

# SCIENTIFIC COMPREHENSION

## NUCLEAR ENERGY

There is energy everywhere inside the atoms that make up everything in the universe. The energy that is stored inside an atom by the forces that hold together the nucleus of an atom is called nuclear energy. The term nuclear comes from the nucleus which is the center of every atom. Over many years of research and experimenting scientists have learned how to harness or capture the incredible amounts of energy from these forces. The energy from the nucleus of an atom can be used to generate electricity.

Albert Einstein discovered a mathematical formula that demonstrated that all matter can be converted into energy. His formula,  $E = mc^2$  may be a simple formula, which he discovered while working on his theory of relativity, proved that a large amount of energy could come from a very small amount of matter, such as the single atom.

In a process called nuclear fission the atom is split. In this process the larger atom is split into two or more smaller atoms and a large amount of energy is then released. When the splitting is controlled and done slowly, such as what happens in a nuclear power plant, it provides electricity to homes and businesses. If the energy is released quickly, all at once, a chain reaction takes place and the result is a nuclear explosion.

The nuclear fission occurring at a nuclear power plant produces heat, the heat is then used to create steam from water, which then powers electrical generators creating the electricity for towns and cities. A non-nuclear power plant may use coal, wind, oil, or water to power generators. Around twenty percent of the electricity in the United States is produced by nuclear power plants.

For fuel, a nuclear power plant uses an element called uranium. Rods of uranium are used to make sure the splitting of the atom takes place in a controlled manner during the chain reaction. If it is not controlled, a nuclear explosion may occur. Unfortunately, one of the consequences of nuclear energy is radioactive waste. Radioactive waste is the leftover material not used during the nuclear reaction that generated the electricity. The material can be dangerous to all life.

An advantage of nuclear power is its ability to be used to power ships and submarines, which can stay under water and travel at high speeds for a long time. There is no need to refuel like traditionally powered ships or submarines.

Nuclear fusion is a second type of nuclear energy. Nuclear fusion takes place when two or more atoms are joined together, not split apart. This is how the stars in the galaxies get their power. Hydrogen atoms deep inside the star are constantly being converted into helium atoms through fusion. The process results in the light and heat energy given off by the Sun and the other stars in the sky.

Unlike fission, scientists do not yet know how to control fusion to produce useable nuclear energy. The advantage to using fusion over fission is that it would produce less radioactive waste. It would also lead to an unlimited supply of energy and electricity.

In summary, nuclear energy is produced by splitting the atom, first introduced by Albert Einstein during experiments with his theory of relativity. When the atom is split in a controlled manner,

energy is produced, and in many places throughout the world, this energy is used for electricity. If the atom is split without this control, a chain reaction can result in a nuclear explosion.

1. Which of the following is the location of the stored energy in the atom?

- A: Inside the nucleus
- B: Outside the nucleus
- C: In an electron
- D: In a proton

2. Which of the following best defines nuclear fission?

- A: A smaller atom is split and made into larger atoms and a large amount of energy is then released.
- B: A larger atom is split into two or more smaller atoms and a large amount of energy is then released.
- C: A smaller atom is combined with other atoms causes a reaction and a large amount of energy is released.
- D: A larger atom is split into another atom and small amounts of energy is then slowly released.

3. Which of the following may occur if the energy of an atom is released too quickly?

- A: Nuclear explosion
- B: Radioactive leak
- C: Electricity
- D: None of the above

4. Which of the following element is used for fuel by a nuclear power plant?

- A: Hydrogen
- B: Helium
- C: Uranium
- D: Oxygen

5. Which of the following takes place deep inside the stars of a galaxy?

- A: Helium atoms are converted to hydrogen through fusion
- B: Helium atoms are joined with hydrogen atoms through fusion
- C: Hydrogen atoms are converted to helium atoms through fusion
- D: Hydrogen atoms are joined with helium atoms through fusion

6. Which of the following takes place when two or more atoms are joined together to produce energy?

- A: Nuclear fusion
- B: Nuclear fission
- C: Nuclear waste
- D: Nuclear collision

# Benjamin Franklin

Benjamin Franklin was one of the Founding Fathers of the United States. He was involved in the struggle of the early colonies to become a country separate from Great Britain. He was also an inventor and diplomat. A diplomat spends time in other countries making friends for his own country.

