Lesson 2

Essential Question

What Does the Evidence Show?

Objectives

- Assess the evidence that scientists use to support theories of origins.
- Compare and contrast creationist and naturalistic interpretations of observable data.
- Define vestigial structure.
- Compare homologous structures with analogous structures.

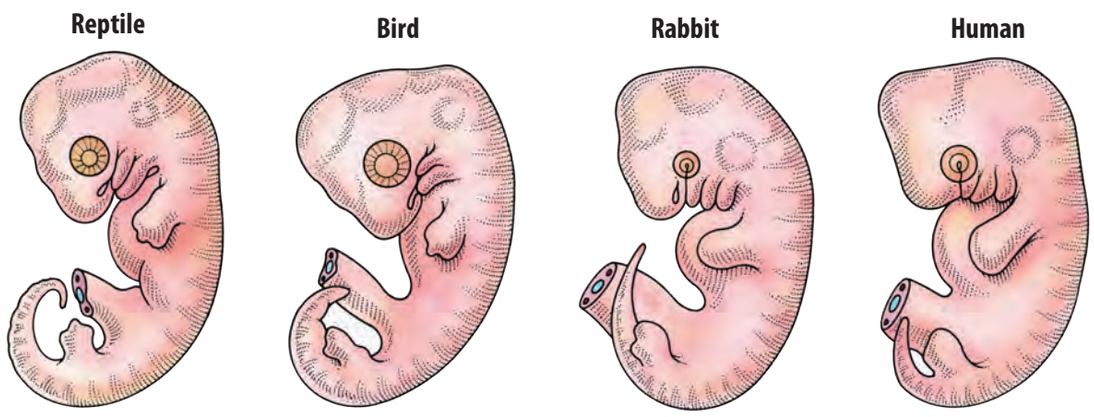
Vocabulary

vestigial structures
homologous structures
analogous structures
conservation of design

With so many different ideas about the origins of life on Earth, how is it possible to know whether any of them are correct? If origins falls into the category of historical science, what kind of data is available on which to base conclusions? Scientists from both worldviews are interested in how scientific evidence matches up with their theories of origins. This lesson will describe several lines of observable data—embryology, vestigial organs, genetic similarities, the fossil record, homology and analogy, and design—and how evolutionists and creationists interpret them.

Embryology Explain

In the late 1800s, Ernst Haeckel drew pictures that compared the embryonic development of lizards, chicks, rabbits, and humans. What similarities do you see in the embryos? What differences are evident? After observing that embryos of these vertebrates were much more similar than the adults, he theorized that during its development in the womb, the embryo actually passed through the different stages of its evolutionary history. Although it is true that embryos of many vertebrates are similar, Haeckel altered his drawings to support his theory, which did not hold up to modern genetic evidence.



In early stages of development, vertebrate animals may be very similar.

Observable Data — Embryology	
Embryos of different animals appear to be similar, though not as similar as originally portrayed by Haeckel's drawings shown on the previous page.	
Creationist Interpretation	**Evolutionist Interpretation**
Because the basic structure of vertebrates is similar, similarities in organisms are visible in the early stages of development. The Designer created an efficient plan to make basic structures first and to then specialize as the process continued.	An embryo resembles the embryonic stages of its ancestors because of evolutionary descent from a common ancestor.

Vestigial Structures

According to the theory of macroevolution, as species evolve new structures, certain older structures that are no longer necessary will slowly disappear. Until a structure disappears completely, a remnant, or vestige, of it may remain. Structures that do not appear to have any use are often presumed to be "leftovers" and are called **vestigial structures**. In 1895, a long list of vestigial organs in mammals was compiled that was considered convincing evidence for macroevolution. More than 80 structures were on that list, including the thyroid, pituitary glands, and the middle ear. Scientists now know that these structures have very specific and important functions. As scientists continue to gather evidence, the list continues to shrink.

Some organs, however, seem to be truly vestigial. Some salamanders that live in dark caves have sightless eyes. Populations of birds found living on islands without predators sometimes have small wings and have lost the ability to fly. It is important to notice that these changes are examples of microevolution, not macroevolution. Also, instead of evolving new structures, these animals lost certain traits.

Observable Data — Vestigial Organs	
Some body parts, called vestigial organs, appear to have no function. Examples include the human coccyx (tailbone), small leg bones in some snakes, eyes in blind amphibians, and wings in flightless birds.	
Creationist Interpretation	**Evolutionist Interpretation**
Just because we don't understand a structure's purpose doesn't mean it doesn't have one. Scientists have discovered the purpose of many structures that used to be considered vestigial. Some vestigial structures may be the result of microevolution that has happened since Creation.	Vestigial organs are remains of an animal's evolutionary history.

In spite of many genetic similarities, humans and chimps are very different.

What are some physical differences between you and a chimpanzee?

