EVOLUTION UNIT PLAN

Key Idea 3:
Individual organisms and species change over time.

Evolution is the change of species over time. This theory is the central unifying theme of biology. Students need to know that in sexually reproducing organisms, only changes in the genes of sex cells can become the basis for evolutionary change and that these evolutionary changes may occur in structure, function, and behavior over time.

Essential Questions

Is change inevitable for all living things?

Desired Results

Enduring Understandings

- The process of evolution provides a scientific explanation for the diversity of life on earth. This process has occurred over a vast amount of geologic time.
- The evidence for evolution lies in studies of the fossil record, structural and molecular homologies, and comparative embryology.
- Biological evolution occurs through the process of natural selection.
- Natural selection occurs because of the genetic variations of traits in a population, overproduction of offspring, limited resources, and the selection by the environment of those offspring who are better able to survive and reproduce under these conditions.
- Genetic variations are the raw material for natural selection.

Guiding Questions

- How can we tell if one organism is related to another?
- How long does it take for evolution to happen?
- How can we prove evolution happened?
- What happens to a species when the environment changes?
- How do small differences add up to big changes?
- How do new species form?

Knowledge and Skills

- Understand the evolution of primates
- Recognize similarities between primates, hominids, and humans
- Understand the geologic time scale
- Know the major biological events in earth's history

- Recognize evidence for evolution through examination of fossils, embryos, structural and biochemical homologies, and our relationship to hominids.
- Explain the process by which natural selection occurs.
- Explain adaptation
- Describe evolution as a branching as opposed to linear process.
- Understand the role of mutations in evolution
- Describe bacteria with antibiotic resistance as a product of evolution.

Assessment Evidence

- Comparison chart of various hominids (quiz)
- Notes on evolution jigsaw
- Group poster on evolution jigsaw (quiz)
- Dialogue between moths
- "Creatures" story
- Essay on the evolution of antibiotic resistant bacteria
- Journals (on Lucy, on videos, Do Nows)

UNIT SKETCH

Key Idea 3: Individual organisms and species change over time.

Essential Question: Is change inevitable for all living things?

	Lesson 1	Lesson 2	Lesson 3	Lesson 4	Lesson 5
Essential and Guiding Questions	How can we tell if one organism is related to another?	How can we tell if one organism is related to another?	How can we tell if one organism is related to another?	How can we tell if one organism is related to another?	How long does it take for evolution to happen?
Learning Opportunities	1. Answer essential question. 2. Work in pairs- observe how your partner walks, then pick up different objects in order to observe grips. 3. Watch segment of Gorillas in the Mist	Opposable thumbs lab Go over testable questions. Go over procedure to test their question. Students test their question.	Read story on "Lucy" Examine pictures of skeletons. Go over observation (evidence) vs. inference. Students collect evidence from the story and make inferences about Lucy's looks and physical behaviors	Comparison of hominid pictures. 1. Students write about distinguishing characteristics of each image. 2. Then create a sequence for their evolution. 3. Read about Early Man and complete table which compares different hominid ancestors (homework or extension)	Construct geologic time scale Watch portions of video to give glimpses of different life forms and early geologic time periods.
Assessments and Reflection	Written comparison how humans and apes use their hands.	Lab notes and reflection In what ways are thumbs important to the way humans use their hands?	Journal	Comparison chart of various hominids.	Questions related to time line
Standard 1	1.2a	1.2a, 3.4a	1.1b	1.1b	
4	3.1a, 3.1i		3.1a, 3.1i.	3.1a	3.1j, 3.1l

Essential Question: Is change inevitable for all living things?

	Lesson 6	**Lesson 7**	**Lesson 8 (optional)**	**Lesson 9**	**Lesson 10**
Essential and Guiding Questions	How can we prove that evolution happened?	How can we prove that evolution happened?	How can we prove that evolution happened?	What happens to a species when their environment changes?	Why do some organisms make it while others don't?
Learning Opportunities	Evolution jigsaw Students meet with "specialists" to analyze information about fossils and geology, hominid skulls, embryology, homologous and vestigial structures	Evolution Jigsaw- part 2 students teach their group members about their topic and group creates a poster in order to present what they have learned.	Watch Odyssey Of Life	Pepper Moth Story Read story to students. Students use data to plot the change in population size of different colored moths.	Reading text on natural selection Students review Darwin's inferences and write in their own words. Students create other examples to fit Darwin's model.
Assessments and Reflection	Individual notes on jigsaw	Group Poster Individual notes	Journal reflection on movie	Graph	Reading notes
Standard 1	1.1a,1.2a	1.1a, 1.2a		3.1a	
4	3.1e, 3.1k	3.1e	3.1e, 3.1g, 3.1h	3.1b, 3.1g , 3.1h	3.1b, 3.1f, 3.1g

Essential Question: Is change inevitable for all living things?