Benjamin Franklin was born in Boston, Massachusetts, in 1706. He was the 15th child of 17 children. Ben's father made candles. Ben stopped going to school when he was 10 but spent the rest of his life reading and learning on his own. At the age of 12, he became an apprentice to his brother who was a printer. His brother printed the Courant, the first newspaper in America to print just American news. An apprentice works with an expert who teaches the apprentice what he needs to know to be able to go out on his own someday in that occupation. He wrote letters about current topics to his brother's paper when he was a teenager and signed them Mrs. Silence Dogood. His brother printed them and never knew they were written by Ben. When he found out, he was angry.

Ben broke his apprenticeship to his brother when he was 17 and ran away to Philadelphia to become a printer. He lived the rest of his life there. His newspaper, the Pennsylvania Gazette, which he bought in 1729, was one of the most successful newspapers in the colonies. He was the first to use maps and publish editorial cartoons in a newspaper. He married Deborah Read and had his first son in 1731. Later he had two more children. In 1748, Benjamin Franklin sold the newspaper and retired from printing. In 1773 he started publishing Poor Richard's Almanack. It contained weather reports, recipes, predictions and funny sayings. He did this for 25 years.

Although Thomas Jefferson was the main writer of the Declaration of Independence, Benjamin Franklin was one of the five men involved in drafting the document. He was Pennsylvania's representative to the Second Continental Congress which met in Philadelphia in 1775. This body declared war on Great Britain and made George Washington the commanding general of the army.

He is the only American who signed all four major documents involved in the founding of the United States. These are the Declaration of Independence, a Treaty of Alliance with France, the Treaty of Paris, and the Constitution of the United States. He was an ambassador to France from the colonies and convinced the French to aid them in their quest for freedom from Great Britain.

Benjamin Franklin was an inventor too. He is most famous for his experiments with electricity, proving that lightning is really electricity. With that knowledge, he invented lightning rods for buildings to protect them from being struck by lightning. He also invented bifocal lenses for glasses, swim fins and the Franklin stove.

Ben started the first public library in the United States and the first fire station in Pennsylvania. He founded a city hospital and a school which later became the University of Pennsylvania. He was active in helping with projects to clean, pave and light the streets of Philadelphia. Benjamin Franklin died in 1790 at the age of 84.

In summary, Benjamin Franklin was one of the most famous of the early founders of the United States. He was a man with many talents and interests. He spent many years in publishing, was very successful as an inventor, cared about his home city of Philadelphia and began many projects to help its people. He also participated in the founding of a new nation separate from Great Britain by helping to write the Declaration of Independence and Constitution of the United States.

7. Which of the following was Benjamin Franklin's first occupation?

- A: Doctor
- B: Businessman
- C: Printer
- D: Candle maker

8. Which of the following did Benjamin Franklin NOT invent?

- A: Typewriter
- B: Lightning rod
- C: Bifocal lenses
- D: Swim fins

9. Where was Benjamin Franklin born?

- A: New York
- B: Boston
- C: Philadelphia
- D: Washington D.C.

10. When was Benjamin Franklin born?

- A: 1706
- B: 1756
- C: 1798
- D: 1726

11. Which of the following did Benjamin Franklin NOT do for the city of Philadelphia?

- A: Start a public library
- B: Start a city hospital
- C: Start a fire station
- D: Start a police station

12. Which of the following is a person who spends time in other countries making friends for his own country?

- A: Diplomat
- B: Governor
- C: President
- D: Councilor

## How the Sun warms the Earth

If a people preferred to live in warm weather all year long, where would they go? Or if they liked cold weather, where would they go? Making that decision depends on the angle at which the sun

hits the earth. The sun warms the earth's surface which in turn transmits heat to the air above it. The angle that the sun hits the earth determines the amount of heat produced.

The sun's path is high overhead and at its hottest at midday. It shines down upon the areas around the equator at this time. At the same time the areas around the North and South Poles are coldest because they are further away at midday and the angles of the sun is different than the angle that hits around the equator. The lower the sun's angle the weaker the sun heats the earth.