Genetic Similarities Explain

Has anyone ever told you that the human and chimpanzee genomes are 98 percent identical? When the chimpanzee genome was actually sequenced, the ratio dropped to 96 percent. Although the published numbers may vary, understanding what these numbers mean can be tricky. Clearly, the human and chimpanzee genomes are more like one another than either is to the banana genome (about half the genes in bananas are similar to human genes). However, there are some very important differences. In particular, the *Y*, or male sex chromosome, is very different. Although the proteins are quite similar, the regulatory genes that control how these proteins are used are different. This is like very different houses being put together with the same types of nails and lumber. Can you think of other examples that illustrate this concept?

Observable Data — Genetic Similarities	
Humans, chimpanzees, and bananas have many similar, but not necessarily identical, genes.	
Creationist Interpretation	**Evolutionist Interpretation**
When the Creator designed different organisms, He used similar parts to build them, just as a builder may use similar bricks to design different buildings. Bananas have relatively few genes in common with humans and chimpanzees, because bananas differ more from either of them than they do from each other. Where necessary, God made different genes for the unique needs of bananas, chimps, and humans.	Similar genes are inherited from a common ancestor. The common ancestor of bananas and humans existed long before the common ancestor of humans and chimpanzees. Therefore, humans and chimps share fewer genes with bananas than they do with each other. Unique genes in each organism evolved by mutation and natural selection. Because this requires random unguided changes, the process takes long periods of time.

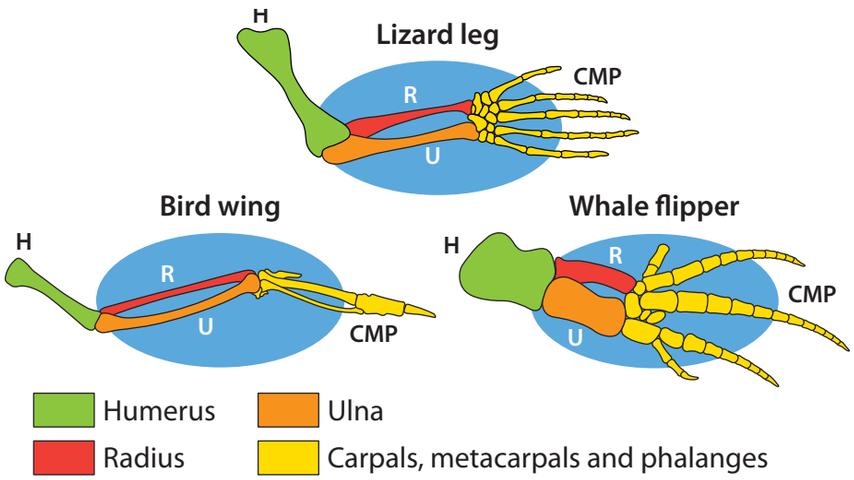
Fossil Record

The fossil record is often used to support the theory of evolution. Evidence about the fossil record will be presented in Chapter 10, but a short summary is included in the chart below.

Observable Data — Fossil Record	
Beginning with a sudden profusion of diverse life forms, the sequence of fossils (from bottom to top of the geologic column) includes invertebrates, fish, amphibians, reptiles, mammals, and humans. New organisms appear abruptly with relatively few examples of gradual "transitions."	
Creationist Interpretation	**Evolutionist Interpretation**
The fossil record is a record of the sequence in which the fossils would have been buried by the Flood and later geologic activity.	The fossil record is a record of the evolution of life forms from common ancestors.

Homology and Analogy Explain

Scientists have noticed that many animals share similar body structures. For example, the human arm and hand, a whale's flipper, a bat's wing, and a lizard's leg have roughly the same sort of bones in the same order. But despite how similar these appendages appear, their functions are very different. Humans can grasp things, whales can swim, birds can fly, and lizards can run using this same basic arrangement of bones. Structures that are similar in construction but that have different functions are called **homologous structures**.



Similar structures that have different functions are called homologous structures.

Which bones are homologous in these three animals?

Notice also how different the structure is in the wings of the butterfly, bird, bat, and pterosaur on the next page. Yet, each of these different structures still results in the ability to fly. Different structures that have the same function are called **analogous structures**. What other homologous and analogous structures can you describe in nature?

Scripture Spotlight

What types of wings are mentioned in these verses: **Exodus 19:4**, **Psalm 55:6**, and **Matthew 23:37**?

Lesson Activity

Think about the many kinds of winged animals. With a partner, make a list of at least ten different winged animals. Are all wings the same? Comparing the wings of animals can reveal more differences than you may have considered. Choose two different types of winged animals from your list and research their structures. Organize your research into a visual presentation. Include photographs, diagrams, or your own drawings in your presentation. Be sure to add captions and labels as needed. Then create a Venn diagram to record the differences between the wings of the two types of winged animals you researched. Share your models and research with the rest of the class.

What differences can you identify relating to the structure and function of wings?

