Team Name:_____ **Score:**_____/

Team Number:_____ **Rank:**_____

California Central Valley Science Olympiad

Edison High School

Directions: This exam consists of 20 stations, each based on different aspects of the Fossils Science Olympiad event. Each Station has an overarching theme which can play to the advantage of well-reasoned teams and can be used to make well time deductions. Each station will last for 2:00 minutes.

Directions for Proctor: This exam is often taken in a room of 20 seats, stationed in a 4x5 row-major order, and listed based on what is convenient for movement and snaking backwards. For example, the first row of seats (closest to the "front" of the room where the proctors time each station) would be labeled from West to East numerically (1-5) and the station immediately behind the fifth station would be labeled as "6". In this manner, students can snake around the classroom without moving too far save having to move from station "20" to "1".

Answer Sheet: Each station is numbered on the answer sheet. Do NOT start on the first station if you are not seated at the appropriate station. You will receive no credit for answers written on the wrong station even if they are correct. If the right answer is not in the right place, it is of no use. Some stations will have labeled items. It is your job to know whether or not to write a specimen name or specimen/item label. For example, if a question provides a carcharodon tooth with a label "A" and asks for the label of a carcharodon sample, writing the animal's name or the word "tooth" would be marked as incorrect as they would be inappropriate responses. Some questions are in fact write-in and may have multiple answers as some items go by multiple scientific names. No extra points will be given for providing more than one correct answer.

For any questions or concerns, please email scienceolympiadedison@gmail.com!

Station 1:

Both samples are part of which…

1) *Phylum?*
2) *Class?*

For Sample [A], please provide the...

3) *Order*
4) *Genus*

For Sample [B], please provide the...

5) *Subclass*

6) Despite being closely related, only sample _____ is still alive today.

7) Despite being closely related, sample _____ appeared first.

8) Fill in the box on the answer sheet.

Station 2:

1) All three samples are part of which Phylum?

For Sample [A] provide the…

2) *Subclass*
3) *Order*
4) *Genus*

For Sample [B] provide the…

5) *Class*
6) *Genus*

For Sample [C] provide the…

7) *Subclass*
8) *Genus*

9) All three samples share what habitat?

10) All three samples share what mode of nutrition?

11) *Of the three samples, sample ____ has intricate suture patterns.*

12) *Sample [C] has a long narrow chamber used for mobility, what is this chamber called?*

Station 3:

The decay of a Plutonium-239 isotope is modeled in graph [A]. Though you are not allowed to use a calculator on this exam, the equation for the graph is provided in figure [B]. Use this information to answer the following questions:

1) *What is the half-life of Plutonium-239?*

*2) If there are 50 grams of **any element**, how many grams would (approximately) be left after three half-lives?*

3) What percentage of the original Plutonium-239 isotope would be left after 48,000 years?

4) What percentage of the original Plutonium-239 isotope would be left after 96,000 years?

5) Graph [C] and figure [D] provide info regarding the radiometric decay of Carbon-14. Given this information, what is the half life of Carbon-14?

6) If there is a controlled system which starts with 800 grams of Carbon-14 and 100 grams of Plutonium-239, how many grams of Carbon and Plutonium would there be when the quantities equal one another for the first time? (Hint: It will take exactly 24,000 years)

Station 4:

All of these creatures are part of…

1) *Phylum*
2) *Subphylum*

3) All creatures within this subphylum share what common attributes (one per line)?

4) All creatures on this list except _____ (letter) are part of which clade?

5) What clade is this creature a part of?

6) Modern descendants of this creature can be found in which class?

7) Modern descendants of the other three creatures can be found in which class?

Creature [A] is part of…

8) *Order*
9) *Genus*

Creature [B] is part of…

10) *Order*

11) What does creature [B]'s name mean?

12) Creature [C] is part of which genus?

13) The creature from the previous question is most closely related to genus?

14) Creature [D] is part of order?

15) Creature [D] is most closely related to which genus?

Station 5:

For sample [A] provide the...

1) *Class*
2) *Genus*

For sample [B] provide the…

3) *Order*
4) *Genus*

5) Sample [B] had how many fingers on each "hand"?

For sample [C] provide the…

6) *Class*
7) *Genus*

8) Sample _____ is the finger of a prehistoric animal,
9) ...it was adapted for the purpose of…

10) The aforementioned sample likely shares the reason for its adaptation with sample _____, but they had one fundamental difference.

11) What is this difference?

12) True or false (circle the appropriate response), all of these creatures, at some point in prehistory, lived during the same period.