The angle at which sunlight strikes the earth's surface is called the angle of insolation. Insolation is short for incoming solar radiation. It means the amount of the sun's energy that reaches earth at a given place and time. The amount of warming depends on the angle of insolation. The angle of insolation is always smaller near the North and South Poles which results in colder temperatures. On the other hand, the angle of insolation near the equator is greater and creates warmer temperatures. That means while it is freezing cold in one area of the earth it is hot in another.

What affects insolation? In the morning the sun is close to the horizon and at midday it is at its highest in the sky. After midday the sun lowers and the angle creates less heat. Measuring the angle of insolation is difficult because light rays are not easy to see. Therefore, the way to measure the angle is by measuring the shadows created by light rays. The shorter the shadow is, the more direct the angle of the light ray. As a result, the hotter the temperature is. The longer the shadow is, the more angle there is and the colder the temperature.

Why do some things get hotter than others? For example, dark colors get hotter than light colors in the same temperature. That is why dark asphalt roads get so hot in sunlight. Dark soils and rocks also get very hot. White sand and light colored rocks do not get as hot. The dark colors absorb the heat from the sun while light color reflects the heat.

The texture of a surface also determines its temperature. Texture is how smooth or rough a surface is. Rough textures cause light to bounce around at many angles. Each time a little more energy is absorbed by the surface. Therefore, rough surfaces tend to get hotter than smooth surfaces. The angles create heat.

If a person wants to live in a hotter climate, he or she would need to move closer to the equator because the sun's angle is at its highest closer to the equator and creates the most heat. On the other hand, if people want to live in a colder climate they need to move closer to the North or South Poles because while the sun is at its highest the Poles are further away and the angle of the sun is at its greatest. Angles create heat. The lower the angle is, the hotter the temperature will be. The higher the angle is, the colder the temperature will be. It is the angle of insolation that must be measured to determine the hotter or colder areas to live.

13. The angle at which sunlight strikes the earth's surface is called which of the following?

- A: Angle of insolation
- B: Angle of isolation
- C: Angle of light
- D: Angle of heat rays

14. Insolation is short for which of the following?

- A: Incoming solar reaction
- B: Incoming Solar reflection
- C: Incoming solar radiation
- D: Incoming solar retraction

15. The angle of insolation is always smaller near which of the following?

- A: Equator
- B: Oceans
- C: Atmosphere
- D: North and South Poles

16. The way to measure the angle is by measuring which of the following?

- A: Sunlight
- B: Shadows
- C: Sun rays
- D: Satellites

17. Which of the following defines how smooth and rough the surface is?

- A: Coarseness
- B: Roughness
- C: Texture
- D: Length

18. Which texture causes light to bounce around the surface?

- A: Smooth
- B: Coarse
- C: Fine
- D: Rough

## The Four Seasons

Parts of the earth about half-way from the Poles and the Equator, either South or North, usually experience four seasons. A season is a period of the year which has different temperatures, weather patterns and changes in nature from the other periods. Seasons occur because while the Earth rotates around the sun each year, it is tilted on its axis. One half, called a hemisphere, leans toward the Sun, and one half leans away. Regions near the equator or the Poles don't have changes in season.

The Northern Hemisphere leans toward the sun for one half of the year, resulting in more sunlight and warmer weather. For the other half of the year, the Northern Hemisphere is tilted away from the sun, resulting in less intense sunlight and cooler weather. While the Northern Hemisphere is enjoying warm weather, the Southern Hemisphere is tilted away from the sun and experiencing cooler weather.

The four seasons are called Fall (sometimes called Autumn), Winter, Spring and Summer. The months of September, October and November are usually considered Fall months. December, January and February are considered Winter months. Spring includes March, April and May. Finally, June, July and August are summer months.

In the Fall, the weather is cool, crops are harvested, apples ripen and are picked. Leaves turn red, yellow and brown and then drop to the ground. School begins. Piles of raked leaves can be found in many places throughout regions with Fall season. Halloween is celebrated this time of the year,

and pumpkins can be seen in some parts of the country. Animals begin to store up food for the winter. Some get ready to hibernate during the long, cold months of the winter.