Observable Data — Homology and Analogy

Homology

	Human hand/arm	Whale flipper	Bat wing	Dog leg
Same structure				
Different functions	Fine manipulations	Swimming	Flying	Running fast

Analogy

	Butterfly wing	Bird wing	Bat wing	Pterosaur wing
Different structure				
Same functions	No bones at all	Finger bones reduced; feathers are the main flight surface	A thin membrane stretches between the digits	Fourth finger alone supports the wing membrane

Creationist Interpretation

An intelligent Creator designed a flexible general plan, which could be altered for different animals. It might be like a computer programmer writing a basic program that could be modified and reused efficiently in other more complex programs. Sometimes this is called the **conservation of design**.

Evolutionist Interpretation

Homology

Similar structures are said to suggest common ancestry. In other words, these traits were passed down to these animals from a common ancestor.

Analogy

Even though animals with analogous structures did have common ancestors at some point in the past, these structures are thought to have evolved sometime since the last common ancestor. That means those traits would have to have evolved more than once, each in a separate evolutionary line.

Structured Inquiry

Discover

Record your work for this inquiry. Your teacher may also assign the related Guided Inquiry.

Science Journal

When You've Seen One, You've Seen Them All

Does similar design mean a common ancestry?

Procedure

Materials
- a variety of cars

1. As a class, visit your school parking lot. Select three cars that are obviously different.
2. **Observe** the cars and identify these common characteristics: headlights, taillights, and side-view mirrors.
3. Then choose two more characteristics that the cars have in common.
4. Create a five-column chart and record one common characteristic at the top of each column. Describe or draw the design of the five characteristics for each of the cars. Record your observations on the chart.

Analyze Results

Compare the common characteristics of the cars. Based on your observations, how does the design of the common characteristics of the cars differ? What are the similarities of the design?

Create Explanations

1. Does similar design mean a common ancestry?
2. Why do different makes of cars share the same features?
3. How are similarities and differences in cars similar to what is found in nature?
4. How does this activity relate to the conservation of design?

Design Explain

If you were walking in the woods and found a watch on the ground, where would you assume it came from? Back in the eighteenth century, a British philosopher and clergyman named William Paley used this question to illustrate the idea that when we see evidence of planning, craftsmanship, beauty, and usefulness, we recognize that those things come from a designer. Since that time, scientists have continued to gather data about the stunning precision of universal constants, the staggering complexity of the molecular machines inside our bodies, and the fascinating processes found in the natural world.

Although most people would immediately recognize design in this data, scientists wanted to find a way to be more scientifically objective about the process of identifying design. William Dembski developed something called the *explanatory filter* to help determine whether direct intervention by a designer should be inferred. If it can be determined that the object could have existed in more than one format, is complex enough that it could not have happened by chance, and is not random but specific, then design can be inferred.

Observable Data — Design		
We live in a finely tuned Universe with dozens of factors, such as gravity, that have to be exactly the way they are for life to exist.	Humans and other animals are made of complex systems, which are made of organs, which are made of tissues, which are made of cells, which are made of organelles, which have hundreds of tiny molecular machines, which are themselves irreducibly complex and work together to accomplish cell processes.	Caterpillars that crawl, eat leaves, and spin silk cocoons but that cannot reproduce melt into a jellylike substance before reassembling into butterflies that fly, drink nectar, and can reproduce caterpillars.
Creationist Interpretation	**Evolutionist Interpretation**	
These are examples of organisms designed, created, and maintained by God.	These organisms arose from random evolutionary processes, directed by environmental constraints, but they have the appearance of conscious design.	

Evaluating the Evidence

Remember that two parts of the scientific process are gathering and interpreting data. As more data is gathered, scientists evaluate it and make adjustments to their theories. As you have seen, scientists with different worldviews can interpret the same data in completely different ways. Both creationists and evolutionists show strong commitments to their worldviews and the assumptions that go with them. As you evaluate the evidence presented here, keep the following points in mind:

- Each theory is ultimately accepted by faith.
- Each theory depends on assumptions that cannot be proved.
- Each theory is supported by scientific evidence.
- Each theory is unable to explain all the scientific evidence.

Moths' eyes do not reflect light. Instead, the light is absorbed and deflected. This antiglare quality helps keep the moth safe from predators.

Concept Check Assess/Reflect

Summary: What does the evidence show? Evolutionists and creationists interpret the same observable data in different ways. Evidence used frequently to debate life's origins includes embryological similarities, vestigial organs, genome similarities, the fossil record, homologous and analogous structures, and design. Ultimately, neither evolutionism nor creationism is a provable theory. Both are based on scientific evidence, but not all is explainable. They are accepted by faith.

1. In your opinion, which is more useful to biologists when studying ancestry: homologous structures or analogous structures? Explain.
2. Would scientists classify the wings of a dragonfly and the wings of a pigeon as homologous or analogous structures? Explain.
3. How might an evolutionist and a creationist describe the evidence that wings in wingless birds give for origins of life?
4. How would an evolutionist say similarities in genetic makeup suggest that humans and chimpanzees evolved from a common ancestor?
5. Give an example and explanation of something that appears to have been created with design in mind, rather than falling together randomly.