

# Evolution Unit Plan

## Stage 1: Identify Desired Results

**Title:** Evolution of Life

### **Unit Description:**

Evolution is a topic that is fundamental to the study of Biology, linking areas such as genetics, molecular biology, reproduction, anatomy and classification. In this unit, students will learn about the history of the theories of evolution, comparing Darwin and Lamarck. They will learn about the process of natural selection and how it is the basis for evolution. They will outline events in the evolution of life on earth from the first unicellular organism to the first multicellular organism and they will learn what evidence has led to our understanding of how life evolved and how new evidence is changing our view of the relatedness of organisms.

### **Unit Enduring Understandings:**

1. All life on earth evolved from a common ancestor that first appeared billions of years ago.
2. Variation exists in all species and allows some individuals to be better able to survive in a particular environment than others.
3. Natural selection is the process by which evolution occurs.

### **Unit Essential Questions:**

1. What is meant by evolution?
2. Are certain lines of evidence for evolution stronger than others?
3. How do genetic mutations and recombination of genes during meiosis enable evolution to occur?
4. What ties all current life on Earth to single-celled organisms that evolved billions of years ago?

### **What students will need to know and be able to do (knowledge and skills):**

1. Identify “key events” in the evolution of life on Earth.
2. Use biochemical evidence (amino acid sequences or DNA sequences) to show how closely two organisms are related.
3. Explain how evolution is linked to how closely two species are related.
4. Give examples of variations and explain their importance to natural selection.
5. Compare and contrast the theories of Darwin and Lamarck and explain why Darwin’s theories are still accepted today.
6. Explain why evolution will never become a scientific law.
7. Explain why evolution is accepted even though it is “just a theory”.

### **What do students typically misunderstand?**

1. Evolution is “just a theory” or the “best guess”, so it is not supported by scientific evidence.
2. Organisms change and evolve because they have a desire to do so.
3. We can’t see evolution happening.
4. Evolution leads to more advanced organisms that are “climbing the evolutionary ladder”.
5. Traits organisms possess arise because of the environment.

6. Evolution occurs in individual organisms.

## **Stage 2: Determine Acceptable Evidence**

**Title:** The Story of the Evolution of Life

**Goal:** The goal of the performance is for students to communicate the “story” of the evolution of life

**Role:** The students are authors of a children's book.

**Audience:** Children ages 7-10

**Situation:** The students will be given the following instructions:

You have been commissioned by a publisher to write a children's book that tells the story of the evolution of life. They would like it to be an illustrate story that will help children understand where life came from and how it has changed over time. They are requesting seven specific events that must be included and you may pick 5 other events that you think might be of interest to children. You are allowed to write it as an adventure, a straightforward non-fiction book, or any other method you think of to convey the story. You can check in with your "editor" from time to time to see if you're on the right track.

**Product:** An illustrated children's book.

### **Standards:**

A. Required Elements: A written description and/or illustration for each of the following events (they are not listed in order) must be included:

1. When organisms got a nucleus.
2. How mitochondria or chloroplasts evolved.
3. What the first organism was and what was the Earth like at that time.
4. When photosynthesis first occurred and what effect it had on the Earth.
5. When and how the Earth was formed.
6. When sexual reproduction occurred (it's a children's book so be careful!).
7. When and where the first multicellular organisms appeared.

B. Other Events: Choose 5 other events in Earth's history and include them in your story.

C. Sequence: The events must be in the order as they would occur in history.

D. Writing Mechanics: Your writing should be clear with correct grammar, punctuation, and spelling.

E. Creative Elements: The children's story should be creative, colorful, and appealing to children.

F. Use of Class Time and Cooperation: You will be given class time to work on this project with a partner(s), be sure to use it effectively. It is not time for socializing, working on other

assignments, or napping-use your time to work as a group!

### **Preconceptions Assessment:**

I have chosen to include the pre-assessment questions that I administered to my students as well as questions that I would ask during the evolution unit to check for understanding and to see if any clarification is needed.