The Winter months bring frost, very cold temperatures, snow and freezing rain. People like to ski, go snowmobiling, ice skate, go for sleigh or sled rides or build snowmen. Others like to sit inside in front of a warm fire. Usually, driving can be dangerous due to icy roads. Plants either are dead or not blooming again until spring. Some animals have trouble finding food. Many people celebrate Christmas by bringing an evergreen tree into their houses to decorate. The new year begins during the winter on January 1st.

Spring brings warmer temperatures and new growth on trees and plants. Beautiful flowers bloom. Sap runs in the maple trees, and maple farmers collect the sap to boil into maple syrup. Farmers plant seeds so that crops can be harvested in the Fall. People like to go for hikes in the warmer weather or play sports. Usually the Spring brings rain and wind also. The rain helps the new plants grow. Children have Easter egg hunts and fly kites.

Temperatures in Summer can be very hot. Thunderstorms occur frequently. Crops grow tall. People like to go fishing, swimming and camping. Independence Day is celebrated on July 4th with parades and fireworks. Children are out of school for a vacation. Many families travel.

In summary, the four seasons are created because the Earth is tilted on its axis as it rotates around the sun. During one half of the year, the Northern Hemisphere, the part of the earth north of the Equator, is tilted toward the sun and experiences warmer temperatures. During the other half of the year, the Northern Hemisphere is tilted away from the sun and temperatures are much colder.

19. In which of the following seasons would a farmer plant seeds?

- A: Spring
- B: Fall
- C: Winter
- D: Summer

20. What happens in the Northern Hemisphere when the earth is tilted away from the sun?

- A: The temperatures are very hot.
- B: The temperatures are cold.
- C: People go swimming.
- D: Flowers bloom.

21. Which of the following is a summer month?

- A: December
- B: July
- C: March
- D: November

22. What are the two halves of the earth called?

- A: Hemispheres
- B: Seasons
- C: Months
- D: Poles

23. In which of the following months does the sap run in the maple trees?

- A: December
- B: October
- C: January
- D: March

24. In which of the following seasons does Independence Day occur?

- A: Fall
- B: Summer
- C: Spring
- D: Winter

## Cloning

Nearly all living organisms have parents in which they were reproduced and born through various stages of the life cycle. Whether it is a human being with a mother and a father or a chicken hatching from an egg, most living organisms have male and female parents. Some living organisms also form from one parent such as when a single-celled amoeba splits into two to reproduce offspring.

However, there is a process which is much different in producing offspring called cloning. Cloning is the process when scientists take DNA from an animal cell and then place it or implant it into an egg cell taken from another animal. Before placing though, the DNA from the cell receiving it is removed.

An example of cloning, which made history in 1997, was when scientists successfully cloned a sheep. The new sheep's name was Dolly, and she was not born in the usual manner. Instead, she became an exact copy of her mother, similar to an identical twin. It would be nearly the same as taking the DNA from the son of a mother, placing the DNA in the egg cell of another woman, but first removing the woman's own DNA, and then allow the growth of the new cell in the woman. Nine months later there would be an exact copy of the mother's son born to the woman.

In the case of cloning, a father is not needed. In the first successful cloning of an animal the DNA molecule had all of the information needed to create a clone, Dolly. The DNA molecules contains the genetic code, which is basically directions for the new offspring. Normally, a new organism gets half of this code from the father and the other half from the mother. When these two cells are joined together they divide millions of times and then grow into the millions of cells which form the body of the animal. Each cell of the body has a copy of the genetic code and all it would need is an egg cell to grow.

So with cloning one of those cells is used and then the cell is simply placed in to the egg cell of the carrier. In the sheep example, the carrier was a female sheep. For Dolly, a single cell was used from the udder of her mother. The DNA in her mother's cell was removed and then transferred to an egg cell of another sheep. About five months later Dolly was born without a father and a copy or clone of her mother.

Though no humans have ever been fully cloned, human embryos have been cloned. Currently it may not be taking place, but in the future it may happen, but today it is rare. In the movies about Jurassic Park, cloning took place to create the dinosaurs, though it was a fictional movie, much of the science behind the process can be real.



Though there are fully developed human clones, other fully developed animals have been cloned besides sheep. They include the rhesus monkey, pig, cattle, cat, rabbit, deer, horse, a few others, and of course mice. Cloning also involves many, many failed attempts before it becomes successful. For instance, Dolly the sheep was not born until after 276 failed attempts. The only true successful cloning takes place when identical twins are born, but they came from a father and a mother. The cloned animals may also experience health problems.

