Evidence for Evolution

Station 1 – Natural Selection

1. What is natural selection? *Natural selection is a process by which organisms that are better adapted to their environment can survive and reproduce more often.*

2. Which color of moth survived better in the country? *The green moths*

3. Which color of moth survived better in the city? *The gray moths*

4. How was the environment in the city different from the environment in the country?
   - The primary colors of the two environments were different. The city had more gray colors, and the country had more green colors in it.

5. Does this evidence support the theory of evolution or go against it? Why?
   - This evidence supports the theory of evolution because it shows that the favorable traits of a population will help the species survive more. For example being a green moth in the green country will allow the moth to survive and reproduce more.

Station 2 – Fossils

6. What is a fossil? *A fossil is the remains or impression of an organism that lived 10,000 years ago or more.*

7. Name the six ways that material from a once-living animal can be preserved as a fossil.
   - 1) Freezing
   - 2) Drying
   - 3) Tar pits
   - 4) Amber
   - 5) Carbonization
   - 6) Permineralization

8. How old are the fossils that are pulled out of the La Brea Tar Pits? *Between 10,000 and 40,000 years old*

9. How do fossils provide evidence for evolution?
   - Fossils provide evidence for evolution because scientists can compare the organism’s bodies from long ago to organisms of today. The scientists can see the gradual changes that have happened over time.

Station 3 – Anatomy

10. What is anatomy?
    - *Anatomy is the study the structure and organization of living things*

11. How does anatomy provide evidence for evolution?
    - Anatomy provides evidence for evolution because scientists can compare the structure and organization of different organisms to hypothesize how closely related they are to each other.
12. What are **homologous structures**? **Homologous structures** are structures in two different species that evolved from a common ancestor.

   Example: The types of bones in the arms of penguins, alligators, bats, and humans

13. What are analogous structures? **Analogous structures** have the same function but did NOT evolve from a common ancestor.

   Example: The dragonfly and the bird pictured below both use wings to fly, but the internal structure of the wings (the way they develop and are built) are very different.

14. What is a vestigial structure? A **vestigial structure** is a structure that has lost all or most of its original function over a long period of time.

   Example: Vestigial pelvic bones in whales.

**Station 4 – Embryology**

15. Embryology is the study of the embryo – an unborn offspring in the process of development.

16. What **differences** can you find between the human, turtle and dolphin embryos?

   **Big differences are the size of the eyes and the size of the head/brain.**

17. What **similarities** can you find between the human, turtle and dolphin embryos?

   **Big similarities are the overall shape (“C” shape), the eye is very visible, etc…**

18. How does embryology provide evidence for evolution?

   **Embryos give evidence for evolution because many different kinds of organisms have embryos that look alike, suggesting that they all evolved from a common ancestor millions of years ago.**

**Station 5 – Biochemistry**

19. Why is **biochemistry** considered the **most powerful source** of evidence for evolution?
DNA evidence is the most powerful evidence for evolution because scientists can use frequency of DNA mutations to quantify how recently two organisms had a common ancestor.

20. Look at the chart at this station. We can see that a particular section of human’s and chimpanzee’s DNA matches up 98% of the time, while human’s and chicken’s DNA matches up only 10% of the time. What does this suggest to scientists about how similar organisms look and the similarities in their DNA?

This suggests that organisms that the more two organisms look alike, the more similar their DNA is.

21. Imagine that you are a biochemist examining a species you recently found in the middle of Boston. This creature is pictured below. You test the organism’s DNA and you find that a certain section matches up with human DNA 15% of the time. Based on what you learned at this station, do you think that it this organism shares a recent common ancestor with humans? **YES** or **NO**

Explain why or why not: This organism probably doesn’t share a recent common ancestor with humans because their DNA is so different from human DNA.
Natural selection is a process by which organisms better adapted to their environment can survive and reproduce more often. Read about the situation below to learn about an example of natural selection.

Two species of moths were introduced once into a city environment and again into a country environment. One species of moth was gray and the other species of moth was green. Both environments have birds that eat the moths as their main source of food. The two environments are pictured below.

City

Country
The survival rate for the two moth populations is shown in the graph below:
STATION 2 -- FOSSILS

A **fossil** is the remains or impression of an organism that lived 10,000 years ago or more.

So how are fossils formed anyway? There are several processes that plants and animals or their parts can be preserved. No matter which way preservation occurs it takes a lot of luck. The following is a list with descriptions answering the question “How are fossils Formed?”

**How are fossils formed?**

1. **Freezing**- There have been remarkable discoveries of mammoth and wooly rhinoceros found in ice from Alaska and Siberia. Specimens with flesh, skin, and hair intact have been found. Some of these finds suggest that they were flash frozen, with food still in the mouth and stomach.