#### Pre-assessment questions:

1. Present day giraffes are believed to have evolved from ancestors who resembled horses. There have been different theories about how this could have occurred. The two main ideas are listed below:

A. One proposed explanation is that the giraffes wanted to reach the leaves higher up on the trees, possible because they were greener or no other species could eat them, so the short-necked ancestors stretched their necks trying to reach the high leaves, causing their necks to become longer. Over many generations of stretching their necks the giraffes' neck became longer and longer until they became the current long-necked species.

B. Another explanation is that some ancestors of modern day giraffes had slightly longer necks than others. These giraffes were able to reach more food, allowing them to become stronger, live longer, and have more offspring. Over time the giraffes with slightly longer necks became the more prevalent group and when these giraffes had offspring, their offspring had even slightly longer necks, and so on until the current long-necked species came about.

*Which of these theories do you agree with most? Explain your position in as much detail as possible.*

2. Students frequently learn about scientific laws, such as Newton's Laws of Motion, the Law of Inertia, or the Law of Gravity and they often learn about scientific theories, such as the Cell Theory, the Theory of Natural Selection, the Theory of Evolution, and the Big Bang Theory. The Theory of Evolution was first introduced by Charles Darwin in 1859. Scientists have a great deal of evidence to support it such as fossil evidence, DNA evidence, structural similarities in the anatomy of organisms, and similar amino acid sequences in proteins.

*A. Explain your view of the difference between a scientific law and a scientific theory. How are they similar and how are they different?*

*B. Do you think the Theory of Evolution will ever become the Law of Evolution? Explain your answer.*

#### Informal questions:

1. What is evolution?
2. How did conditions when Earth first formed compare to how they are today?
3. How did there come to be so many different kinds of birds?
4. What makes species change or evolve?
5. How long does evolution take?
6. Why do species become extinct?

### **Quizzes, Tests, and Academic Prompts:**

Students will be given a traditional assessment about evolution. It will consist of fill-in-the-blank types of questions, true/false questions where they have to make the statement true, and short answer questions that have students explain how closely various species are related or how recently they had a common ancestor based on the various types of evidence, as well as other essay/short answer questions about other concepts relating to evolution, including the original pre-assessment questions. They will also have to write a response to a “letter to the editor” that argues that evolution is not accepted and is not real science. They will act as an educated citizen who is outraged by the uninformed author and they will have to explain why evolution is scientific fact and what evidence there is to support it.

### **Other Evidence:**

Students will complete the following activities/assignments that will be graded or reviewed for student understanding.

1. Modeling Natural Selection- The process of natural selection will be modeled in a population of microbes (beans) that have variations (different sizes and colors) that make them better adapted to their environment (bowl with holes in the bottom).
2. Evolution of Dragon Fossils- Students will show the evolution of dragons based on pictures of “fossils” and explain their reasoning for the sequence they chose. They will need to include what variations they used and a story about what environmental factors played a role in the process of natural selection.
3. Biochemical Evidence for Evolution- Students compare amino acid sequences in hemoglobin from three species and show which species are most closely related.
4. Questions based on readings from the textbook and articles.
5. Construction of a web diagram showing relationships between concepts related to evolution.
6. Create a Venn diagram showing the similarities and differences between scientific theories, laws and hypotheses.
7. Study Guides and worksheets from the textbook.

## **Stage 3: Plan Learning Experiences, Instruction, and Resources**

### **Where:**

Students will be provided with a unit outline, listing the unit objectives, activities, and assessments. They will also be referred to the course syllabus and we will discuss what topics we covered recently and how evolution relates to molecular genetics and how it relates to taxonomy (our next unit).

### **Hook:**

Students will watch a brief clip from the video “Inherit the Wind” about the Scopes Monkey Trial and we will briefly relate it to current events.

### **Experiences:**

I have chosen to list the student experiences as a brief description of my lesson plans for each day of the unit.