	Lesson 11	**Lesson 12**	**Lesson 13**	**Lesson 14**	**Lesson 15**
	How do small changes add up to big differences?	How do small changes add up to big differences?	How does a new species form?	How does a new species form?	How does a new species form?
Learning Opportunities	Creatures lab Students examine "fossils". Students work in groups to formulate an evolutionary sequence. Students keep notes on their process as a group.	Creatures lab- (continued) Students use reading on move from water to land in order to further develop their sequences. Students present their sequences and justification to the class. Go over idea of punctuated equilibrium. Go over extinction	Evolution in Action- Antibiotic Resistant Bacteria Students examine all the given information and develop Paragraphs for three possible outcomes to the story. Students watch 60 minutes segment on tuberculosis resistance in Russia.	Luria's experiment Analysis Mutations are random, rare events that can be passed on to offspring. Mutations can be caused by radiation and exposure to chemicals.	Evolution of Antibiotic Resistant Bacteria- part two Students read about antibiotic resistance. Students begin writing essays.
Assessments and Reflection	Individual notes on the group activity	Essay	Three paragraphs and journal reflection on 60 minutes		Essay
Standard 1	1.1a, 2.3a	1.1a, 2.3a		1.1b, 1.2a, 3.3	
4	3.1a, 3.1g, 3.1h, 3.1k	3.1a, 3.1g, 3.1h, 3.1k, 3.1l	3.1f, 3.1g, 3.1h	3.1b, 3.1 d	3.1f, 3.1g, 3.1h

Lesson # 1

Unit Topic/ Essential Question: Is change inevitable for all living things?

Aim/ Guiding Question: How can we tell if one organism is related to another?

Objectives

Students will be able to:

- Compare their relatedness to non-human primates.
- Appreciate that there are certain characteristics that humans share with other animals, although the expression of them is different.
- Make observations in order to help them conduct an inquiry..

New Terms:

opposable thumb
bipedal

Materials/ Preparations:

For each group:

Tennis ball	Glass or paper cup
Yarn or thick twine	Penny
Pen	Key

Video of ***Gorillas in the Mist***

Time (min)	Development	Instructional Strategies
15	In groups of 3 or 4, students pick up and use various objects placed on table. Students record how the hand, and fingers are used with each object.	Do Now, Observation, Note taking
5	Whole class discussion of the activity. Teacher asks for volunteer Student walks across the room and class makes notes about how hands and legs are used.	Discussion, Assessment Motivation, Observation
15	Watch segment of ***Gorillas in the Mist*** (or any documentary showing movement of primates) Students keep notes on the use of hands, feet, arms and legs	Making observations and comparisons
5	Students respond to the essential question: in their journal. Teacher collects response.	Assessing Prior knowledge

Suggested Homework:

Students write reflection that compares the use of limbs in apes and humans.

Alternate: Students read the essay “Get a Grip” (pp. E6-8, BSCS) and answer the following question: Describe the qualities that distinguish humans from other primates (include opposable thumbs, bipedalism, leg bones, feet, spine, and brain size)

References:

BSCS Biology- A Human Approach (pp. 20-21)

Standards Addressed:

Standard 1: 1.2a
Standard 4: 3.1a, 3.1i

Lesson # 2

Essential Question: Is change inevitable for all living things?

Aim/ Guiding Question: How can we tell if one organism is related to another?

Objectives

Students will be able to:

- Understand the usefulness of opposable thumbs in humans.
- Conduct an inquiry that involves asking a question and gathering data to answer a question.

New Terms

Same as day 1

Materials/ Procedures:

For each group of 3 or 4:
Lock and key
Masking tape
Stop watch or a clock with a second hand.

Note: this lesson can be done as a class demonstration if many locks and keys are not available.

