

Appendix A

Interview Protocol October 2008

Key Words

When the student provides an answer containing any of these words, ask them to explain/define it:

- Evolution
- Trait
- Fossil
- Intelligent Design
- Theory
- Evolutionary Tree

Lead In 1: Evolutionary Theory and the Nature of Science

Today we'll be talking about ideas and evidence related to biological evolution. Much of what modern scientists think about evolution is based on research and writing done before 1900.

Here are two early claims by prominent British naturalists about where Earth's organisms came from. The first is from the 17th century: "...[O]ne species never springs from the seed of another."

The second claim is from the mid 1800's, and states: "...all the organic beings which have ever lived on this earth have descended from some one primordial form..."

Question 1: Can you explain in your own words the differences between these two claims?

Question 2: Which of the claims is more closely related to the theory of evolution by descent with modification?

Question 3: What does 'descent with modification' mean? Can you explain it in plain English?

Some people think that evolutionary biology is not a real science in the same way that microbiology or physics is. They argue that true science is based on making direct observations and testing predictions. If you can't directly observe the events happening, because they happened in the past or too far away, then you can't test predictions.

Question 4: In your day-to-day life, have you ever been able to figure out something that happened even though you weren't there to see it? If so, how did you do it?

Some research scientists may set up experiments in the laboratory or field site. By manipulating variables and observing events, they can determine the causes of patterns we see in this world.

Now, compare two other fields of research: cosmogony (the study of the origin of the universe) and evolutionary biology. In both cosmogony and evolutionary biology, some of the events that scientists study can't be directly observed—either because they happened in the past or because they take too long to watch.

Question 5: Can a cosmogonist or an evolutionary biologist make testable predictions about events they can't see directly?

A [Student answers, "Yes"]: How are they able to make testable predictions when they can't watch the events they study? Can you give some examples of the types of predictions they can make and test?

B [Student answers, "Yes" for one, "No" for other]: In what way are cosmogony and biology different?

C [Student answers, "No" for both]: What makes their predictions inherently untestable? Can you give an example of an untestable prediction from one or both fields?

Lead In 2: Nested Traits and Common Ancestry

Recently CNN and other news outlets reported that the carcass of a "Bigfoot" (or Sasquatch) had been found in the southern US. People who believe that Bigfoot is real often suggest that it is a "missing link" between humans and apes. This time, it turned out to be a rubber gorilla suit. However, suppose a "Bigfoot" specimen WAS actually found.

Question 6: What evidence would scientists look for to determine if "Bigfoot" was related to humans and other primates?

Scientists think that all living things on Earth are related because they share common ancestors. However, some organisms are more closely related than others. For instance, humans are more closely related to chimpanzees than they are to orangutans, yet all three are related through a common ancestor.

Question 7: How do scientists know that humans are more closely related to chimpanzees than they are to orangutans?

Humans share a number of traits with other primates. [SHOW INTERVIEWEE PICTURES OF PRIMATES – ALLOW INTERVIEWEE TO LOOK IT OVER]

- All primates have hair.

- All have eyes that look out from the fronts of their heads, giving them stereoscopic vision and the ability to see how far away things are.
- The apes, including gibbons, chimps, and gorillas, all lack tails.
- The great apes are relatively large.
- Only humans are truly bipedal.

Question 8: Which evolved first: bipedal gait, hair, stereoscopic vision, or tailless-ness? How do you know?

Question 9: Which evolved most recently? How do you know?

Question 10: What, if anything, does this pattern of shared versus exclusive traits tell us about descent with modification?

Lead In 3: Patterns in the Fossil Record

Both scientists and creationists claim that patterns in the fossil record support their view of the history of life on Earth. For example, scientists think that birds arose from an ancestral dinosaur. In support of this, they point to fossils of Archaeopteryx, a species with sharp teeth, claws, and bony tails like dinosaur ancestors, and feathers and wings like a bird. [SHOW INTERVIEWEE PICTURES OF FOSSIL AND LINE SKETCHES - ALLOW INTERVIEWEE TO LOOK IT OVER]

Question 11: Why do scientists say a fossil like Archaeopteryx provides support for descent with modification?

Question 12: What would a creationist say about fossils of Archaeopteryx?

Question 13: Which view do you think is correct, and why?

Scientists think that whales share a common ancestor with camels and other even-toed hoofed mammals. A team of scientists recently found fossilized remains of a transitional species, Ambulocetus, which provides strong evidence for this claim.

Question 14: Can you describe what sorts of traits you might expect to see in the transitional species *Ambulocetus*?

Imagine that you are a creationist looking for evidence to refute descent with modification. You take your team out to Montana, and begin digging for fossils.

Question 15: What sorts of fossils would you expect to find if the theory of descent with modification from common ancestors were, in general, wrong?