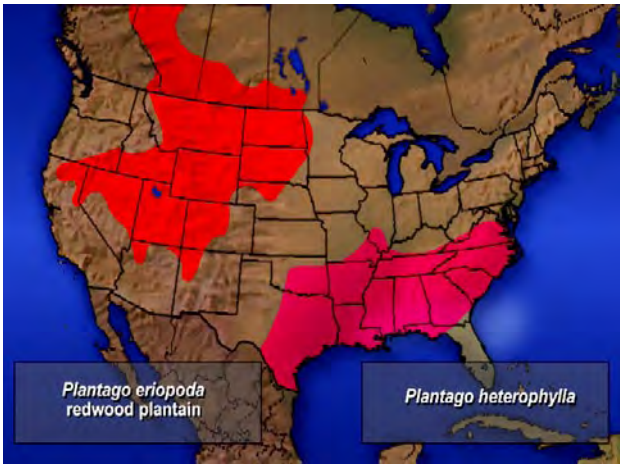
Southern Sea-blite

Three-seeded Mercury



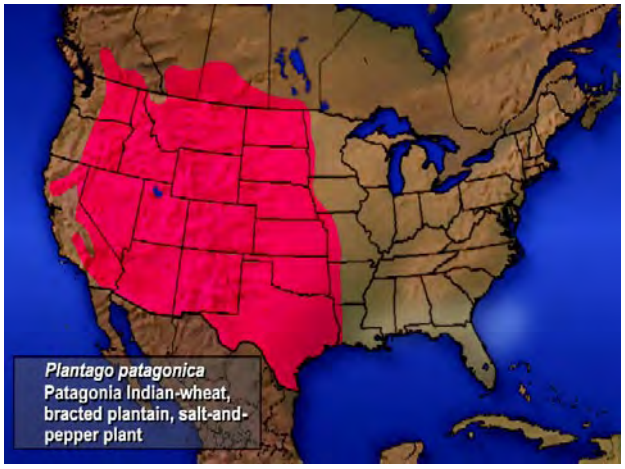
Prairie Plantain

Heart-leaved Plantain



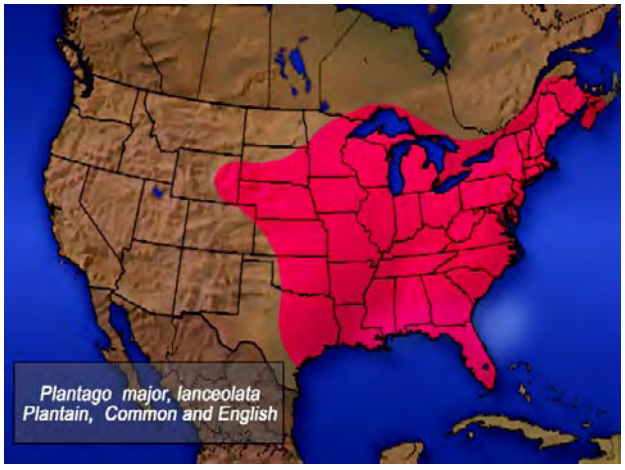
Redwood Plantain

Plantain

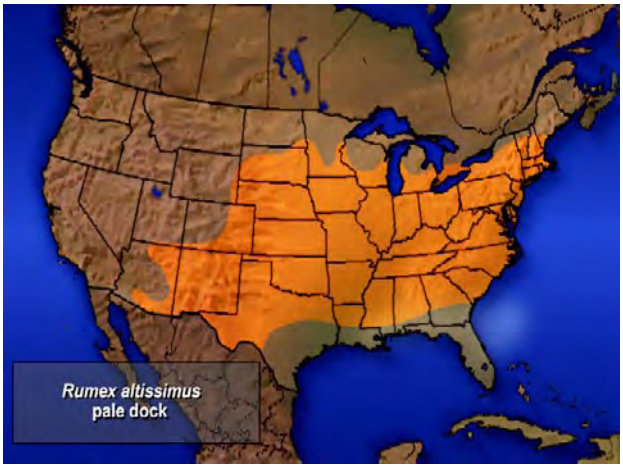


Indian Wheat or
Salt-and-pepper plant

Seaside Plantain



English Plantain

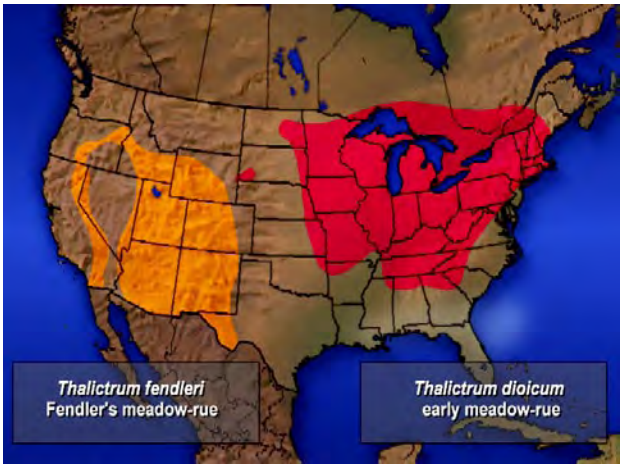


Pale Dock

Distribution Maps

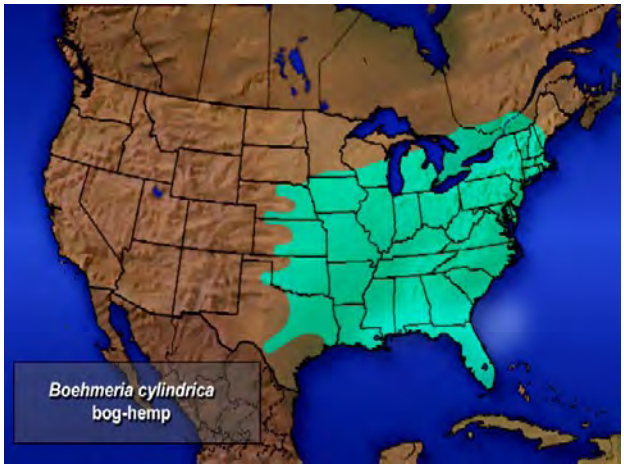
Alpine Sheep Sorrel

Swamp Dock

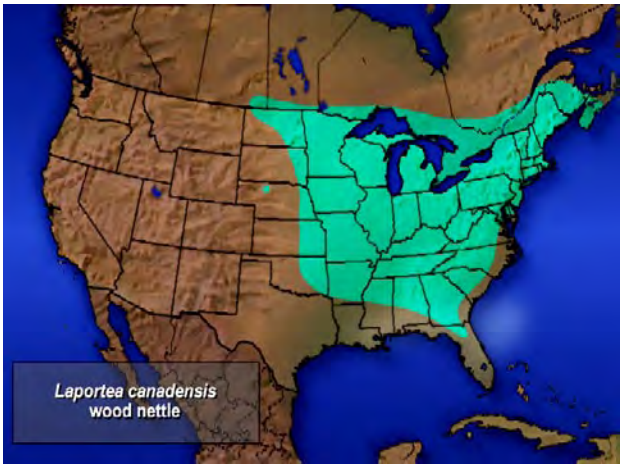


Meadow-rue, Fendler's

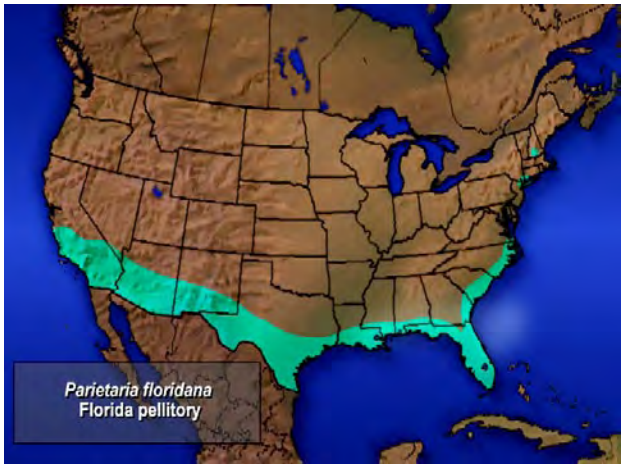
Meadow-rue, Early



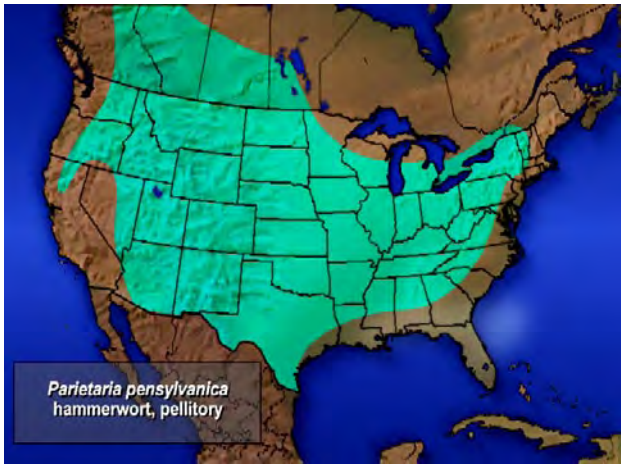
Bog-hemp



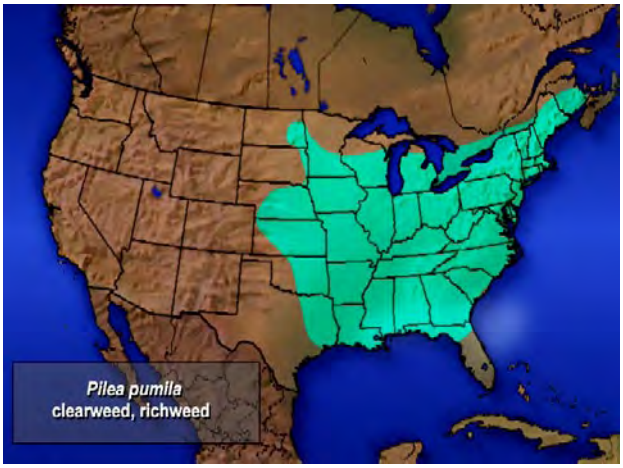
Wood Nettle



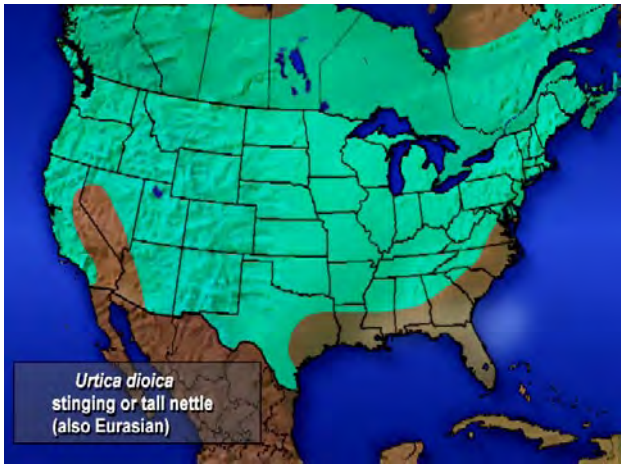
Pellitory, Florida