![Mammoth Image]

2. **Drying**- Mummified bodies of animals including humans have been discovered in arid parts of the world. The soft tissues including skin and organs are preserved for thousands of years because they are completely dried out.

![Lion Image]
3. **Tar pits** - In what is now downtown Los Angeles lies a 23 acre park called The La Brea Tar Pits, officially Hancock Park. Within the park are over 100 pits filled with sticky asphalt or tar. The pits are famous for the number and high quality of fossils that have been pulled from the pits. The fossils date between 10 and 40 thousand years old. Asphalt is an excellent preservative. Bones, teeth, shells, the exoskeletons of insects, and even some plant seeds have been pulled from the pits.

**Fossilized saber-toothed tiger**

[Image of fossilized saber-toothed tiger]

[Image of what scientists believe the saber-toothed tiger looked like]

[Image of tar]
Tar pit

4. **Amber**- Insects, spiders, and even small lizards have been found, nearly perfectly preserved in amber. Picture this!! A fly lands on a tree branch near the ocean. While looking for food it steps in sticky sap from a tree. As the fly struggles to escape it becomes more and more covered in the sap until it is completely engulfed and suffocates. The tree eventually dies and falls into the swampy water it grew in. Over the course of millions of years the sap hardens with our fly inside. The sap becomes so hard, that it eventually turns into amber and the ancient fly is preserved.

5. **Carbonization**- In this process of fossilization plant leaves, some soft body parts of fish, reptiles, and marine invertebrates decompose leaving behind only the carbon (an element that makes up the matter of all living things). This carbon creates an impression in the rock outlining the fossil, sometimes with great detail.

6. **Permineralization**- This is the most common method of fossil preservation. Minerals fill the cellular spaces and crystallize. The shape of the original plant or animal is preserved as rock. Sometimes the original
material is dissolved away leaving the form and structure but none of the organic material remains.

**STATION 3 -- ANATOMY**

*Anatomy* is the study the structure and organization of living things.

Anatomy provides evidence for evolution because **scientists can compare the structure and organization of different organisms to hypothesize how closely related they are to each other.**

**Homologous structures** are structures in two different species that evolved from a common ancestor. They can be similar in the way they are put together, in function (what they do), or in both.

*Example: The types of bones in the arms of penguins, alligators, bats, and humans are all the same, but have different shapes and uses.*
Analogous structures have the same function but did not evolve from a common ancestor. These are also evidence for evolution because they show that two organisms that came from different ancestors, but when placed in the same environment, they can evolve the same adaptations.

Example: The dragonfly and the bird pictured below both use wings to fly, but the internal structure of the wings (the way they develop and are built) are very different.
A **vestigial structure** is a structure that has lost all or most of its original function over a long period of time.

*Example: Vestigial pelvic bones in whales. These whales no longer walk with legs, but still have the hip bones needed to support legs.*

The image on the right shows the way that scientists believe whales evolved from an ancient walking ancestor.

**STATION 4 --- EMBRYOLOGY**

**Embryology** is the study of the **embryo** – an unborn offspring in the process of development. Embryos give evidence for evolution because **many different kinds of organisms have embryos that look alike, suggesting that they all evolved from a common ancestor millions of years ago.**
Biochemistry is the study of small molecules that make up the body. An example of an important biochemical structure in the body is DNA (deoxyribonucleic acid). DNA is the information center of the human body and carries important genetic information throughout life.

Biochemistry provides evidence for evolution because all organisms use DNA to function and survive. This fact has influenced scientists to think that all organisms came from the same ancestor.

It is thought that the more similar organism’s DNA sequences are, the more closely related the organisms are to each other. Today, DNA evidence is the most powerful evidence for evolution because scientists can use frequency of DNA mutations to quantify how recently two organisms had a common ancestor.
# DNA Comparisons between Humans and other Species

<table>
<thead>
<tr>
<th>Species</th>
<th>Percent DNA Binding</th>
</tr>
</thead>
<tbody>
<tr>
<td>Human</td>
<td>100</td>
</tr>
<tr>
<td>Chimpanzee</td>
<td>98</td>
</tr>
<tr>
<td>Gibbon</td>
<td>94</td>
</tr>
<tr>
<td>Rhesus monkey</td>
<td>88</td>
</tr>
<tr>
<td>Tarsier</td>
<td>65</td>
</tr>
<tr>
<td>Lemur</td>
<td>47</td>
</tr>
<tr>
<td>Mouse</td>
<td>21</td>
</tr>
<tr>
<td>Chicken</td>
<td>10</td>
</tr>
</tbody>
</table>

The table above shows the similarities between human DNA and the DNA for other organisms. The comparison was made using a small section of the DNA molecule.
New species found in Boston, MA

This new species was discovered to have only 15% DNA binding with human DNA.