1. How does ordering supplies for the school bookstore compare to Darwin’s Theory of Natural Selection?

2. How does genetic variation increase an entire species chance of survival?

3. What factors contribute to the extinction of a species?

4. What environmental changes could potentially cause *homo sapiens* to become extinct?
Objectives for Unit 2 - Part 1: Natural Selection/Evolution

You will UNDERSTAND the following concepts...

- **Species** change over time.
- Genetic **diversity** between parents and offspring can lead to changes in future generations.
- Changes in environmental conditions can affect the survival of individual organisms.
- The usefulness of a trait depends on the environment.
- In the history of the Earth, **extinction** is a common event.
- Over time, Earth’s environment has changed dramatically.
- **Fossils** are evidence that a variety of species existed in the past which is support for the process of natural selection which leads to evolution.

You will KNOW the following ideas and concepts...

- A **species** is a group of the same type of organisms that can mate and reproduce **fertile** offspring.
- A **population** is a group of the same species of organism living in the same area.
- The process of sexual reproduction gives rise to a variety of **traits** within a species.
- A **variation** is a difference in form, function, shape, or structure between two organisms of the same species.
- Organisms of the same species have **variations** in their genetic make-up (traits).
- **Mutations** give rise to a variety of traits within a species.
- An **adaptation** is a trait that is useful for an organism’s survival.
- A **predator** is an organism that hunts and eats other organisms, which are known as **predy**.
- Organisms with certain traits are more likely to survive than organisms with other traits (in a given environment).
- Organisms that have beneficial survival traits (such as **camouflage**) are more likely to reproduce and pass on these genes to their offspring.
- **Natural Selection** is the process whereby organisms that are best adapted to their environment are able to survive and pass on their genes. This can also be described as “**survival of the fittest**”.
- Small genetic differences between parents and offspring can accumulate in successive generations so that descendants are very different from their ancestors.
- Human activities such as selective breeding and genetic engineering may affect the variations within a species.
- **Competition** occurs when two or more organisms need the same resource.
- Competition can be between members of the same species or between members of different species.
- **Resources** are necessities that organisms need for survival such as food, shelter, air, etc.
- **Extinction** means there are NO organisms left of a certain species.
- **Endangered** means there are very FEW organisms left of a certain species.
- Extinction of a species occurs when the environment changes and the species’ adaptations are insufficient to allow for its survival.
- **Evolution** is the process of an entire species changing over many generations; **it is not** a change in one individual organism.
- Some species can evolve in a shorter period of time than other species due to reproduction rates, lifespan, number of offspring, etc.
- Bacteria and insects have evolved in the time that humans have been observing them.
  - There are three types of **adaptations**: behavioral (actions), structural (body features or parts), and physiological (automatic responses to stimuli)
  - A superbug (antibiotic resistant bacteria) is an example of a species evolving in a short period of time.
  - **Extinction** of one species can have profound effects on an entire ecosystem.
  - Charles Darwin made observations of finches and other organisms that lead to the modern theory of **evolution**.

→ → CONTINUES ON FOLLOWING PAGE...
You will **BE ABLE TO DO** the following activities...

- Interpret/analyze data/graphs and draw conclusions
- Describe examples of adaptations in both plants and animal
- Experience how difficult survival can be without specific adaptations (no thumbs activity)
- Describe an example of natural selection
- Complete the Battle of the Beaks lab
- Compare and contrast Lamarck’s and Darwin’s thought about evolution
- Sort examples of adaptations into one of the three types (structural, behavioral, physiological)
- Study adaptations to a geographic region
- Research an endangered species
- Complete “Life has a History” webquest
Using three or more sentences, describe what you think natural selection means and how it works. At the end of the activity, you will be asked to answer the same question to see what you have learned.