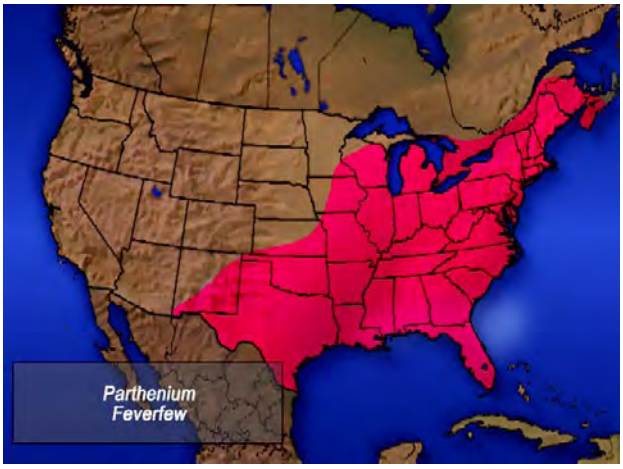
Pellitory,
Hammerwort



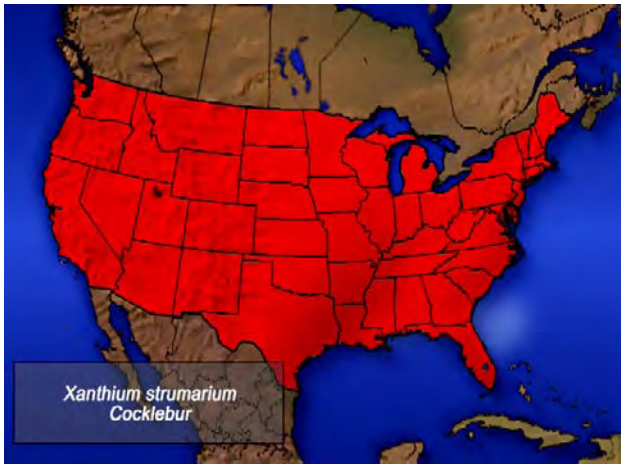
Clearweed, Richweed



Stinging Nettle

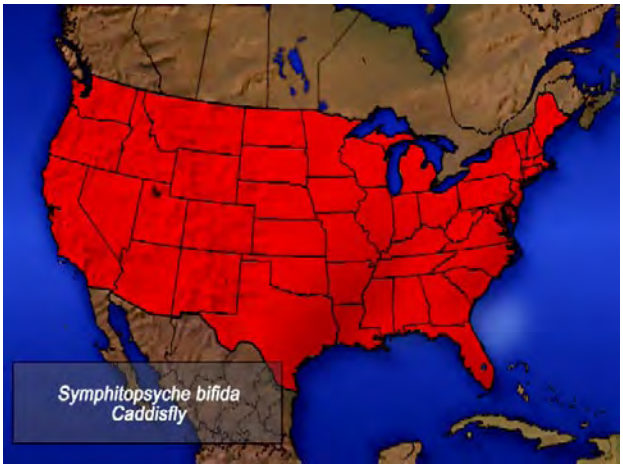


Feverfew



Cocklebur

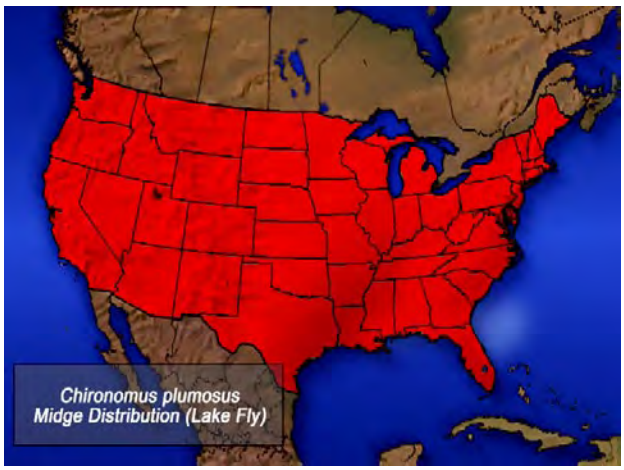
Australian Pine



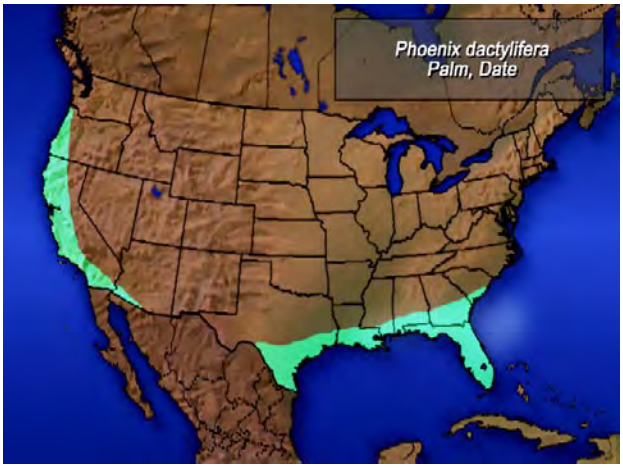
Caddisfly

Fire Ant

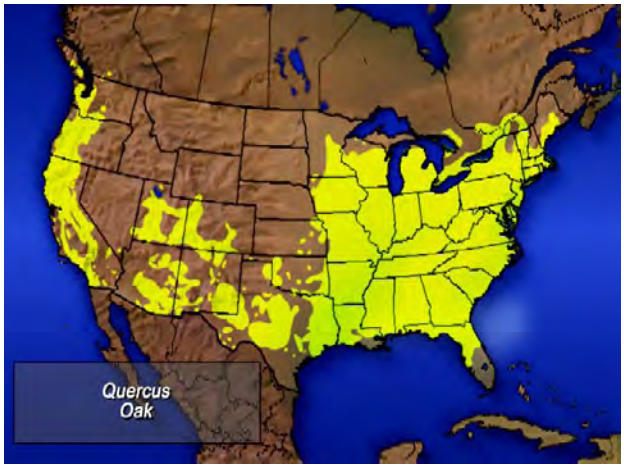
Olive



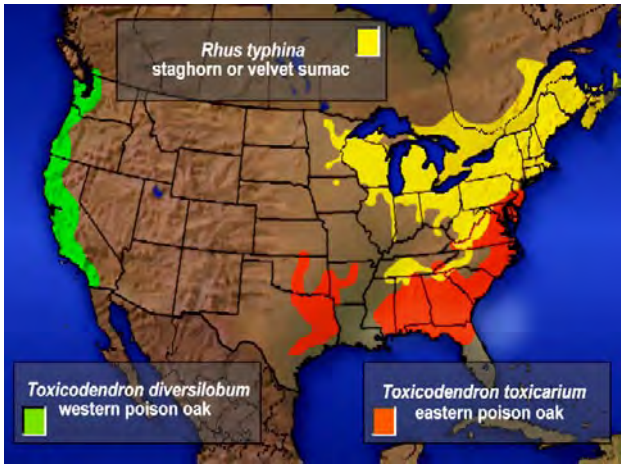
Midges or Lake Flies



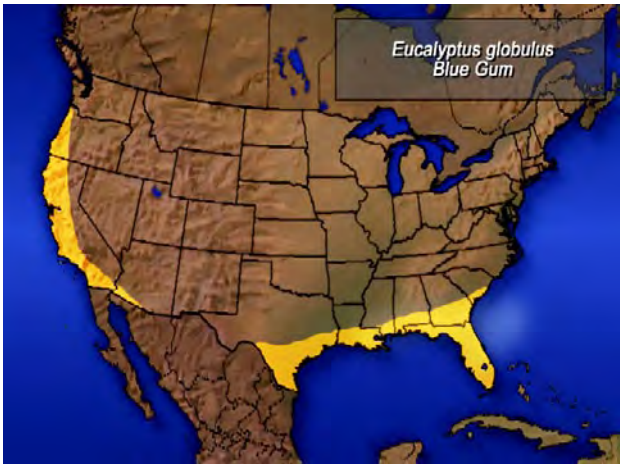
Palm, Date



Oak



Poison Oaks Sumac



Blue Gum

Glossary

Aeroallergen An allergen source material distributed in the ambient air.

Aerobiology The study of biological materials in the atmosphere.

Allergen Any substance capable of inducing an allergic immune response in a host, usually with the production of the allergy antibody, IgE.