Time (min)	Development	Instructional Strategies
5	Students write down their most striking observation about the movement of primates yesterday.	Do Now, Motivation
5	*Teacher writes two questions on board*: What is the importance of an opposable thumb for the ways in which humans use their hands? Without using your thumbs, can you open a lock? *Ask students and discuss:* As a scientist, which question would be easier to answer? Why is it easier to answer? Students will identify some of the characteristics of a testable question, for example: it is specific, it can be tested, has a clear outcome… *Teacher goes over the concept of a testable question.* In science, we have to ask questions in a way that will allow us to answer them/ test them.	Direct instruction, Introduction of lab activity
20	Students complete the activity and record data in lab notebooks	Small group work

Suggested Homework:

Students answer the following questions:

1. Explain the results of your experiment. What did the results show?
2. In what ways do you think the thumb is important to the way humans use their hands?
3. How does the way that apes use their hands and feet compare to the way that we do?

References:

BSCS Biology, a Human Approach

Standards Addressed:

Standard 1: 1.2a, 3.4a

Testing the Question:
Without using your thumbs can you use a lock and key?

1. Get a lock, key, and masking tape.
2. Decide roles: you will need a timekeeper, recorder, and subject.
3. Create a data table with the columns: Name, Condition, Time
4. When the timekeeper says “begin”, the subject will pick up the lock and key and unlock it. Recorder writes down the time it took.
5. Switch places and repeat the test.
6. Now tape down your thumbs to your hand and repeat the test.
7. Switch roles and repeat the test so that all the people in your group participate in the test.

Lesson # 3

Unit Topic/ Essential Question: **Is change inevitable for all living things?**

Aim/ Guiding Question: How can we tell if one organism is related to another?

Objectives

Students will be able to:

- Identify that the fossil Lucy helps us to build a case for how we are related to and have grown from hominids.

New Terms:

Hominid
Australopithicus

Materials/ Preparations

Pictures of "Lucy" and her skeleton (easily found in most textbooks)
Reading from BSCS Biology- A Human Approach- p. 34

Time (min)	Development	Instructional Strategies
5	Students respond to the question: Do you think we are related to apes? Why or why not?	Do Now Motivation
10	Teacher reads the story "Digging up the Past" (BSCS- A Human Approach, p. 34) to students. *This story is about the discovery of Lucy's skeleton in the Afar desert in 1973. You may have a similar story that you can use as a substitute.* Students respond to the question: What did the scientists OBSERVE by writing down specifics about the appearance of the skeleton based on what they hear.	Read Aloud. Note Taking
15	Teacher passes around pictures of skeleton and of "Lucy" Students write about the following: How may Lucy have looked and what were her physical behaviors? How did she live? What pieces of evidence lead you to think this?	Creative writing
10	Students share their responses. Teacher clarifies the difference between observation (evidence) and inference. Teacher asks: How might Lucy bridge the gap between modern humans and nonhuman primates? Explain the branching of Australopithicines from apes and the consequent development of humans. (just introduce this idea- there is a lesson to follow which delves deeper into this concept)	Discussion Direct Instruction

Suggested Homework:

If you were comparing hominids from Lucy's lifetime to your own, do you think that there have been more changes in the physical characteristics of the body (such as hands, feet, head, posture) or more changes in the way that the hominids lived (shelter, getting around, getting food, family life)? Explain in writing (one page).

References*:*

BSCS Biology, A Human Approach (pp 34-35)

Standards Addressed:

Standard 1: 1.1b
Standard 4: 3.1a, 3.1i

Lesson # 4

Unit Topic/ Essential Question: **Is change inevitable for all living things?**

Aim/ Guiding Question: How can we tell if one organism is related to another?

Objectives

Students will be able to:

- Use their observations in order to interpret an evolutionary pattern in hominids over time.

New Terms:

None.

Materials/ Preparations

Human Ancestor drawings- one copy for each group.
Human Ancestors table- one per student

Time (min)	Development	Instructional Strategies
5	Students respond in brief discussion to the question: How long do you think humans have been on earth?	Motivation
5	Teacher explains that scientists have created artistic impressions of human ancestors based on fossil evidence. Students will be examining these drawings in order to create a sequence of evolution for these ancestors.	Direct instruction
15-20	Student task: 1. In groups, students will list three distinguishing characteristics of ancestor in each drawing. 2. Students will come up with a sequence from earliest human to most recent human 3. Students explain the reason for their choice of the earliest and most recent. Teacher collects student notes	Group work
10	Students share their work with class. Teacher goes over the "correct" order.	Assessment Discussion

Suggested Homework

Students use the table (see attached) and reading on Human ancestors (on Being Human or from Holt) to complete the table.
Note: you may want to save this activity for another class day. Teachers can easily obtain 3 or 4 different readings on hominids. You can do a reading jigsaw in class and students can work in cooperative groups to complete the table.