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**Battle of the Beaks**

Part 1: Eat, Drink, and Be Merry on the Mainland

My beak: ____________________________________________

<table>
<thead>
<tr>
<th>TABLE 1</th>
<th>beans (beetles/berries)</th>
<th>elbow macaroni (duckweed)</th>
<th>M &amp; M’s (grubs)</th>
<th>colored water (nectar)</th>
<th>raisins (ants)</th>
<th>gummy worms (worms)</th>
<th>paper clips (spiders)</th>
<th>rotini macaroni (fish)</th>
<th>washers (small rodents)</th>
<th>small seeds</th>
<th>large seeds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amount</td>
<td></td>
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<td></td>
<td></td>
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</tr>
</tbody>
</table>

Top three foods = □  Lowest three foods = □  Use a highlighter to indicate choices.
1. In this activity, you randomly received a beak with a certain trait such as spoon shaped or magnetic. In real life situations, where do organisms get their traits?

___________________________________

2. All the birds on the Mainland were able to survive living together. Why?

__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
____________________________________________________________

3. A long time ago, most of the birds of this species had pretty much the same kind of beak with some slight differences. For example, some of the birds had beaks that were slightly more pointed and others had beaks that were a bit longer. Some birds had slightly stronger beaks while others had wider beaks. What two factors are responsible for these variations among the finches?

a. __________________________________________

b. __________________________________________

4. What does the word variation mean?

___________________________________________________________________

Due to a very big and long lasting storm, many of these happy and successful birds were blown to different places. Many birds ended up on islands off the mainland. These islands were different from the mainland in that each island only had certain foods, not all the foods.

Two of the islands and their ONLY foods are listed:

Santa Cruz: Ants, spiders, and small seeds
Isabela: Worms, beetles, and grubs
1. What type of beak do you have? ________________________________

2. Food is considered a **resource** in this activity. What is a resource? ________________________________

3. What are some other **resources** birds need? Can you list at least three? ________________________________

4. Use your results in **Table 1** to make a hypothesis about your survival on each of the two islands. **Consider your top three foods only** when determining your chance for success. **Explain yourself!**

<table>
<thead>
<tr>
<th>Isabela Hypothesis</th>
<th>Santa Cruz Hypothesis</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tbody>
</table>

**Part 3: Struggle for Survival**

<table>
<thead>
<tr>
<th>Table 2 Santa Cruz</th>
<th>Number of birds (x100)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Many generations pass</td>
</tr>
<tr>
<td></td>
<td>#1 #2 #3 #4 #5 #6 #7 #8</td>
</tr>
<tr>
<td><strong>Fork</strong></td>
<td>1</td>
</tr>
<tr>
<td><strong>Holder</strong></td>
<td>1</td>
</tr>
<tr>
<td><strong>Dropper</strong></td>
<td>1</td>
</tr>
<tr>
<td><strong>Spoon</strong></td>
<td>1</td>
</tr>
<tr>
<td><strong>Magnet</strong></td>
<td>1</td>
</tr>
<tr>
<td><strong>Toothpick</strong></td>
<td>1</td>
</tr>
<tr>
<td><strong>Scooper</strong></td>
<td>1</td>
</tr>
</tbody>
</table>

An **adaptation** is a variation that proves to be useful for survival.

☒ Which beak variation(s) are adaptation(s) on **Santa Cruz**? Use a highlighter to indicate choices.
An adaptation is a variation that proves to be useful for survival.

Which beak variation(s) are adaptation(s) on Isabela? Use a highlighter to indicate choices.

---

### Checking for Understanding

1. What beak(s) are adaptations on Santa Cruz? ____________________________________________

2. What beak(s) are adaptations on Isabela? ____________________________________________

3. Why do these islands support different adaptations? Use the word environment in your answer.

_________________________________________________________________________________
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_________________________________________________________________________________
Part 4: Being a Scientist

The birds on each of these islands today do not exactly resemble (look like) the original mainland birds. This activity was designed to help you understand the mechanism (how it works) behind the changes in the birds that happened over time.

1. You have discovered that not all birds were able to survive on each island and that certain variations were better than others depending on the island. For each island, put an X through beaks that would be less beneficial on that island. Circle the face that you think the most common type of bird would look like on that island. Use Table 2 and Table 3 to remind you of the best variations.