All of these creatures are state fossils. Which U.S. state does…

13) *Sample [A] represent?*
14) *Sample [B] represent?*
15) *Sample [C] represent?*

Station 6:

For sample [A] provide the…

1) *Kingdom*
2) *Mode of preservation*

*3) What is a common method for measuring the age of a **living or recently deceased** sample of this entity?*

*4) What is a common method for measuring the age of a **fossilized** sample of this entity?*

For sample [B] provide the…

5) *Phylum*
6) *Superclass*
7) *Class*

8) This animal is preserved in which form of sediment?

Say that your paleontological group discovered this sample and knows the ages of the rock layers above and below it.

9) *Using this information, the age of the sample can be determined using…*

10) If you were able to determine the exact age of the rock the sample is in, you would be able to use what method to determine the sample's age?

11) On which of the following sites would this specimen most likely to be discovered (shade the appropriate box)?

☐ *Mazon Creek*
☐ *Yixian Formation*
☐ *Beecher's Trilobite Bed*
☐ *Green River Formation*

12) Sample [C] is an element that is commonly associated with a mode of mineral replacement known as…

13) There are also other elements and minerals which can partake in replacement, such as (provide two responses)...

Station 7:

All samples shown are part of which…

1) *Phylum?*
2) *Class?*

3) Sample [B] is part of what genus?

Below is a diagram of the body parts which make up one of the creatures from the class above.

4) Identify the genus of the creature in the diagram...

5) ...and then label each of its body parts in the boxes provided.

6) Creatures in this class predominantly fall into what two feeder types?

7) Which adaptation did these creatures have as evidence of these feeder types (a specific body part not indicated above)?

8) What mode of life best suites these creatures?

9) Most creatures in this class had an eye similar to modern flies, which have thousands of lenses known as ommatidia packed together to allow for a wider range of visibility, what is this eye called?

10) This specific class of creatures was wiped out in a massive extinction level event known as the…

11) This major event had multiple causes, provide one of those causes.

12) All three of these creatures are preserved in what rock?

Station 8:

All samples shown are part of which…

1) *Phylum?*
2) *Subphylum?*
3) *Class?*
4) *Family?*

5) What advantages did the bone structure seen in sample [B] provide to this creature?

*6) In the past decade, a large discovery has been made regarding the shape and function of what part of this creature's body? (*Hint* the incorrect version of this body part was modeled after that of modern whales.)*

7) An index fossil exhibits what quality that makes it so useful? What can this quality be used for?

8) Are these samples considered index fossils?

9) If a rock is found with one of these samples, about how old could the rock layer be?

10) What does the name of this creature mean?

Station 9:

1) All specimens here belong to what class?

Identify the genus…

2) *Specimen [A].*
3) *Specimen [B].*
4) *Specimen [C].*

5) What does the name of specimen [B] mean?

6) Why are the teeth of specimen [B] have their distinct shape?

7) Specimen [A] has a common ancestor of genus…

8) Specimen [A] once inhabited North America, but went missing and was reintroduced how?

9) True or false (circle the appropriate response), all of these creatures, at some point in prehistory, lived during the same period.

Station 10:

All fossils in this set belong to…

1) *Class*
2) *Superorder*

3) For sample [A], provide the feeder type.

4) For sample [B], provide the genus.

5) True or false (circle the appropriate response), all genuses within the aforementioned superorder are extant.

6) What is the largest known species within this superorder?

7) True or false (circle the appropriate response), this species has existed simultaneously with Homo Sapiens.

8) Describe one advantage all creatures within this class have.

9) Provide the most common mode of life among creatures in this class.

10) Explain why teeth are the most common and often only remains of creatures within this class.

Station 11:

1) Both samples [A] and [B] are known as trace fossils, specifically, they are…

2) What does this mean?

3) What insight can these fossils grant us regarding the habits of these living creatures?

Sample [C] is part of which…

4) *Clade?*
5) *Order?*

6) If samples [A] and [B] are linked to a sauropod, what can be assumed of their composition?

7) Based on your answer to the previous question, sauropods had what in common with most Ornithischians?

8) Many sauropods have been found with rounded rocks in the remains, particularly within their ribcage, even when they are found away from the site of any water source. What are these rocks called?

9) What purpose do they serve?

*10) Most mammals have what adaptation for this said purpose (*hint* think of human anatomy)?*

Station 12:

Sample [A] is part of what…

1) *Phylum?*
2) *Class?*
3) *Genus?*

Sample [B] is part of what…

4) *Phylum?*
5) *Class?*

6) What is a defining adaptation of all creatures within this class?

7) Which feeder type most closely describes fossil [B]'s lifestyle?