Anemophily Pollination by the wind.

Angiosperm A flowering plant which distributes its seeds within the mature fruit or ovary.

Annulus A ring like region, such as the thickened area the exine surrounding the pore of a pollen grain.

Antigen Any material or substance capable of inducing a specific immune response.

Aperture The preformed, weakened area of a pollen exine grain through which the pollen tube will exit the pollen.

Atopic The human hereditary trait which allows the individual to become sensitized to allergens, and to develop hypersensitivity.

Bisexual A plant containing both male and female structures and producing both male and female gametes.

Budding A form of asexual reproduction wherein a spore produces a progeny via motisis.

Catkin An elongated, spike-like inflorescence of a unisexual flower.

Chitin A complex carbohydrate in the walls of fungal cells.

Colporate A compound aperture with both a colpus (furrow) and an os (pore).

Colpus An elongated opening, or aperture, of a germinal furrow.

Deciduous Plants that have parts which separate from the plant as a result of a change in environment, as in a frost or a drought.

Elliptic An elliptically shaped structure with the widest axis at the middle.

Equatorial view The aperture is directed at the viewer allowing one to measure the distance between the poles.

Excrescence A process, such as a wart or tuber, on the sexine surface.

Dioecious A unisexual plant with separate male and female parts or individuals.

Exine The outer, resistant wall of a pollen grain which consists of the sexine and the nexine.

Facultative A process taking place under restrictive conditions.

Fruit A mature ripened ovary containing seeds.

Granule Small rounded processes on the surface of the sexine.

Gymnosperm A cone bearing plant with exposed seeds.

Haustoria Nutrient absorbing hyphae that invade host cells without killing the host.

Hyphae Threadlike filaments that develop spores.

Hypersensitivity An altered state of reactivity wherein an individual is more sensitive than a normal person to either nonspecific irritants or allergens; and if by allergens, then usually by mechanisms of excessive immune response involving antibodies (IgE) or lymphocytes (T cells).

Inflorescence A flower cluster containing the reproductive structures of the plant..