References

Teaching and Learning Plans

Standards Addressed

Standard 1: 1.1b
Standard 4: 3.1a

Lesson # 5

Unit Topic/ Essential Question: Is change inevitable in all living things?

Aim/ Guiding Question: How long does it take for evolution to happen?

Objectives:

Students will be able to:

- Identify major biological and geological events in the history of the earth.
- Appreciate the immensity of time in the history of the earth.

New Terms:

geologic	Eukaryote
pleistocene	Pangea
amphibian	multicellular
vertebrate	

Materials/ Preparations

About 15 ft of twine
Cards- folded in half (so that they can hang over the twine) with major events written on them- use two colors – one for biological and one for geological events.
(see attached for list of events)
The Origin of Life- video

Time (min)	Development	Instructional Strategies
10	Students write down a sequence for the following events (earliest to most recent) • First dinosaurs • Formation of Rocky Mountains • First hominids • First life (bacteria) • First modern humans • First oxygen in atmosphere • First land plants Students work individually and then compare their answers with a partner. Partners talk about the logic behind their choice.	Do Now, Motivation, Think-Pair-Share
10	Teacher posts a table of major events or gives out table to students. Students compare their sequence to the one given. Discuss questions that students have. *Show* students the pre-marked twine. Go over the scale of the timeline (Each red line represents 1 billion, each black line represents 100 million). *Ask* students to point out where 3 billion would be, where 3 million would be in order to reinforce the concept of scale.	Class discussion

5	*Give* students event cards and ask them to hang them in the appropriate location on the timeline. Discuss patterns observed as a whole class.	Assessment
15	*Show* movie in order to give visual images of events that students just read about and classified. Be sure to highlight the formation of the earth, "toxic soup", importance of cyanobacteria.	Re-teach, review, reinforce

Suggested Homework:

Students answer the following based on class work:

a. List three of the patterns you observed between biological and geological events in the history of the earth.

b. What did the time line help you understand about the earth's history?

References:

BSCS Biology- A Human Approach (pp. 36-38)

Standards Addressed:

Standard 4: 3.1j, 3.1l

Major Events in the Earth's History

Geological Events:	**When (in millions of years)**
Pleistocene Ice Age	1.6
Land bridge between North and South America	5.7
Antarctic Ice cap	24
Mississippi River	35
Separation of Antarctica and Australia	50
Formation of the Himalayas	55
Formation of the Rocky Mountains	70
Breakup of Pangea	165
Oxygen building up in atmosphere	600-2500
Formation of the earth	4600
Biological Events	
Pictograms (written communication)	.005
Modern humans	.04
Neanderthals	.10
Manufactures stone tools	2.5
Lucy	3.2
Hominids	4.0
Monkeys	35
Primates	65
Flowering plants	140
Birds	150
Mammals	225
Dinosaurs	235
Reptiles	300
Seed producing plants	350
Amphibians	360
Land animals	400
Land plants	430
Vertebrates	520
Animals with hard shells	590
Soft bodied animals	680
Multicellular organisms	1000
Eukaryotes	1400
Bacteria	3500

Note: 1 billion equals 1000 million

Unit Topic/ Essential Question: **Is change inevitable for all living things?**

Aim/ Guiding Question: How can we prove that evolution happened?

Objectives:

Students will be able to:

- Understand that populations of organisms change over long periods of and that there is scientific evidence to support this idea.
- Analyze data and use it as evidence to support an idea.