☐ *Filter feeder*

☐ *Predator/Carnivore*

☐ *Autotrophic*

☐ *Grazing/Consumer*

8) Which most closely describes fossil [A]'s lifestyle?

☐ *Nektonic*

☐ *Benthic Infaunal*

☐ *Pelagic*

☐ *Sessile*

9) Both of these creatures are extant, but sample ____ appeared during the Jurassic.

10) Both classes survived multiple extinction level-events. Which advantages did these specific creatures and their habitats have that allowed them to survive (name one)?

11) True or false (circle the appropriate response), sample [a] is a common fossil.

Station 13:

1) Which letter indicates an unconformity?

2) Which letter indicates a fault?

3) Which law assures that layer "A" is younger than layer "B"?

4) Which letter indicates an intrusion?

5) Which is older, the fault or the intrusion?

6) By what law?

7) Despite having a distinct curvature, layers "J"," H"," I", and "G" were once level as layers "A" and "B" are. This statement is supported by what law?

8) What is a naturally occurring event which could have given the aforementioned layers their curvature?

9) By letter, label all of the layers from oldest to youngest.

Station 14:

Sample [A] was likely created by a creature in…

1) *Class*
2) *Genus*

3) What purpose was this sample likely use for?

4) Creatures in this genus have origins traced to which continent?

5) Around 30,000 years ago, animals within this genus migrated across a land bridge known as the Bering Strait hunting what animal?

6) What lifestyle does this practice indicate?

☐ *Nomadic lifestyle*

☐ *Sedentary lifestyle*

☐ *Tribal lifestyle*

☐ *Warrior lifestyle*

7) Knowing this information, these creatures were likely:

☐ *Autotrophs*

☐ *Omnivores*

☐ *Herbivores*

☐ *Filter Feeders*

8) Image [B] shows the skull of species homo sapiens, which are currently alive today (taking this test)! A species within the same genus that went extinct was…

9) What adaptation of the skull allowed homo sapiens to survive as opposed to this other species?

Station 15:

1) Samples [A] and [B] are evidence of what sort of natural disaster?

2) This disaster is seen as the main cause of what major extinction?

3) Which clade went extinct in this event?

4) Where on the planet did this disaster likely occur?

5) This disaster had multiple effects, which was **NOT** *one of them?*

☐ *The obscurance of the atmosphere by ash*

☐ *The immediate destruction of multiple habitats*

☐ *The suffocation of many breathing creatures*

☐ *The elimination of most small mammals*

6) True or false (circle the appropriate response), this event led to the extinction of over 97% of animal species.

7) Despite many genuses, particularly mammals, going extinct following end of the Eocene, this is not characterized as a major extinction. Explain why.

8) Of the five major extinctions, in which did Graptolites go extinct?

9) Coelophysis went extinct during what major extinction event?

10)What is unique about the causes of the extinction event identified in the previous question?

Station 16:

1) Samples [A] is a trace fossil, specifically…

2) Mold [E] depicts a sample from kingdom…

For sample [D] provide the…

3) *Phylum*

4) This sample is a/an _____, meaning that it's seeds are enclosed in an ovary.

Image [B] shows an animal of what…

5) *Phylum?*

6) *Class?*

7) This animal secretes a mucus that traces its path, as seen in image [C]. What is this path called?

8) On which of the following sites would sample [D] likely be preserved (shade the appropriate box)?

☐ *Ghost Ranch*

☐ *Yixian Formation*

☐ *LaBrea Tar Pits*

☐ *Green River Formation*

Station 17:

Samples [A] is part of what…

1) *Phylum?*
2) *Genus?*

Sample [B] is part of what…

3) *Phylum?*
4) *Genus?*

5) Of the two samples, sample ____ is a gymnosperm.

6) Meaning what?

7) Sample [A] only has a single living species today, what is this species?

8) What is one place where this species can be found?

9) What is a living fossil?

10) Is sample [B] a living fossil, why or why not?

11) Of the following, which **two** *creatures on the Science Olympiad do* ***NOT*** *meet the criteria of a "living fossil"?*

☐ *Archaeopteryx*

☐ *Hydnoceras*

☐ *Coelacanthiformes*

☐ *Tiktaalik*

12) Despite not being "living fossils" these creatures provide what important information about the fossil record?

Station 18:

For the creature featured in the logo on the cover, please provide the…

1) *Phylum*
2) *Order*
3) *Mode of Life*
4) *Mode of Nutrition*

5) This creature is the state fossil for the state of…

6) True or false (circle the appropriate response), animals of this phylum were the first land animals.

7) Describe the breathing mechanism of this creature.