In summary, cloning is basically creating another organism without the father involved, and the clone is an exact copy of the mother with the same genetic code. However, if cloning ever became 100% successful, the clones may look alike, but it would not mean they would behave in the same way.

25. In what year did cloning first take place and make history?

- A: 1997
- B: 1987
- C: 1999
- D: 2002

26. Cloning is the process of taking DNA from an animal cell and then implant it into which kind of cell in another animal?

- A: DNA cell
- B: Skin cell
- C: Sperm cell
- D: Egg cell

27. What must first take place before implanting the DNA in the egg cell of the carrier for cloning?

- A: The father's DNA must be included
- B: The carrier's DNA must be removed
- C: The cells must be an exact match between the carrier and clone
- D: All of the above

28. Which of the following is considered the "directions" for a new offspring?

- A: Cells
- B: Sperm cell
- C: Genetic code
- D: Egg cell

29. Once the single cell was used from the udder of Dolly's mother, how much time passed before Dolly was born?

- A: 3 months
- B: 4 months
- C: 5 months
- D: 6 months

30. All of the following animals have been cloned at least one time EXCEPT:

- A: Pig and cattle
- B: Mice and rabbit
- C: Giraffe and elephant
- D: Human embryo and deer

# Big Bang Theory

The Big Bang Theory is an effort to explain what happened at the very beginning of our universe. Discoveries and physics have revealed beyond a reasonable doubt that the universe did have a beginning. Before that moment, there was nothing; during and after that moment there was something: our universe. The big bang theory is the endless, debatable conclusion to explain what happened after that moment.

According to standard theory, the universe sprang into existence as a singularity around 13.7 billion years ago. No one knows for sure what the exact definition of a singularity is, but is theorized as zones which defy the understanding of physics. These zones are thought to exist at the very core of black holes. Black holes are areas of intense gravitational pressure. The pressure is so intense that matter is believed to be produced through density. It is the zones of density that are called singularities. Our universe is thought to have begun as a small, hot, and infinitely dense something. We still are not certain where it came from or why it appeared.

After the initial appearance, it inflated, expanded and then cooled going from very small and hot to the size and temperature of our current universe. It continues daily to expand and cool as we reside within it. Just think, the universe, as a result of the big bang theory, leaves incredible creatures living on a unique planet circling a beautiful star clustered together with several hundred billion other stars in a galaxy soaring through the cosmos all of which lie inside of an expanding universe that began as a single moment that appeared out of nowhere for reasons unknown.

There are many misconceptions surrounding the Big Bang theory. For example, we tend to imagine a giant explosion. Experts however say that there was no explosion; there was, and continues to be an expansion. Rather than imagining a balloon popping and releasing its contents, imagine a balloon expanding: an extremely tiny balloon expanding to the size of our current universe.

Another misconception is that we tend to imagine the singularity as a little fireball appearing somewhere in space. According to the many experts however, space did not exist prior to the Big Bang. According to their calculations, time and space had a finite beginning that corresponded to the origin of matter and energy. The singularity did not appear in space; rather, space began inside of the singularity. Prior to the singularity, nothing existed, not space, time, matter, or energy - nothing. So where and in what did the singularity appear if not in space? We don't know. We don't know where it came from, why it is here, or even where it is. All we really know is that we are inside of it and at one time it didn't exist and neither did we.

If there is so much uncertainty about the existence of the Big Bang theory, what evidence supports such a theory? First of all, we are reasonably sure that the universe had a beginning. Secondly, galaxies appear to be moving away from us at speeds that are consistent with their distance from us. This supports the notion that the universe was once compact and is always expanding away from us. Finally, there are an abundance of light elements of helium and hydrogen that support the origin of the Big Bang Theory. When combined, there appears to be sufficient evidence to at least consider the Big Bang Theory as a plausible event 13 billion years ago.

The only thing we know for sure is that the universe had a beginning. The Big Bang Theory is the effort to explain what happened at the beginning of our universe. It may not be the only theory, but it remains as the most popular theory.