New Terms:

Fossils
Embryology
Homologous structures

Materials/ Preparations:

Day 1

Time (min)	Development	Instructional Strategies
10	*Divide* students into groups of four. Each student in group will become a specialist in one of the following: Embryology, homologous and vestigial structures, fossils, hominid development. *Explain* that we will be exploring the different types of evidence for change across time.	
30	Students meet with specialist groups. Teacher gives out materials for each group. Students complete readings and activities together. (see attached for details on each group)	Jigsaw, Group work

Day 2

Time (min)	Development	Instructional Strategies
5	Teacher gives out table for recording evidence. Teacher explains that when you are teaching, you must not read from your paper directly, and you must not let others copy your work. Hints: students can go over key words or the activity that they did and what they learned from it.	Direct instruction
20	Students return to original groups to teach group members about the evidence they studied.	Jigsaw
15	Each group creates a poster to present one piece of their learning. Note: keep the guidelines open so that student groups can really present what they feel they learned well. Given the time that you have in class, you may want students to create more elaborate posters or something simple that can serve as a group assessment of the task.	Group work Assessment

Suggested Homework:
Students complete the table given out in class (this serves as an individual assessment of the task/learning)

References:
BSCS Biology- A Human Approach
Holt

Standards Addressed:
Standard 1: 1.1a, 1.2a
Standard 4: 3.1e, 3.1k

Notes on Evolution Jigsaw

You may gather reading and visual pieces from almost any textbook. I will list here the items that I have used and the tasks that students completed in order to gain an understanding of the different types of evidence for evolution.

Embryology

1. Give students pictures of different embryos (chick, pig, tadpole and human) at different stages of development. Students must try to organize these embryos by type and developmental stages (these cut outs can be obtained through the BSCS Biology- A Human Approach teacher's guide)
2. After students have completed the task, give them a handout that shows the correct organization of the cutouts. Also give students a reading on embryology (ex from Amsco- Living Environment)
3. Students answer the following questions:
    a. What is embryology?
    b. In general, which organisms have embryonic stages that are the most similar and the least similar? Explain your answer.
    c. What did you learn from comparing the drawings of the different embryos?
    d. How do these embryos provide evidence for evolution?

Hominid Development

1. Give students pictures of different hominid skulls. (I found a web site through *Natural History* magazine that displays the skulls of Lucy, Homo Erectus, and Neanderthals. It is dynamic and fun for students to use. If you do not have access to the internet, use skull sketches from Holt- Investigating Biology Lab Book- Investigation 11-1)

2. Students make a table like the following:

	Lucy	**Homo Erectus**	**Neanderthals**
Size of Jaw			
Slope of Face			
Size of Brain (cranial capacity)			
Brow Ridge			
Shape of Teeth			

3. Students answer the following questions together (and write down answers individually)
    a. summarize the changes that you see in the skulls that you observed.
    b. What shows you that these skulls are related to each other?
    c. How are these skulls evidence for evolution?

Homologous Structures

(adapted from Chapter 9 focus activity Holt- Investigating Biology)

1. Give students drawings of the forelimbs of frog, whale, horse, lion, human, bat, bird (or other related organisms). (you can cut out each drawing so that each individual has their own to focus on. This will facilitate participation and accountability).
2. Students observe the general shape of the limb, number of bones in the upper limb, number of bones in the lower limb, description of arrangement of bones and the function of the limb.
3. Students answer the following:
    a. How are the limbs of the organisms you observed similar? How are they different?
    b. Which of the limbs perform similar function?
    c. What is the relationship between structure of the limbs and function of the limbs in the organisms that you observed?
    d. How are homologous structures evidence for evolution?
4. Students examine the chart of relatedness of DNA between organisms and read story of red panda and giant panda. Students answer the following questions:
    a. Why is DNA an important molecule?
    b. How did scientists use DNA to study the relationship between the red panda and great panda?
    c. How are similarities in DNA an important piece of evidence for evolution?

Fossils:

Give students pictures of different fossils- these can be found in textbooks or on the internet- and then scanned through a color printer for a high quality image. Alternatively use the video, *The Origin of Life* and show students the segment that

begins by highlighting the Burgess Shale and talks about how the shale has been studied by scientists.

1. Students read about the formation of fossils (can be obtained from any textbook).
2. Answer (based on observation and reading)-
    a. What is a fossil?
    b. Why would it be useful to study fossils when you are trying to understand how living things have changed over time?

Lesson # 8
(optional)

Unit Topic/Essential Question: Is change inevitable for all living things?

Aim/ Guiding Question: How can we prove that evolution happened?

Objectives:
Students will be able to:
- Understand that populations of organisms change over long periods of and that there is scientific evidence to support this idea.