8) Provide the common name for creatures of this order.

9) Explain why this name is misleading.

Station 19:

1) All three images show creatures of what phylum?

4) Specimen [A] is part of what genus?

For specimen [B], provide the…

3) *Class*
4) *Genus*

5) Specimen [B] goes by what common name?

6) Specimen [B] likely used its beak for what purpose?

For specimen [C], provide the…

7) *Order*
8) *Genus*

9) Specimen [C] likely used its horns for what?

10) Order these creatures by letter from most ancient to most recent based on the geologic time scale.

11) The animal in image [A] went extinct in what major extinction event?

12) What was the "beak" of the animal in image [A] used for?

Station 20:

For sample [A] provide the…

1) *Phylum*
2) *Class*
3) *Order*

For sample [B] provide the…

4) *Phylum*
5) *Clade*
6) *Class*
7) *Genus*

8) True or false, specimen [A] is often misappropriated in mass media as being in the same clade as specimen [B].

9) Specimen [B] had a diet primarily composed of what animal?

10) Said animal was likely in what class?

11) Sample [B] connects what two major groups of animals?

12) The sample in image [B] is an excerpt from books by Paul Chambers and Christian Foth. At which site would this fossil likely have been photographed?

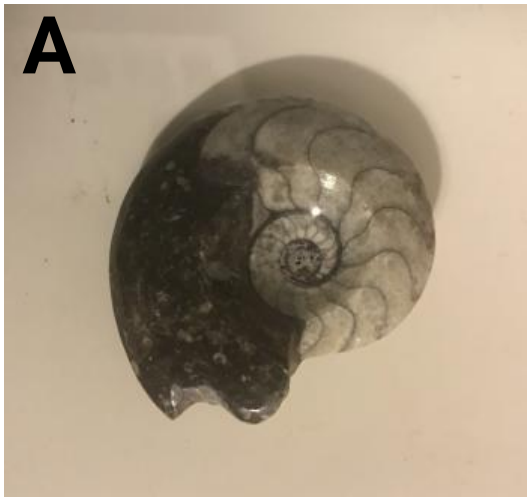
☐ *Solnhofen Limestone*
☐ *Burgess Shale*
☐ *Beecher's Trilobite Bed*
☐ *Yixian Formation*