31. According to standard theory, the universe sprang into existence as a singularity around which of the following time?
- A: 13 billion years ago
  - B: 20 billion years ago
  - C: 25 billion years ago
  - D: 28 billion years ago
32. The Big Bang Theory is an effort to explain which of the following?
- A: The moment when light existed
  - B: The moment when the solar system expanded
  - C: The moment at the very beginning of the universe
  - D: The moment when space cooled off
33. After the initial appearance, all of the following occurred with the universe EXCEPT:
- A: Cooled
  - B: Inflated
  - C: Expanded
  - D: Exploded
34. All of the following support the evidence of a Big Bang Theory EXCEPT:
- A: We are reasonably sure that the universe had a beginning
  - B: Galaxies appear to be moving away from us
  - C: A cluster of stars appears in the universe periodically
  - D: There is an abundance of light elements in the universe
35. According to the many experts on the Big Bang Theory which of the following is TRUE?
- A: Prior to the Big Bang Theory space did not exist
  - B: Prior to the Big Bang Theory space existed
  - C: Prior to the Big Bang Theory light formed in space
  - D: Prior to the Big Bang Theory star began to cluster
36. No one knows for sure what the exact definition of a singularity is, but is theorized as zones which defy our understanding of physics. These zones are thought to exist at the very core of which of the following?
- A: Black holes
  - B: Black galaxies
  - C: Black nights
  - D: Black energy

## Puberty

One thing that every human being has in common is that they went through a process in their lives called puberty. Puberty is basically the period of human development during which physical growth and sexual maturation occurs in adolescents. The age when this occurs is different for everyone, but usually begins earlier for females than males. Before any changes occur physically, the brain

begins to do the work which will change a person from a child to an adult. However, simply going through puberty does not necessarily cause a person to start thinking and being as responsible as a typical adult.

In the brain there are two parts called the hypothalamus and the pituitary gland. They begin making a lot more of hormones including different growth hormones. The hormones then act upon other parts of a young person's body to prompt the changes in puberty to begin. Boys and girls have the hormones, but they act on different parts of the body.

The hormones are chemicals made by glands in the body to act on the different parts. An example is a hormone that acts on the bones. This hormone works by making the leg, foot, and arm bones grow longer. The different hormones travel through the bloodstream around your body doing different jobs.

For boys, there are hormones that work on their testes, to help make sperm, and adrenal glands (located next to the kidneys) to make androgens (sex hormones) such as testosterone.

For girls, the hormones work on their ovaries (where the stored eggs they had since birth are located), and also on their adrenal glands, where female sex hormones are made, estrogen and progesterone. Boys and girls have both male and female sex hormones; however, boys have more androgens and girls have more estrogens. The different levels are what makes the differences in a boy and girl's body.

However, a person is not fully sexually mature until two or three years after reaching full adult height, but girls can have a baby, and boys can father a child even when they are not fully physically mature.

All of this hormonal activity is the basis of puberty and for girls it can take place anywhere between the ages of 8 and 13, though it can be earlier or later. The first change usually takes place around 10 or 11. For boys it is a bit later, usually between ages 10 and 15, with the first changes usually occurring around 11 or 12. Everyone is different and the changes may take place earlier for some and later for others. This is normal.

Changes that take place for both boys and girls can include getting taller with bigger feet, change in body shape, mood changes, hair growing on arms, legs, under arms, and in the pubic area, sweating more, oilier skin along with pimples, and having sexual feelings. There are several other changes and everyone's experience can and usually is a little different.

The average age for a girl to finish growing is about seventeen, and for a boy it is about nineteen, but it can also end earlier or later. No two people are exactly the same.

In summary, puberty is the period of human development during which physical growth and sexual maturation occurs in adolescents. Since each person is different, the age at which puberty begins and ends may be different as well, which is completely normal. There are also many physical and emotional changes which take place, but it is a normal process of life which every adult of every age on Earth has experienced at one time in their life as well.