Materials/ Preparations
Odyssey of Life- video (available through channel 13- Nova).

Time (min)	Development	Instructional Strategies
10	Introduce movie. Lead students to make predictions about the movie.	Activating prior knowledge
30	Watch movie.	Visual Instruction.

Suggested Homework
Students write about what they learned from watching the movie, the Odyssey Of Life. (1 page response)

References:
Nova – *Odyssey of Life, The Ultimate Journey*

Standards Addressed:
Standard 4: 3.1e, 3.1g, 3.1h

Lesson # 9

Unit Topic/ Essential Question: Is change inevitable for all living things?

Aim/ Guiding Question: What happens to a species when their environment changes?

Objectives:

Students will be able to:

- Understand that natural selection provides a scientific explanation for changes seen in organisms over time.
- Understand how the environment influences the struggle for survival of certain populations.
- Understand that variation of organisms within aspecies increases the likelihood that at least some members of the species will survive under changed environmental conditions.
-

New Terms:

Camouflage	traits	variation	ancestors
descendants	offspring	industrial melanism	

Materials/ Preparations

Graph paper	2 colored pencils	over-head projector

Holt- *Visualizing Life*

Note: although this activity is seen as one that is acceptable for middle school standards, I use it here under the assumption that many students may not have actually learned these concepts in middle school. If this is not the case for you, the activity may be substituted with other examples of natural selection in action.

Time (min)	Development	Instructional Strategies
5	*Write* down your own definition of evolution. Explain why you think it happens.	Do Now, Review, Motivation
10	*Discuss* student responses. *Explain* when the environment changes, organisms change with it. Over time, descendants often look different from their ancestors. The pepper moths in England are a good example of this idea. Go over industrial revolution of the 1850's in England. It caused the soot to cover trees and change the color of trunks from light to dark. A man named Kettleworth performed an experiment to test the effects of pollution on moths. *Give out* or post on over head projector table 9.2 (p. 188) from Holt. Students write a summary of what he did. (This table breaks down Kettleworth's experiments into three steps)	Direct Instruction Individual work
15	Students make graphs of population of pepper moths over ten years.	Individual work

10	Answer as a whole class: Which variety of moths increased over the ten year period? What could have caused this change? What allowed the other variety to increase in population size? What do you think Kettleworth observed in Dorset, which was far from industrial Manchester? What would happen if there were only light moths in Manchester? (the importance of variation).	Assessment Direct Instruction

Suggested Homework:
Write a dialogue between a light colored moth and a dark moth. Have them discuss why one is surviving while the other is fearing it's life and survival of it's descendants. Discuss how the environment has created this situation.

References:
Holt- Visualizing Life

Standards Addressed:
Standard 4: 3.1b, 3.1g, 3.1h

Lesson # 10

Unit Topic/ Essential Question: **Is change inevitable for all living things?**

Aim/ Guiding Question: Why do some organisms make it while others don't?

Objectives

Students will be able to:

- Explain how species evolve over time.
- Explain that evolution is the consequence of overproduction of individuals in a population, genetic variability, competition, and selection of those organisms best suited to survive in a given environment.

New Terms:

natural selection artificial Selection variation
species adaptation

Materials/ Preparations:

Reading on natural selection (the struggle for survival)
Suggested texts: *Amsco, The Living Environment*
BSCS Biology- A Human Approach

Time (min)	Development	Instructional Strategies
5	*Show* students cabbage, brussel sprouts, and kale. *Ask* them to list how they are related.	Do Now
5	*Explain* that all of these plants are from the same **species** although they have been bred for certain characteristics just like dogs. The traits (genes) that are selected have to be present in sperm and egg so that they can be passed on to the offspring. This is called SELECTION. In nature, this process takes place naturally. Charles Darwin was the first person to explain the process. Student goal for today is to re-write his theory in a way that a first grader would understand it.	Motivation, Direct Instruction
15	Class reads aloud together. Go over major points and write on board or have students underline the major points in the reading. The major points are: • If populations could, they would grow infinitely. • Since there are limited resources, there is a fierce struggle for existence in a population. • Only a small part of the population survives as a result of this struggle.	Read Aloud, Direct Instruction