California Central Valley

Science Olympiad

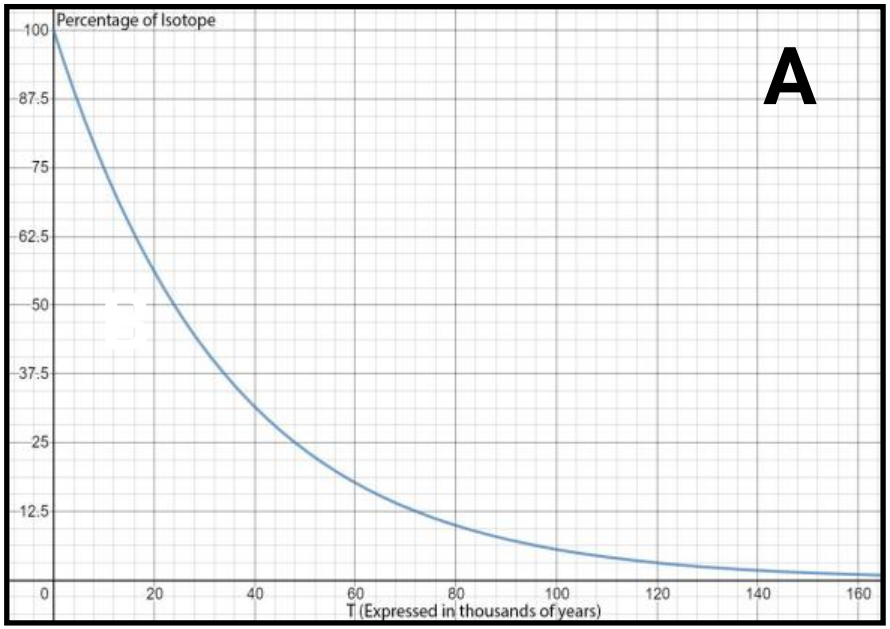
Edison High School

Station 1



Station 2

Station 3



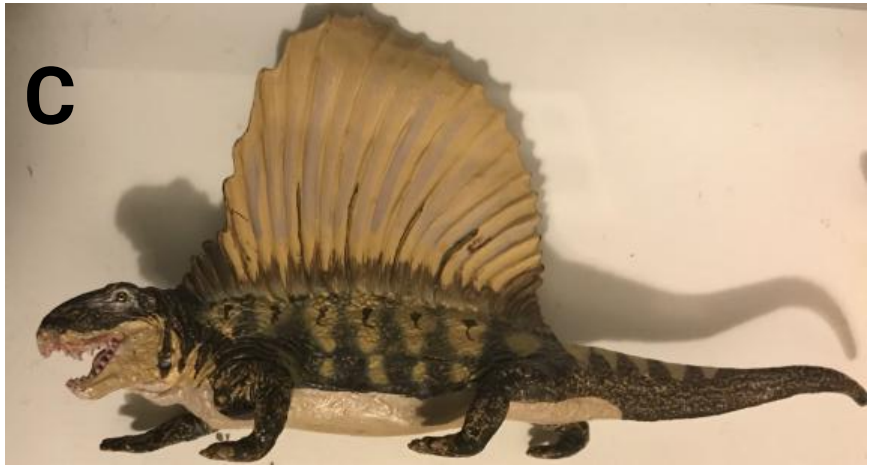
A

C

B $N(t)=N(0)e^{\frac{-0.693t}{24}}$

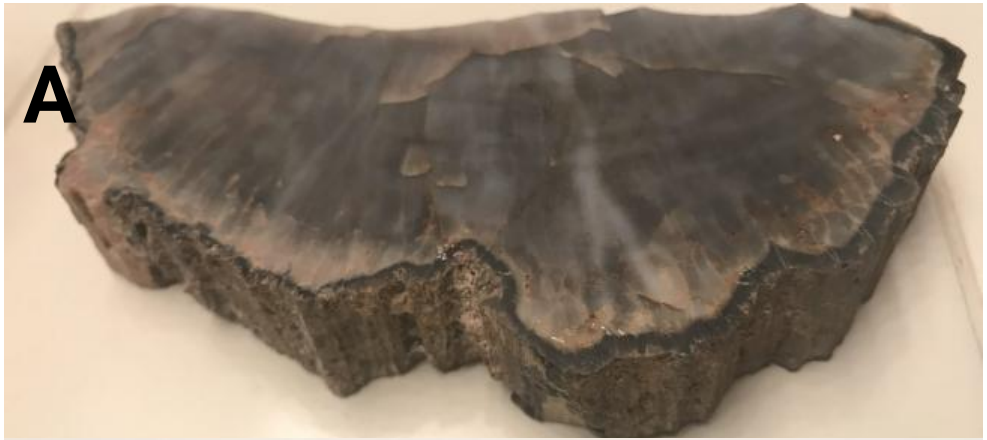
D $N(t)=N(0)e^{\frac{-0.693t}{6}}$