37. Which of the following ages is the time when puberty begins?

A: 8-9

B: 9-10

C: 11-12

D: Different for everyone

38. All of the following are sex hormones for boys or girls EXCEPT:

- A: Adrenalin
- B: Testosterone and Androgens
- C: Estrogen
- D: Progesterone

39. Which of the following is a CORRECT statement?

- A: Boys have only androgens, and girls have only estrogen and progesterone.
- B: Boys can have testosterone and androgen but not progesterone.
- C: Girls can have androgens but boys cannot have estrogen
- D: Both boys and girls have male and female sex hormones.

40. Which of the following sex hormones do boys have more of than girls?

- A: Estrogen
- B: Androgen
- C: Progesterone
- D: None of the above

41. Which of the following is NOT a change that may take place during puberty?

- A: Hair appearing in places
- B: Intelligence change
- C: Sexual feelings
- D: Sweating

42. The average ages for a girl and boy to finish growing is which of the following?

- A: Boys-17, girls-17
- B: Boys-17, girls-19
- C: Boys-19, girls-17
- D: Boys-19, girls-19

## Sound

Everything a person hears is called sound. Sound is a vibration or wave traveling through solids, liquids, or gases and can be heard. A sound begins by some type of mechanical movement which can include a person playing an instrument, a door slamming, or thunder in the sky. The molecules of these objects vibrate and in turn cause the surrounding molecules to vibrate, thus causing the sound to travel.

Without matter like a solid, liquid or gas, sound could not travel. It needs the vibration of molecules from the matter in order for there to be a sound that can be heard. Outer space is void of any objects and is a vacuum so there is no sound and it is very quiet. The solid, liquid, or gas that transports the sound is called a medium.

Next, the speed of sound is how fast the sound wave or the vibration travels through the object, medium, or matter. Depending on whether it is a solid, liquid, or gas, the sound will travel at different speeds. Sound will travel faster in water than in air, but much faster in steel.

The amount of moisture in the air will also affect the speed of sound. In dry air, sound will travel 768 miles per hour, but faster in water. At 768 mph, sound will travel one mile in 5 seconds through dry air, but four times faster in water, and 13 times faster through steel.

The term sound barrier is often heard when airplanes go faster than the speed of sound. When this happens, the plane breaks the sound barrier. They also create a sonic boom, which is a loud explosive-sounding noise that is caused by a number of sound waves that are forced together as the plane moves faster than sound.

Decibels are used to measure the loudness of sound. The more decibels the louder the sound. A whisper may only measure 15 to 20 decibels, but a jet engine may generate 150 decibels. Pain in the ears may occur if a person hears a sound measured at about 130 decibels, which can damage the ears or even cause a loss of hearing. This is why listening to loud music through headphones can be harmful.

Sound also includes a measurement called frequency. Frequency is related to the pitch of sound. For example, a thin guitar string that is plucked will vibrate faster and create a high sound or pitch. A thicker string will vibrate slowly and create a low sound or pitch. This is what leads to different musical notes.

Sound also helps humans talk and listen to each other. It is a very complex process and many parts of the body work together, but the vibration of vocal cords in the throat leads to sound. The mouth, tongue, and lungs also contribute to the sounds a human makes from their mouth.

Finally, acoustics is the study of sound and how it travels. Someone specializing in acoustics learns how sound moves, which is important when building auditoriums, theaters, and other types of buildings. In some places, like in a theater staging plays, it is important for sound to travel throughout the room, in a library however, it is more important to control the sound and prevent it from traveling. Using different materials on the walls or ceilings will help regulate the movement of sound waves.

In summary, sound is a vibration or wave traveling through solids, liquids, or gases and can be heard. Sound travels at different speeds depending on the medium that the sound wave travels through. The loudness of sound is measured in decibels and the pitch of sound is related to frequency. The study of sound and its movement is called acoustics.

43. Which of the following is a loud explosion that is caused by a number of sound waves that are forced together?

- A: Sound barrier
- B: Sonic boom
- C: Frequency
- D: Decibel

44. Which of the following is used to measure the loudness of sound?

- A: Acoustics
- B: Sonic boom
- C: Frequency
- D: Decibel

45. Which of the following measurement of sound would begin to cause damage to the human ear?

- A: 130
- B: 20

C: 150  
D: 768

46. If a person wanted to build a movie room in their home, they may want to call an expert in which of the following?

- A: Frequency
- B: Decibels
- C: Mediums
- D: Acoustics

## Optical Illusions in the sky

When looking up into the sky there are many things people see that be explained through science. Some of the sights in the sky that can be explained by science include the blue color of the sky, rainbows, auroras, and a blue moon.

