

Overview:

Students engage in learning activities that highlight the broad concept of natural selection then choose a more specific topic to research and present to peers.

NOTE: This lesson can be completed over two or more class periods, or student research project may be assigned as homework.

Objectives:

The student will:

- play a game that simulates the process of natural selection;
- view media that highlights examples of natural selection; and
- research a topic related to natural selection and present findings to peers.

Targeted Alaska Grade Level Expectations:**Science**

[11] SC1.2 The student demonstrates an understanding of how science explains changes in life forms over time, including genetics, heredity, the process of natural selection, and biological evolution by researching how the processes of natural selection cause changes in species over time.

Vocabulary:

evolution – the process by which species of organisms undergo change over a long period of time through genetic variations and natural selection, resulting in the development of a new species; the evolutionary history of a species can be traced using fossils and recent advances in DNA technology to determine the relationships between it and earlier species to which it is related

habitat – the area or natural environment in which an animal or plant normally lives, such as a desert, coral reef, or freshwater lake; a habitat can often be home to many different organisms

natural selection – the principle that only organisms best suited to their environment survive long enough to pass on their genetic characteristics to their offspring; according to this principle, the proportion of the species having these characteristics increases with each generation; natural selection results from random variations of genetic traits in a species and forms the basis of the process of evolution

Whole Picture:

Athabaskan legends are full of tales of how the world came to be and illustrate an understanding that there are many processes at work in shaping Earth and its inhabitants. Take, for example, the story of how land formed. In the beginning there was nothing but water. Beaver got tired of swimming so he dove down and scooped up mud to build the land.

And how about the legend of how mosquitoes came to be? In the far past, Raven had six wives. Their constant bickering drove him crazy until he ran them all off into the woods. When he wanted them to come back they refused and hid from him so he created mosquitoes to flush them from their hiding places. It wasn't long before the wives sought the shelter of the house again.

Another version goes like this: After the Raven created humans, a man came and stole his wife away from him so Raven went out and gathered rotten willow wood, pulverized it to dust then scattered it into the air. The dust became mosquitoes, which would forever torment mankind.

The scientific study of the process of changes in life forms throughout history looks to the concept of natural selection. Natural selection is the process through which certain traits are either passed on or eliminated depending on how they affect the survival of the carrier. In other words, natural selection produces species better adapted to their environment through changes in the genetic composition of a population from one generation to the next.

Materials:

- Patterned fabric, 1'- to 2'-foot square (one per small group)
- Paper dots from hole punch, 3 different colors
- Colored pencils that match colors of paper dots
- Graph paper (one per small group)
- Timer/Stopwatch
- Glue
- Index cards (three per pair)
- Multimedia projector
- STUDENT LAB: "Hunting for Dots"
- TEACHER INSTRUCTION SHEET: "Natural Selection Research Topics"
- STUDENT WORKSHEET: "Natural Selection Research"

Activity Preparation:

1. The purpose of the first activity is to highlight the benefits of certain traits in wildlife survival. It is best to choose patterned fabric and colored dots that will serve this purpose. Read STUDENT LAB: "Hunting for Dots" and Activity Procedure 2 for more clarification.
2. The PBS website contains a section with videos, animations and activities about natural selection and evolution. Review the site for appropriate illustrations to share with the class. Some recommendations are included in Activity Procedure 3.
3. Locate and print out (or save to a hard drive) natural selections images and comics to share with students. Many are very funny and do a good job of simplifying the concept of natural selection. Using an Internet search engine, enter the search term "natural selection" and choose to view images. Alternately, enter the search term "natural selection cartoons."
4. The University of Colorado at Boulder provides an interactive natural selection activity where students can conduct simple experiments by selecting for dominant and recessive traits, limiting factors, and environmental differences for a population of rabbits. <http://phet.colorado.edu/en/simulation/natural-selection>. Review the simulation to prepare for introducing it to students if time allows. (See Extension Ideas)

Activity Procedure:

1. Divide students into small groups. Hand out STUDENT LAB: "Hunting for Dots." Hand out materials and explain the lab. Either be prepared to be the timekeeper, or appoint a student to be the timekeeper. Allow students to complete lab. Circulate to gauge understanding, especially during graphing.
2. When students have completed the lab, ask the following critical thinking questions. Different groups may have different results depending of fabric type, colors of dots and aggressiveness of predators. Allow for all groups to answer.
 - a. Of the first generation of dots, did one color of dot seem to survive more than others?
 - b. How about in the second generation?
 - c. Why do you think the predators didn't select those colors as often as other colors?
 - d. What effect did capturing a particular color have on the number in the following generation?
3. Remind students the activity was a simple demonstration of natural selection. Review the definition of natural selection. If available, share images and cartoons selected earlier. (See Activity Preparation)
4. Using a multimedia projector, access the PBS website section about evolution and share several examples: <http://www.pbs.org/wgbh/evolution/library/01/index.html>. Consider sharing:
 - a. Under the heading Adaptation, see the short video "Evolution of Camouflage," about a type of praying mantis.