	• Those organisms that have traits best adapted (or fit or suited) for their environment are the ones that survive because they are more likely to get the resources they need. • Over time, the organisms reproduce and pass on these traits to their offspring, thereby leading to gradual change in the population and slowly to the evolution of new species.	
15	Students make table with following heading: Darwin said--------I say----Example. Students re-read in pairs and identify main points and look for a more simple way to explain these ideas. They then apply the concepts to an example of their choice (like dark and light lizards in an environment with dark sand- or rabbits with thick and thin fur in a cold environment)	Reinforcement

Suggested Homework:

1. Write a few sentences linking all of these words together.

Environment
Traits
Natural selection
Change
Adaptation
Compete
Resources

2. Who/What does the "selection" in natural selection? In artificial breeding?

References:

BSCS Biology- A Human Approach

Standards Addressed:

Standard 4: 3.1b, 3.1f, 3.1g

Lessons # 11-12

Unit Topic/ Essential Question: Is change inevitable for all living things?

Aim/ Guiding Question: How do small changes add up to big differences?

Objectives:

Students will be able to:

- Classify organisms into groups based on evolutionary relationships.
- Apply information about homology and the adaptations for life on land to construct phylogenetic trees of imaginary organisms
- Understand that evolution does not lead to long term progress in a set direction. Rather some branches survive, some die out altogether, some change even more.

New Terms:

punctuated equilibrium
extinction

Materials/ Preparations

For each pair or group of 3	A set of "creatures"
Construction paper	Glue or tape

Time (min)	Development	Instructional Strategies
5	*Show* video clip of the Precambrian sea (from the Origin of Life- Discovery Channel). It explains how scientists used fossils uncovered at the Burgess shale to explain the diversity of life at this time.	Do Now Motivation
5	Put students in groups. Set up scenario: Imagine that you are an evolutionary biologist lie the ones studying the Burgess Shale. You uncover this fascinating series of fossils which are the key to understanding how organisms made the move from water to land.	Motivation
15	In groups students group the fossils in a way that makes sense to them. They write a rationale for their choice, describing the characteristics by which they determined the grouping.	Group work
15	In groups- come up with an evolutionary sequence. Find a way to explain their evolution. Individually, in writing students explain what things determined the order in which they placed the fossils. Also explain which fossils were difficult to place and why. On a separate fossil sheet record the order that you have decided upon and a short summary of why. *Teacher collects these fossil sheets. Students place the other fossils in an envelope to use for the next day.*	Group work Assessment

Day 2

Time (min)	Development	Instructional Strategies
5	Consider this statement and write down whether you agree or disagree: Evolution occurs in different directions like a branching tree. Some species die off and and some undergo many changes over time	Do Now Assessment
10	Students continue to view piece from The Origin of Life. Show the piece on extinction of the diversity of life in the Precambrian Sea. Alternatively, read about the extinction of dinosaurs. Ask- what causes organisms to die out? Define extinction. Explain that extinction is quite common.	Direct Instruction
10	Students observe two branching diagrams showing the evolution of hominids. One is more linear, the other more branched. Compare as a whole class. Ask students: What kind of story does each diagram tell? Remind students that the branched diagram is more commonly accepted by the scientific community.	Direct Instruction Class Discussion
10	Students go back to their groups and complete constructing their evolutionary trees. Students glue the fossils when they have decided on a final order.	Group Work
5	Have some student groups share their evolutionary trees. Go over guidelines for writing story.	Sharing Discussion Informal assessment

Suggested Homework:

Day 1-Students read about the move of animals from water to land (use any textbook).
Students answer: What major adaptations had to occur for animals to move to land?
Day 2-Students write creative story- see attached.

References:

Biology Regents Lab guide

Standards Addressed:

Standard 1: 1.1a, 2.3a
Standard 4: 3.1a, 3.1g, 3.1h, 3.1k, 3.1l

Lesson # 13

Unit Topic/ Essential Question: Is change inevitable for all living things?

Aim/ Guiding Question: How does a new species form?

Objectives:
Students will be able to:
- Describe the evolutionary change that has occurred in bacteria
- Identify the factor that is exerting selective pressure on the bacteria.
- Understand the importance of variation in the survival of the species of bacteria.

New Terms:
variation
strain
antibiotic

Materials/ Preparations
Note: the story about the girl in the hospital describes a girl who is about to have her appendix removed. She develops an infection after twenty four hours. It can be obtained through *BSCS Biology- A Human Approach.*

Contact *60 Minutes* to order the video clip about tuberculosis. It aired in 1999 was shown again in the spring of 2000.