Day 0: Following test on molecular genetics, the students will watch a video clip from “*Inherit the Wind*”.

Day 1: The History of Life on Earth:

- Watch a video (*History of the Earth*) about the history of life on earth.
- Create a timeline showing major events in the history of the Earth
- Study Guide from textbook about the history of life on Earth

Day 2: Introduce the children’s book assignment and then the students will work with their partner(s) on their children’s book.

Day 3: Variations and Natural Selection

- Group work and class discussion about examples of variations and how some can be helpful.
- Modeling Natural Selection Lab- In this activity, students will identify variations they think will be beneficial to the survival of a population of microbes (beans) in an environment with some selective pressure (holes in the bottom of a Styrofoam bowl). They will then make a graph of their data and use it to make predictions about future microbe populations. They will then write a conclusion for the activity.
- Work on book

Day 4: Evolutionary Theories:

- Show students a diagram comparing the evolutionary theories of Lamarck and Darwin.
- Discuss how the diagrams are different.
- Compare and summarize the theories of Lamarck and Darwin
- Explain why Lamarck was wrong and Darwin was correct
- Study Guide from textbook about the theories of evolution

Day 5: Watch video: *The Jeff Corwin Experience: The Galapagos Islands: Land of Evolutionary Change* and take notes about what Darwin observed (and we still can) on the Galapagos Islands that led to his theories about natural selection. After the video we will discuss their observations.

Day 6: Fossils as a source of evidence of evolution

- Class discussion about fossils, examples, what they show about evolution, why there are gaps in the fossil record.
- Evolution of Dragon Fossils activity- Students will cut out pictures (fossils) of dragons and place them in a sequence to show how they think they evolved. Then they will explain their decision based on the traits the dragons exhibit and including environmental factors that selected the advantageous traits.
- Work on book

Day 7: Evidence from Anatomy and Embryology (all video clips come from PBS evolution at <http://www.pbs.org/wgbh/evolution/library/04/index.html> )

- Watch video clip (*Evolving Ideas: How do we know evolution happens?*) about fossil

- evidence and whale evolution and review fossil evidence
- Discuss anatomical evidence- homologous parts and show examples of homologous parts in diagrams of bones from human arm, horse leg, cat forelimb, bat wing, and whale flipper, color code homologous bones.
- Discuss vestigial organs, give examples, and how they may show evidence of evolution.
- Watch video clip about comparative embryology (from *Nova: Odyssey of Life*), example pictures of embryos of fish, turtle, pig, human, chick, and rabbit. Discuss how they are similar and at what stages they are different. Link the similarities to the influence of genes.
- Study Guide from textbook about evidence of evolution.

#### Day 8: Evidence from Biochemistry and Direct Evidence

- Review sources of evidence
- Discuss types of biochemical evidence and how DNA is linked to proteins and how comparing nucleic acid sequences and amino acid sequences can prove that two species had a common ancestor.
- Watch video clip (*The Evolutionary Arms Race* from PBS evolution at <http://www.pbs.org/wgbh/evolution>) about antibiotic resistant bacteria, discuss how it shows evolution.
- Read article about antibiotic resistant bacteria.

#### Day 9: Biochemical Evidence of Evolution

- Perform activity comparing the number differences in amino acid sequences in the hemoglobin of a human, gorilla, and a horse and the number of each type of amino acid. Explain how the differences and types of amino acids compare, what that shows about the DNA sequences of the hemoglobin gene, and what mechanism could cause the differences between the human and the gorilla. Connect the comparisons to evolutionary relationships and the distance between the species and common ancestors.

#### Day 10: ...but it's just a theory.

- Review examples of the various types of evidence.
- Watch video clip (*Evolving Ideas: Isn't Evolution Just a Theory?* at <http://www.pbs.org/wgbh/evolution/>) discussing the theory of evolution and why it is accepted.
- Create a Venn Diagram comparing scientific laws, theories, and hypotheses.