Station 4



Station 5

Station 6

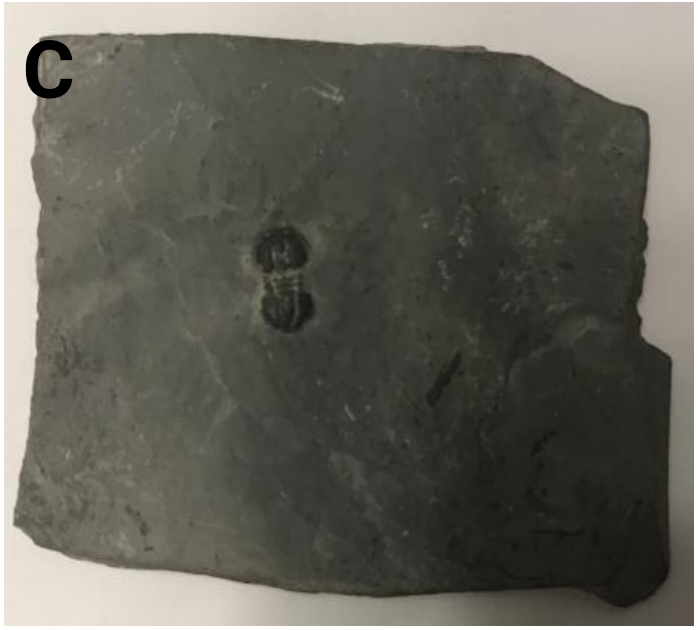


Station 7

A

B

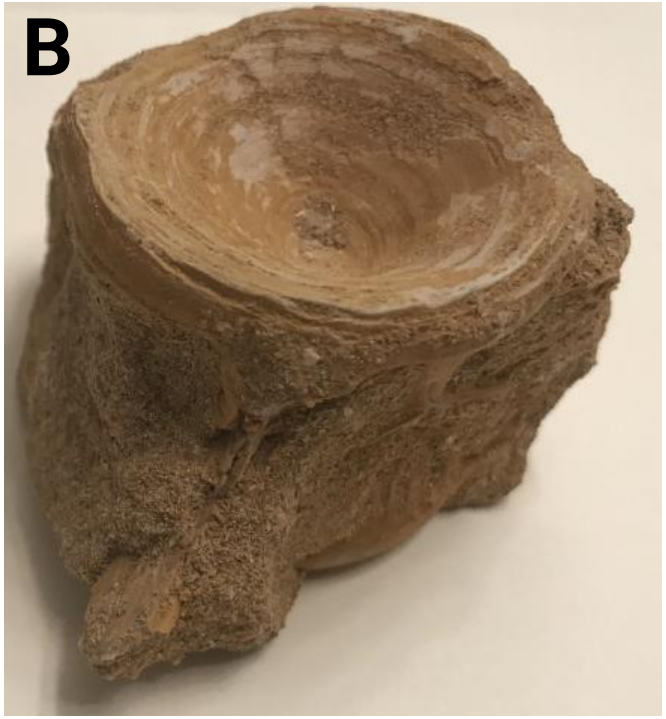
C



Station 8

A

B

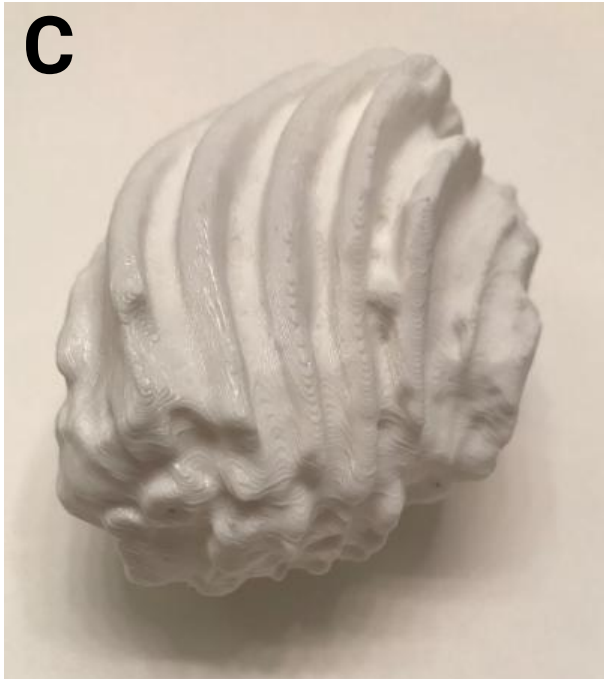


Station 9

A

B

C



Station 10

A

B

Station 11

A

B

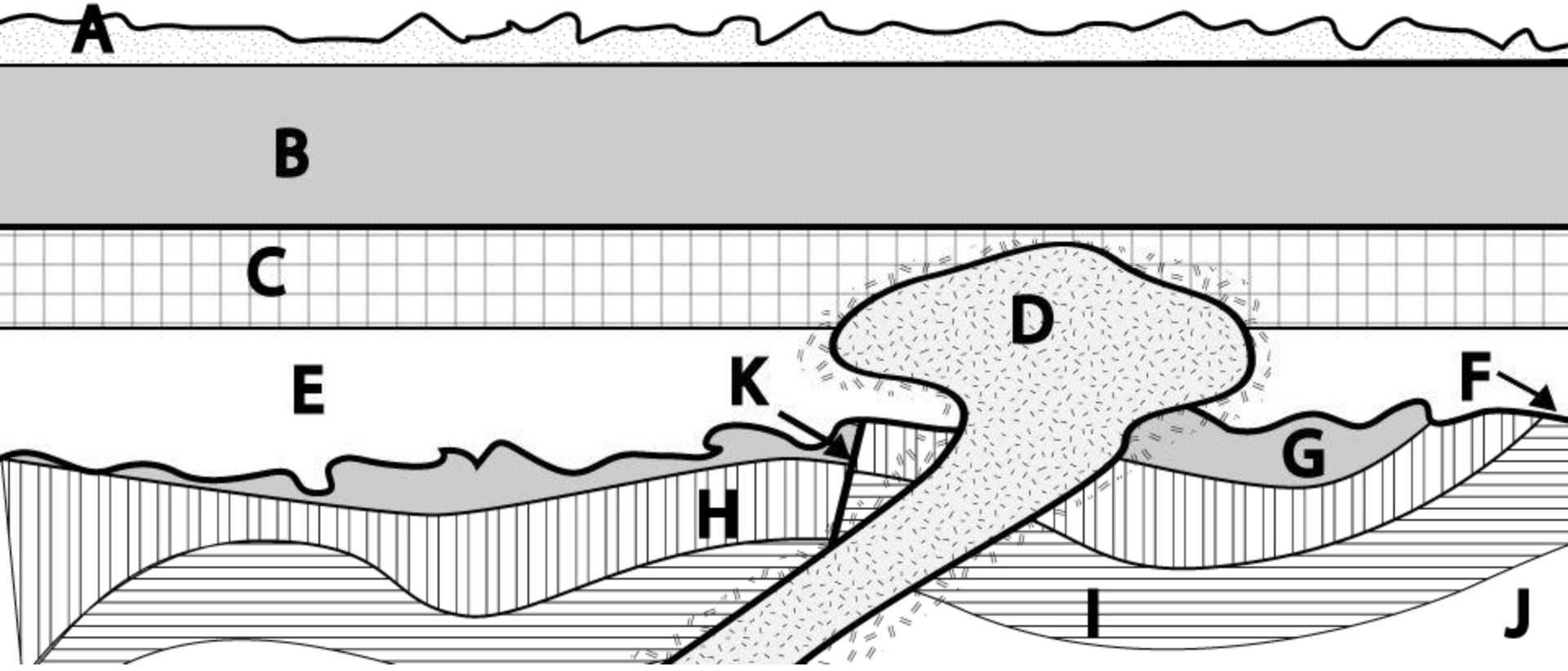