- b. Under the heading Adaptive Compromise, see the short video “A Mutation Story,” about the role of the sickle cell gene in natural selection.
 - c. Under the heading Coevolution, see the Web activity “Coral Reef Connections” to discuss the ecological relationships among reef creatures.
 - d. Under the heading Coevolution, see the short video “Toxic Newts” about the hyper-toxic newt and the predator that can stomach it.
 - e. Under the heading Natural and Sexual Selection, see the short video “Tale of the Peacock” explaining the bird’s extravagant tail feathers.
 - f. Under the heading Natural and Sexual Selection, see the text and image for “Adaptive Radiation: Darwin’s Finches” to see how the birds have adapted to a variety of available food sources.
5. Divide students into pairs. Hand out STUDENT WORKSHEET: “Natural Selection Research”. Explain the directions to students then review the potential research topics found on TEACHER INSTRUCTION SHEET: “Natural Selection Research Topics”. The instruction sheet was designed so topics could be cut away and handed to students, if desired. Additional copies may be required if more than one pair shares the same topic. Allow class time for research and worksheet completion. Each pair must be ready to hand in three note cards upon completion of the worksheet. These will be used to review later.
 6. Allow each pair two to three minutes to report their findings to the class. Presenting pairs should use completed worksheets as a guide. Explain all students will need to pay attention in order to win a game as the end. After all pairs have had a chance to present, use the note cards to play the following review game:
Trash Ball: Divide the class into two groups or teams (for example Group A and Group B). Within each team students form a numbered line-up to take turns answering questions. The first question will go to Group A, student one. If the student gets the answer correct, the team gets one point. Then the student gets to throw a huge paper ball (made of wadded paper) into a trashcan. If the student chooses to throw from across the room and makes it, the team gets three points. If the student chooses to throw from six feet and makes it, the team gets one point. A correct answer has the potential of earning from two to four points total. Then the next team gets their chance, with Group B, student one. Return to Group A, student two, and so on.

Extension Idea:

The University of Colorado at Boulder provides an interactive natural selection activity where students can conduct simple experiments by selecting for dominant and recessive traits, limiting factors, and environmental differences for a population of rabbits. See <http://phet.colorado.edu/en/simulation/natural-selection>.

Answers:

STUDENT LAB: “Hunting for Dots”

Answers will vary according to lab results. Each lab should have a graph attached corresponding to data collected.

STUDENT WORKSHEET: “Natural Selection Research”

1.- 3. Answers will vary. Pairs must hand in 3 note cards, each with one question and one answer about their topic.

Below are suggested research topics for students. Based on the needs of the class, use the topics suggested or allow students to decide their own topic. Students must get teacher approval before proceeding with research.

Arctic/Alaska specific focus:

Caribou – in 2003 researchers documented the Western Arctic Caribou Herd at 490,000. Just four years later, in 2007, the same herd had dropped to just 377,000. Researchers are monitoring the herd to discover the reasons for the decline. Begin with search term(s): decline of caribou in the Arctic.

Climate change – Earth’s climate has experienced dramatic changes through the ages. Dinosaurs lived in an age of warmer, sunnier climate – even in the Arctic – but experienced mass extinction. During the last ice age woolly mammoth roamed the north. There are hundreds of thousands of examples of animals that are now extinct because Earth’s climate no longer provides the ideal habitat. Begin with search term(s): extinction of animals in Alaska.

Muskox – the muskox survived the last ice age but currently faces a depleted population. Muskox effectively resist natural prey, however the animals’ defense is not effective against hunters. It may also be impacted by the warming climate. Begin with search term(s): decline of muskox.

Salmon – salmon returns to Bristol Bay have been falling short and so have returns to the Yukon-Kuskokwim River. Some scientists say this is a natural oceanic cycle. Others are worried climate change is having an impact. Begin with search term(s): Alaska’s declining salmon population.

Possible Resources:

Alaska Department of Fish and Game: <http://www.adfg.alaska.gov/index.cfm>

Alaska Sea Life Center: <http://www.alaskasealife.org/>

Climate Change: <http://icb.oxfordjournals.org/content/44/2/140.full>

Muskox: <http://naturalsciencemuseum.blogspot.com/2010/03/climate-change-cause-of-decline-in.html>

General focus:

Antibiotics – antibiotics can kill most bacteria, but some strains of bacteria are resistant to antibiotics. When a population of bacteria is exposed to an antibiotic, the resistant strains are able to reproduce and pass on their genes. Soon there is a population of antibiotic-resistant bacteria. Begin with search term(s): antibiotics and natural selection.

Artificial versus natural selection – natural selection is considered the driving force of evolution. Artificial selection is primarily driven by the goals of the human population. Begin with search term(s): artificial versus natural selection.

Darwin's Galapagos finches – when Charles Darwin visited the Galapagos Islands, he noted several species of finch that all had different beaks, each one adapted to suit the finch's specific diet. Begin with search term(s): Darwin's finches.