   Santa Cruz

   Why did you pick this bird?

   __________________________________________________________
   ___________________________________________________________________

   Isabela

   Why did you pick this bird?

   __________________________________________________________
   ___________________________________________________________________

2. Notice that you did not pick the same bird face for each island. The species has changed over a long period of time. The birds on each island are uniquely adapted to that island. This would not have been able to happen if there weren’t beneficial mutations to a specific island present in the population BEFORE the big storm. In other words, individual birds can’t just change to be suited for a certain place.

   It is not just the beaks that changed over a long period of time on the new island. Other traits like color and feet changed over time as well, too. The birds that had the best color and feet for the island were most likely to survive and reproduce more birds with these beneficial traits.

   On Santa Cruz, there are many small rodents, such as mice. Put an X through the feet that would be less beneficial on this island. Circle the feet that would most likely populate Santa Cruz over a long period of time.

   Why did you pick these feet?

   __________________________________________________________
   ___________________________________________________________________
3. This activity represents how **Darwin’s Theory of Natural Selection** works. In your own words, describe how each of the steps of Natural Selection is modeled in the experiment.

Use the following words in your work. Check each word off as you use it. **Underline** it in your answer.

- adaptation
- competition
- variation

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
<th>How the activity modeled this.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>All organisms of the same species are somewhat different from one another.</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Limited resources and large numbers of organisms leads to a struggle for survival.</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Individuals with certain traits have a better chance of surviving and reproducing. This is known as <strong>survival of the fittest</strong>.</td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Those organisms that do survive and reproduce will pass their traits on to their offspring.</td>
<td></td>
</tr>
</tbody>
</table>
Describe what **natural selection** means and **how it works**. Use the following vocabulary words to enhance your answers. **Check** them off and **underline** them as you use them.

- adaptation
- competition
- environment
- mutation
- resource
- survival of the fittest
- variation

<p>| | | | |</p>
<table>
<thead>
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</thead>
<tbody>
<tr>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>All the vocabulary words are used appropriately and are used in a way that enhances the explanation.</td>
<td>Most of the vocabulary words are used appropriately and there is an attempt to connect them to the explanation.</td>
<td>Some of the vocabulary words are used appropriately, but there is only a loose connection to the explanation.</td>
<td>Most of the vocabulary words are used inappropriately and/or are not used effectively.</td>
</tr>
<tr>
<td>The work is organized and explains natural selection with a high degree of understanding.</td>
<td>The work is fairly organized and explains natural selection with an acceptable degree of understanding.</td>
<td>The work is somewhat disorganized and/or fails to explain natural selection with a reasonable degree of understanding.</td>
<td>The work is disorganized and/or demonstrates a lack of understanding.</td>
</tr>
</tbody>
</table>
Charles Darwin spent seven years, from 1831-1838, aboard the H.M.S. Beagle as a naturalist. This was a rare opportunity for a man of just 22 years. He observed, recorded, collected, and preserved everything he could. His notebook included information on plants, animals, rocks, soils, climate, people, and geography.

In 1835, Darwin spent some time in the Galapagos Islands. Of all the things that Darwin observed here, small birds called finches, captured his attention the most. He noticed that these birds resembled each other closely except for one set of characteristics - the size and shape of their beaks. Darwin counted 14 species of finch. It is believed that they evolved from a single species from the mainland of South America. As the finches settled on various islands, they adapted in a unique way suitable to their new habitat. These changes occurred over a long period of time. On some of the islands there were trees for the finches to nest in. Other islands contained cacti. Others still forced the birds to basically inhabit the ground. The food source on the various islands also differed. Some islands offered seeds while others offered fruit or insects. The single finch population, over time, changed to become the 14 species we see today.

The pictures on the next page represent some examples of the types of beaks Darwin encountered and the habitat and food source found on that particular island.
Darwin’s Finches

The cactus finch has a probing beak to reach into the flower of the cactus for nectar. Why do you think this beak shape is helpful?

This finch has a strong crushing beak to grind large hard seeds. It resembles the beak of a parrot. Where do you think it finds the seeds?