C

Station 12

A

B

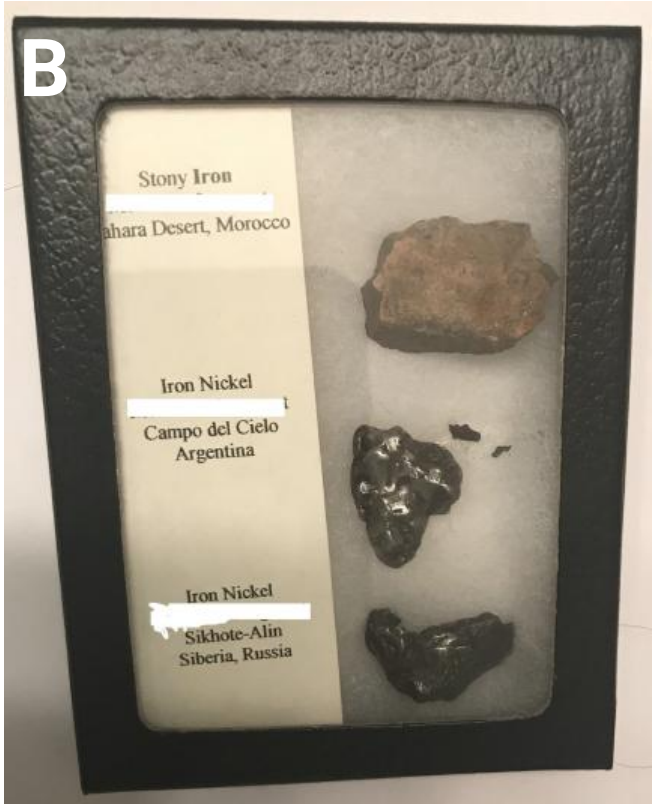
Station 13



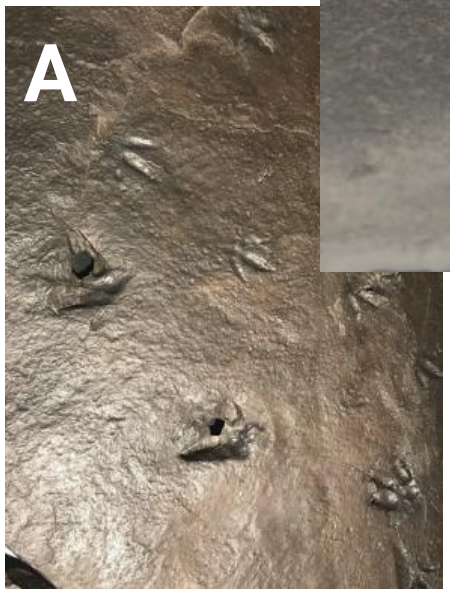
Station 14

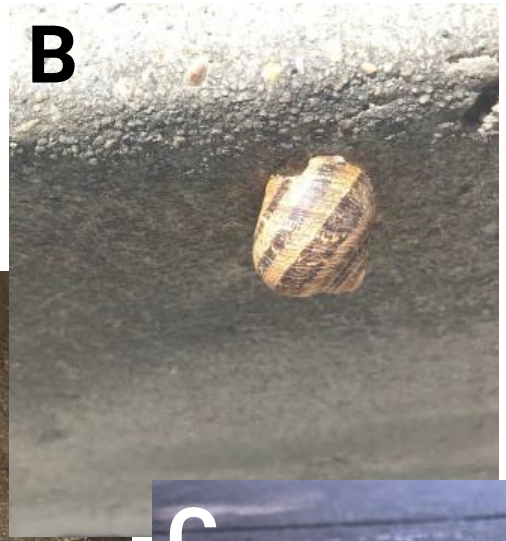
Station 15

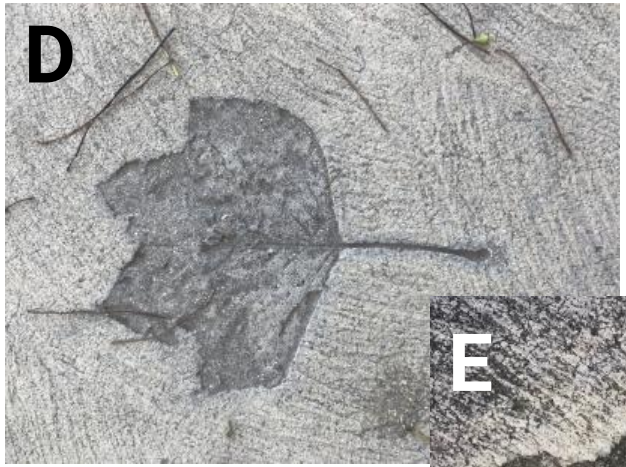
(Of extraterrestrial origin)

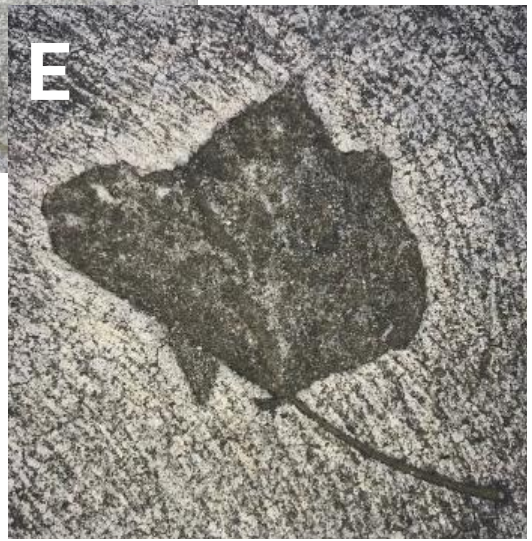