Time (min)	Development	Instructional Strategies
5	With a partner, talk about the word variation. What does it mean? Why is variation important in the study of evolution?	Do Now
20	Students watch 60 Minutes clip on resistant strains of tuberculosis in Russia. Students respond to the question: Why are resistant strains of tuberculosis a world health threat? How is this story related to our study of evolution? What is the living thing that is being selected? What is causing natural selection to happen?	Individual Response
5	*Read* story of the girl in hospital to students (from BSCS Biology- a Human Approach, p.52).	Read aloud
10	*Give* students handout which describes three possible scenarios. Students complete task (see attached).	Assessment

Suggested Homework
Students explain in writing why variations in strains of tuberculosis are potentially deadly to humans.

References:
BSCS Biology- A Human Approach

Standards Addressed:
Standard 4: 3.1f, 3.1g, 3.1h

Lesson # 14

Unit Topic/ Essential Question: **Is change inevitable for all living things?**

Aim/ Guiding Question: How do new species form?

Objectives

Students will be able to:

- Explain that new characteristics result from new combinations of existing genes or from mutations.
- Explain that mutations are rare, random events. They can occur at any time.
- Understand that mutations can be caused by radiation and chemicals.
- Understand that mutations are passed on to offspring and when the mutation is beneficial, it increases in the population as it is passed on to offspring.

New Terms:

bacteriophage	virus	Lamarck
acquired	random	mutation

Materials/ Preparations

Handout (see attached)

Time (min)	Development	Instructional Strategies
5	Students write: If you were a gambler, explain how you could win at slot machines.	Do Now Motivation
5	Students share responses. *Define* **mutation:** **a change in that happens in genes of an individual randomly and *rarely.*** *Explain:* Before the 1940's scientists did not believe that bacteria mutated (changed) like other organisms. They believed that eht environment changed the bacteria. Then a man named Luria came up with an idea to test this assumption. *Give out cartoon.*	Class Discussion Direct Instruction
5	Students write: how is a mutation like a slot machine?	Analogy
5	Teacher goes over "Luria's Question" Students make a drawing of what is described (Test tubes turn cloudy when they are populated with bacteria. Sometimes, after 24 hours, Luria would observe a test tube that was cloudy even if it had been given the bacteria killing viru because the bacteria with the mutation passed it on to it's offspring.)	Reading comprehension
10	In pairs, students use the handout with drawings of his experiment and results and summarize what Luria did, what Luria observed and what Luria concluded (see attached)	Work in pairs.

5	Go over Luria's conclusion and reasoning as a whole class. If the environment changed the bacteria, then all the plates would have looked the same (with the same amount of growth), since they were all exposed to the virus at the same time. If he observed random growth, it meant that bacteria had changed at different times, making mutations a random event (like the slot machines). Mutations can also be caused exposure to radiation and chemicals.	Informal Assessment Direct Instruction

Suggested Homework:
Students answer the following: Explain how the scenario of the girl in 1965 or the TB in Russia story is related to Luria's findings.

References:
Hoagland, and Dodson, *The Way Life Works*

Standards Addressed:
Standard 1: 1.1b, 1.2a, 3.3
Standard 4: 3.1b, 3.1d

Lesson # 15

Unit Topic/ Essential Question: **Is change inevitable for all living things?**

Aim/ Guiding Question: How do new species develop?

Objectives:

Students will be able to:

- Describe the evolutionary change that has occurred in bacteria
- Identify the factor that is exerting selective pressure on the bacteria.
- Understand the importance of variation in the survival of the species of bacteria.

New Terms:

None

Materials/ Preparations

Class set of the article from US News and World Report (Fall, 1998).

Time (min)	Development	Instructional Strategies
10	As a whole class read about antibiotic resistance and impact on people in US. The story describes a child who is very ill as a result of antibiotic resistance.	Do Now, Motivation
10	Individually, students look for key points that demonstrate that this is an example of evolution in action, and write in their won words.	Individual assessment
5	Go over outline of essay (see attached).	
15	Students begin to work on writing their essays using the outline (see attached).	Writing

Suggested Homework:

Students work on essay.

References:

BSCS Biology- A Human Approach

Standards Addressed:

Standard 4: 3.1f, 3.1g, 3.1h