#### Day 11: Review

- Create a web diagram showing various ideas related to evolution from a list of terms, phrases, pictures, and student generated ideas and examples.
- Review game.

#### Day 12: Test

#### **Reflect:**

Students will reflect upon their ideas during analysis questions for the natural selection activity, evolution of dragons activity, evidence from biochemistry activity, and during class

discussions. They will also have to examine their understanding of events in the history of life on Earth while constructing their children's book.

**Exhibit:**

The children's book is evidence of their understanding of events in the evolution of life. Students also were able to exhibit their understandings of topics through conclusions that were written for the various activities. In the activities I included items that needed to be addressed in their conclusion. This allowed the students to see if the conclusion they wrote provided enough information. They also asked other groups to proof-read their conclusions to see if they missed any information.

## The Story of Life

Name: \_\_\_\_\_

CATEGORY	4	3	2	1
Sequence	Correct sequence	3 or more events out of sequence	4 or more events out of sequence	5 or more events out of sequence
Origin of Earth	Accurate illustration and/or description of events and conditions	Illustration or description does not completely describe the events and or conditions	Illustration or description is missing details about events or conditions	Illustration or description does not describe events and conditions.
The First Organism	Accurate illustration and/or description of events and conditions	Illustration or description does not completely describe the events and or conditions	Illustration or description is missing details about events or conditions	Illustration or description does not describe events and conditions.
Appearance of Photosynthesis	Accurate illustration and/or description of events and conditions	Illustration or description does not completely describe the events and or conditions	Illustration or description is missing details about events or conditions	Illustration or description does not describe events and conditions.
Appearance of a Nucleus	Accurate illustration and/or description of events and conditions	Illustration or description does not completely describe the events and or conditions	Illustration or description is missing details about events or conditions	Illustration or description does not describe events and conditions.
Origin of Mitochondria & Chloroplast	Accurate illustration and/or description of events and conditions	Illustration or description does not completely describe the events and or conditions	Illustration or description is missing details about events or conditions	Illustration or description does not describe events and conditions.
Sexual Reproduction	Accurate illustration and/or description of events and conditions	Illustration or description does not completely describe the events and or conditions	Illustration or description is missing details about events or conditions	Illustration or description does not describe events and conditions.

Multicellular Organisms	Accurate illustration and/or description of events and conditions	Illustration or description does not completely describe the events and or conditions	Illustration or description is missing details about events or conditions	Illustration or description does not describe events and conditions.
Appearance	Neat, colorful, and visually appealing overall.	Some writing or illustrations are somewhat sloppy or hard to read.	Most writing or illustrations are sloppy or hard to read.	Very sloppy and hard to read.
Use of Class Time	Worked diligently during all time given	Spent some time off task	Spent much of time off task	Almost no work done in class
Creativity	Neat, colorful, illustrations included for all events	Some illustrations are not colored or a few are missing	Illustrations present but very sloppy or no color included or some events missing illustrations	No illustrations included
Writing mechanics	No spelling or grammar mistakes	2-4 spelling and/or grammar mistakes	5-6 spelling and/or grammar mistakes	More than 6 spelling and/or grammar mistakes
<b>Category</b>	<b>2</b>	<b>1.5</b>	<b>1</b>	<b>0</b>
Additional Event 1	Accurate illustration and/or illustration of event.	Some information provided or illustration included, but vague	Included but no details or information given	No event included.
Additional Event 2	Accurate illustration and/or illustration of event.	Some information provided or illustration included, but vague	Included but no details or information given	No event included.
Additional Event 3	Accurate illustration and/or illustration of event.	Some information provided or illustration included, but vague	Included but no details or information given	No event included.
Additional Event 4	Accurate illustration and/or illustration of event.	Some information provided or illustration included, but vague	Included but no details or information given	No event included.
Additional Event 5	Accurate illustration and/or illustration of event.	Some information provided or illustration included, but vague	Included but no details or information given	No event included.