Station 16

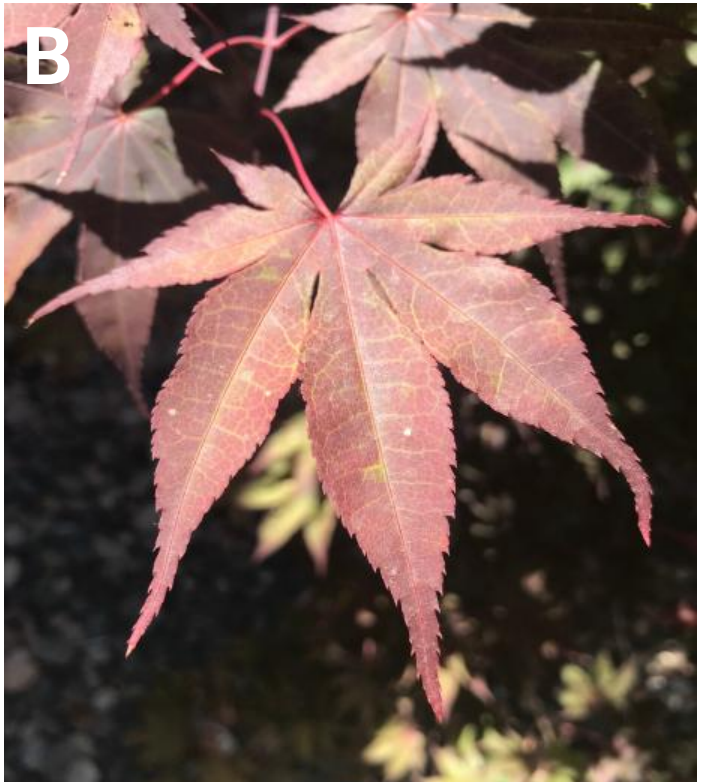








Station 17



Station 19

Credit to the Office of Engineering and Outreach at the Massachusetts Institute of Technology

Station 20

Credit to Paul Chambers and Christian Foth
Chambers, P. (2002). Bones of Contention.