The atmosphere of the Earth is like a very thin blanket in which the sun's rays pass through at different angles. The sun shines white and black light to our planet through the atmosphere. The white light has all the different colors in it. In the upper atmosphere, there are dust particles and oxygen molecules. The white light, which includes all the colors of a rainbow, shines through the upper levels of the atmosphere. The blue light then scatters across the entire planet. That is why the sky is blue. It does not reflect off the ocean water like some people believe. The sky is blue because of how the sun's rays pass through the atmosphere of the Earth.

Rainbows are beautiful rays of color. Even though the sunlight looks white or yellow, it is really made up of different colors...red, orange, yellow, green, blue, indigo, and violet. The sun makes rainbows when white sunlight passes through rain drops. The raindrops then act like tiny prisms. They bend the different colors in white light, so the light spreads out into a band of colors that can be reflected back as a rainbow in the sky.

Three things must take place before someone can see a rainbow. It must be raining. Next, the sun must be shining. Finally, the observer must be standing between the sun and the rain. The lower the sun is in the sky, the higher the arc of a rainbow will be. One of the ways to remember the colors of the rainbow is by using the first letters in a name: ROY G. BIV, which is red, orange, yellow, green, blue, indigo, and violet.

Auroras are the result of interactions between the Sun and Earth's outer atmosphere. They occur in response to energetic particles from a solar storm, which cause the gases of the thin upper atmosphere to glow. A solar storm is a type of large explosion in the sun's atmosphere. The auroras take place at heights between 50 to 100 miles above the Earth. The aurora can last anywhere between a few minutes to several hours. The various colors are caused by some of the gases in the atmosphere. One example of an aurora on Earth is the Northern Lights, also called the Aurora Borealis.

A blue moon is usually referred to as a second full moon in the same month. It happens every 2.7 years and never in the month of February because there are not enough days. The moon is not necessarily blue. Blue moons can occur though, but they can occur at any time of the year. If there is a volcanic eruption or even a forest fire, the smoke in the sky can make the moon look blue.

In summary there are several optical illusions in the sky that can be explained by science. The blue color of the sky, rainbows, auroras, and blue moons all occur due to the interaction between the

sun, the Earth's atmosphere, and other variables such as rain, smoke, or particles in the air. The Northern Lights is an aurora which is caused by a solar storm in the Sun's atmosphere. All of these optical illusions give off beautiful colors and can be seen for miles. All of it, though, can also be explained by science.

47. Which of the following shows the colors of the rainbow in order?

- A: violet, red, orange, green, yellow, blue, indigo
- B: red, orange, yellow, green, blue, indigo, violet
- C: red, blue, orange, yellow, green, indigo, violet
- D: green, indigo, blue, red, orange, violet, yellow

48. Which of the following is like a very thin blanket in which the sun's rays pass through at different angles?

- A: Aurora
- B: Rainbow
- C: Atmosphere
- D: Solar storm

49. Why is the sky blue?

- A: The reflection of the sun's rays off the ocean
- B: The sunlight causes our eyes to see blue and no other color
- C: How the sun's rays pass through the atmosphere of the Earth
- D: How the sun's rays react to a solar storm

50. A solar storm is taking place during which of the following?

- A: Rainbow
- B: Blue moon
- C: Aurora
- D: Rain

## Key

- 1. A
- 2. B
- 3. A
- 4. C
- 5. D
- 6. A
- 7. C
- 8. A
- 9. B
- 10. A
- 11. D
- 12. A
- 13. A
- 14. C
- 15. D
- 16. B
- 17. C



- 18. D
- 19. A
- 20. B
- 21. B
- 22. A
- 23. D
- 24. B
- 25. A
- 26. D
- 27. B
- 28. C
- 29. B
- 30. C
- 31. A
- 32. C
- 33. D
- 34. C
- 35. A
- 36. A
- 37. D
- 38. A
- 39. D
- 40. B
- 41. B
- 42. C
- 43. B
- 44. D
- 45. A
- 46. D
- 47. B
- 48. C
- 49. D
- 50. C