Intine The innermost, nonresistant wall of the pollen between the nexine and the protoplasm.

Lumen A cavity between the ridges of the reticulum.

Micropore A small, minute opening or pore in the tectum.

Monoecious Any plant producing either male or female gametes with stamens and pistils on separate flowers.

Mycelium A network of elongated hyphae.

Nexine The inner, nonsculptured resistant wall of the exine lying between the sexine and the intine.

Nut A dry one seeded fruit.

Oblong The widest axis is at the midpoint of the structure with the margins being parallel.

Os A pore or opening.

Phialides Flask-shaped cells that give rise to conidia or spores.

Glossary

Phylogeny The evolutionary history of a life form.

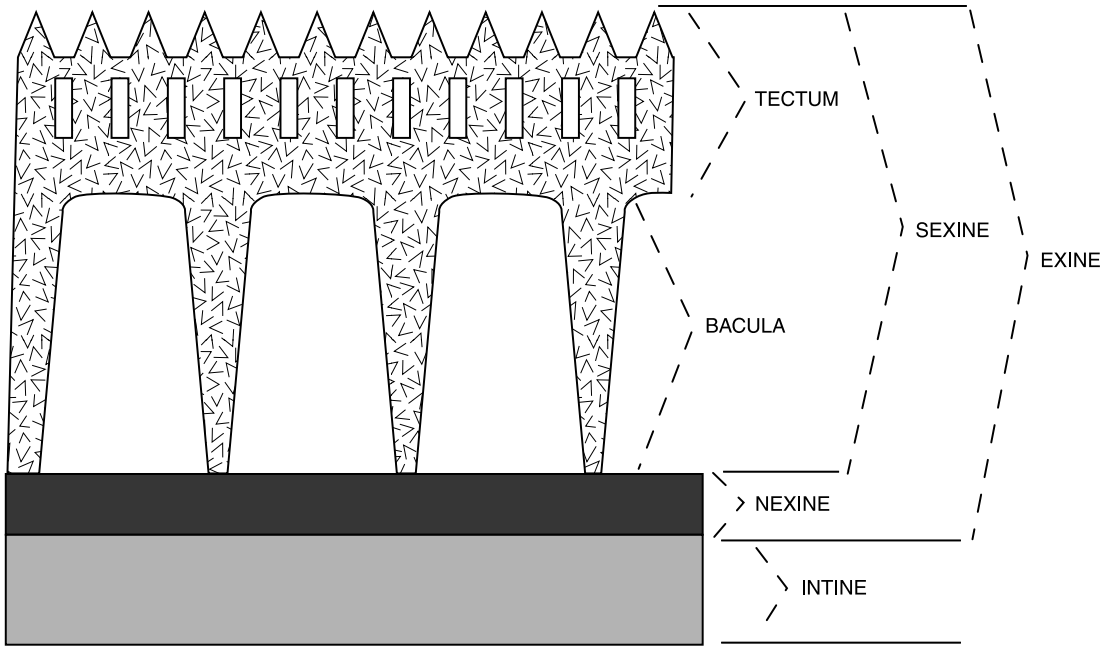
Pistil The central structure of a flower consisting of the ovary, style and stigma.

Pistillate A flower with a pistil but no functional stamens.

Polar view The view in which the polar axis of a pollen grain is looking directly at the viewer.

Pollen grain The male gamete of a Gymnosperm or an Angiosperm plant having a haploid number of sperm at maturity (two).

Pollen wall



Pollination The movement of pollen from its source, the anther, to a stigma.\tab

Pollinosis An allergic disorder induced by pollen allergens.

Pore A circular, ovoid germinal aperture or foramen, also known as an os.

Reticulum A netlike sculptured surface of the exine which is formed by connected ridges between cavities.

Sexine The outer, resistant wall of the exine.

Spheroidal A pollen shape having nearly equal dimensions in the equatorial and polar axes.

Spike An inflorescence with a long main axis and sessile flowers.

Spine A long pointed plant process usually > 3 um in size.

Sporangium A spore producing sac like structure, such as a mushroom cap

Sporosis An allergic disorder induced by allergens within spores.

Stamen Pollen producing region of the plant, usually consisting of an anther and a filament.

Stellate A star shaped appearance.

Stigma The upper most area of the plant pistil which acts as the receptive surface for pollen, and upon which pollen germinates.

Tectum The outer most part of the sexine with a continuous surface.