Dog breeding – humans use artificial selection, or selective breeding, to breed dogs with favorable traits. Artificial selection is contrasted with natural selections in which traits that increase the likelihood of reproduction are passed on. Begin with search term(s): dog breeding and natural selection.

History of evolution – the first evidence of the theory that life has developed over time can be traced back to ancient Greece. Charles Darwin refined many of those beliefs and is considered the father of the theory of evolution. Begin with search term(s): history of evolution.

Sickle cell anemia – people who inherit the blood disease sickle cell anemia can experience life-threatening symptoms, but they are also immune to the affects of malaria. Begin with search term(s): sickle cell anemia and natural selection.

Possible Resources:

The Complete Works of Charles Darwin Online: <http://darwin-online.org.uk/>

Understanding Evolution: <http://evolution.berkeley.edu/>

PBS evolution library: <http://www.pbs.org/wgbh/evolution/library/01/index.html>

15 Evolutionary Gems from Nature: <http://www.nature.com/nature/newspdf/evolutiongems.pdf>

Sickle Cell Anemia: http://sickle.bwh.harvard.edu/malaria_sickle.html

Dog Breeding: Artificial versus Natural Selection: <http://ncse.com/book/export/html/5251>

Antibiotic Resistance: http://en.wikipedia.org/wiki/Antibiotic_resistance

NAME: _____
HUNTING FOR DOTS

Wildlife keeper: _____

Predator 1: _____

Predator 2: _____

Recorder: _____

Materials

- 1 piece patterned fabric
- Paper dots, 3 different colors (at least 30 of each color)
- 3 colored pencils (same colors as dots)
- Timer/Stopwatch

STEP ONE: Wildlife keeper—prepare the habitat. (Predators must look away during this time.)

- A. Lay out a piece of patterned fabric, pattern side up.
- B. Choose 20 dot of each color (for a total of 60 dots) and spread them over fabric.
- C. Record colors of dots in the column titled COLOR on the chart below.

STEP TWO: Timekeeper—count 15 seconds for predators.

- A. When the timekeeper (teacher or assigned timekeeper) says START, predators will have 15 seconds to pick up as many colored dots as possible.
- B. When the timekeeper says STOP, the wildlife keeper sorts remaining dots into three separate piles. The recorder then marks the number of remaining dots of each color on the chart under "After First Hunt."

STEP THREE: 2nd Generation is born.

- A. Wildlife keeper, simulate reproduction by adding one paper dot for each remaining dot of that color. (The remaining dots of each color will double in number.)
- B. Recorder, mark the number of dots on the chart under 2nd Generation.

STEP FOUR: Timekeeper—count 15 seconds for predators.

- A. When the timekeeper says START, predators will have 15 seconds to pick up the second generation of colored dots.
- B. When the timekeeper says STOP, the wildlife keeper sorts remaining dots into three separate piles. The recorder marks the remaining dots under "After Second Hunt."

STEP FIVE: 3rd Generation is born.

- A. Wildlife keeper, simulate reproduction by adding one paper dot for each remaining dot of that color. (Again, the remaining dots will double in number.)
- B. Recorder, mark the number of dots on the chart under 2nd Generation.

STEP SIX: Graph the results.

- A. Using graph paper, make a graph to visually represent your results.
- B. Label your graph. Include a title, labels for both the X and Y axes, and a legend. Attach your graph to this lab before handing it in.

Color (dots)	1 st Generation (start)	After First Hunt	2 nd Generation (after reproduction)	After Second Hunt	3 rd Generation (after reproduction)
1.	20				
2.	20				
3.	20				

NAME: _____
NATURAL SELECTION RESEARCH

STUDENT WORKSHEET
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natural selection – the principle that organisms best suited to their environment survive long enough to pass on their genetic characteristics to their offspring more often than less well-suited organisms. According to this principle, the proportion of the species having these characteristics increases with each generation. Natural selection results from variations of genetic traits in a species and forms the basis of the theory of evolution.

With the approval of my teacher I have picked the following natural selection topic to further research:

Directions: Research your topic using classroom, library and Internet resources. Record your sources in the space provided. Be prepared to share your findings with your peers.

1. Provide a summary of your topic or issue. _____

2. How is this topic related to natural selection? Explain. _____

Source(s): _____

(If you need more room to document sources, use the back of this page.)

NAME: _____
NATURAL SELECTION RESEARCH

STUDENT WORKSHEET
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1. Now it's time to prepare to teach your classmates about your topic. Using the information you have gathered so far, write down three points you want your classmates to learn about your topic.

A. _____

B. _____

C. _____

Directions: Using the three points above, fill in three questions and answers in the spaces below. When complete, cut them out. Glue the question on the front of an index card with the corresponding answer on the back. The teacher will use these in a quiz game to test you and your classmates.

Question 1:	Answer 1:
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Question 2:	Answer 2:
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Question 3:	Answer 3:
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