Unisexual An organism with separate sexes and producing one kind of gamete, male or female, and thus being dioecious.

Verrucate Warty outer surfaces of the exine, with the basal diameter greater than the height.

Warty See: verrucate.

Zoophily Pollinated by animals instead of airborne dispersal.

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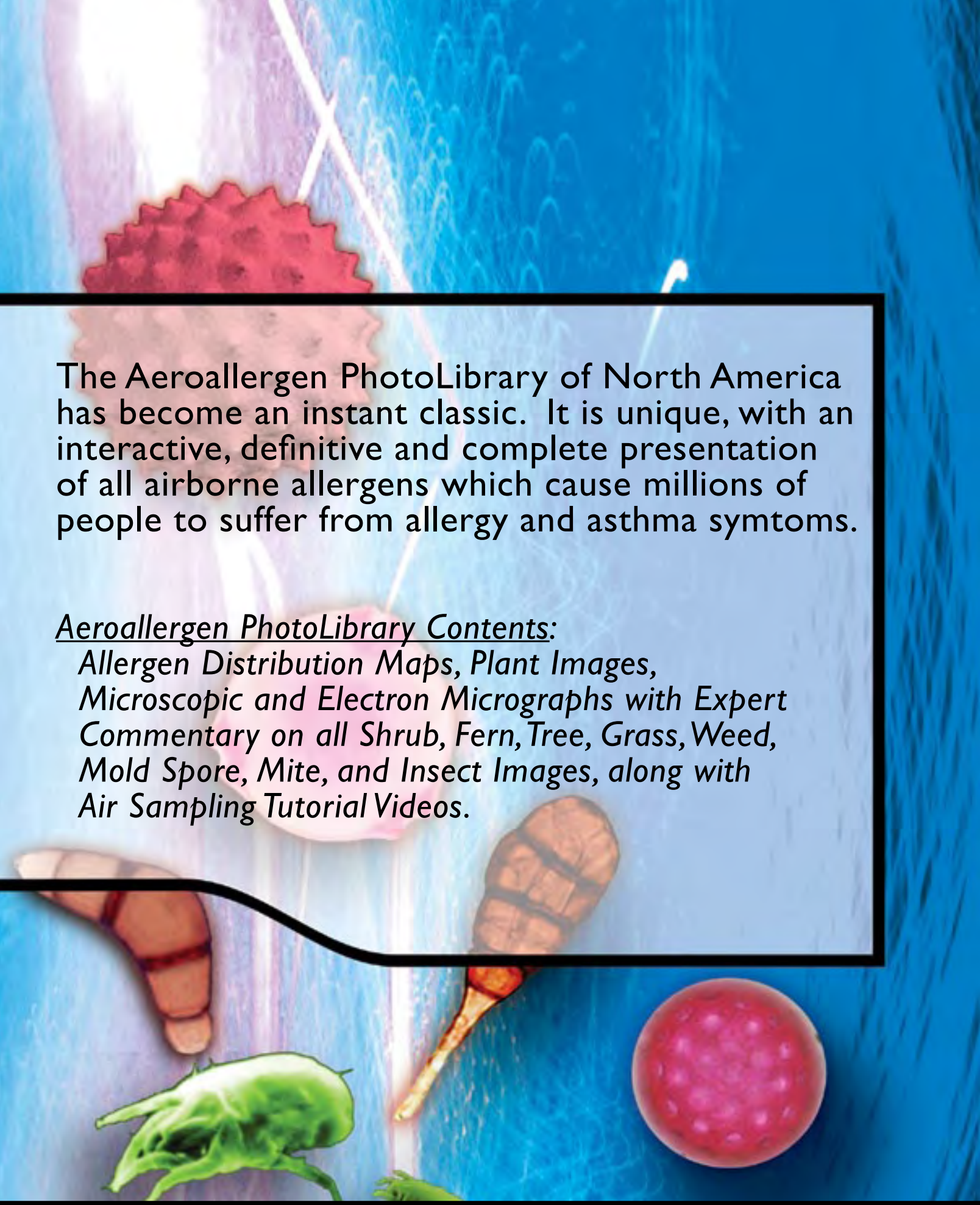

The Aeroallergen PhotoLibrary of North America has become an instant classic. It is unique, with an interactive, definitive and complete presentation of all airborne allergens which cause millions of people to suffer from allergy and asthma symtoms.

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