The beak of this finch is quite delicate looking. It is used to eat aphids and small berries. It is designed to grasp. Where do you think it spends most of its time?

This ground finch uses its pointed beak to eat small seeds and ticks from iguanas. What type of symbiotic relationship is this? Why?
Test your bird IQ

Read each statement and answer the question.
Each correct answer is worth two insects.

1. What is the relationship between the shape of the beak and the food that the bird eats?

2. What information about the environment on the mainland would you need to determine the appearance of the beaks from the original mainland finches?

3. Why were the birds' beaks on each island different from each other?

4. Why did Darwin think these birds, called finches, were related?

5. It is believed that these finches changed over time due to their ability to adapt to a new environment. What is the process of "change over time" called?

Add up your score and check your bird IQ!

8-10 insects Great job. You are in good shape. Your ability to adapt will come in handy very soon.

6-7 insects You are on the threatened list. There is concern about your future.

4-5 insects You are on the endangered list. Your time may be short if measures are not taken to save you.

0-3 insects You are extinct. All efforts to save you have failed. Cloning is your only hope.
Name: ____________________________   Class: ______________

# Adaptations For Survival

## Procedure

1. Do each of the following activities and have your partner time how long it takes you to do each one. Record the times in the data table below.
   a. Pick up a piece of paper off the floor (use one hand only on this one)
   b. Write your full name (first and last) on a piece of paper
   c. Unscrew a bottle cap and screw it back on again
   d. Untie and tie one of your shoelaces
   e. Tear off a small piece of masking tape

2. Have your teacher or your partner tape each of your thumbs to the palm of your hand with masking tape.

3. After your thumbs are securely taped, try each of the activities listed in step 1 again. Time each activity as you did before and record the time in the data table. **If an activity is not done in two minutes, record it as “unsuccessful.”**

## Data

<table>
<thead>
<tr>
<th>Action</th>
<th>Time to complete the action (seconds)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Thumbs Free</td>
</tr>
<tr>
<td>Pick up Paper</td>
<td></td>
</tr>
<tr>
<td>Writing Name</td>
<td></td>
</tr>
<tr>
<td>Bottle Cap</td>
<td></td>
</tr>
<tr>
<td>Shoelace</td>
<td></td>
</tr>
<tr>
<td>Tape</td>
<td></td>
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</tbody>
</table>

## Explanation

Living things have bodies that are adapted for the places they live and the things they do. An adaptation is a trait that enables an organism to be more successful in its environment. Fish have gills so that they can remove oxygen that is dissolved in water. Most plants have green leaves which contain chlorophyll so that they can make food. Jellyfish have stinging cells to capture prey. Birds have hollow spongy bones so that they will be light enough to fly. Arctic animals have layers of fat and thick coats of fur to keep warm in the frigid Arctic climate. There are hundreds of examples of ways that organisms are adapted for a successful lifestyle.
Think of another adaptation and write it in the box below.

Conclusions

Summarize what you did in this activity. Describe your results and explain why you think you had those results.

________________________________________________________________________
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In your own words describe what an adaptation is.

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

What advantage(s) does our thumb adaptation provide us?

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
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________________________________________________________________________
________________________________________________________________________

**Mystery Adaptations**

**Directions:**

1. Cut out the following boxes
2. Arrange the cards into three groups based on similarities.
3. On the next page, place your groups of three into one of the column in the data table.
4. Brainstorm a title for each column.
5. Paste them in the data table once you have received approval from your teacher.

<table>
<thead>
<tr>
<th>A wolf will grow a thicker coat in the winter. In the summer, when it is warmer, it will shed this thick coat.</th>
<th>A duck has webbed feet to swim faster</th>
<th>Fish swim in schools for protection.</th>
</tr>
</thead>
<tbody>
<tr>
<td>A monkey has an opposable thumb to help grasp branches as it swings from tree to tree.</td>
<td>When you get cold, you shiver</td>
<td>Snakes have a hinged jaw to help them consume large prey.</td>
</tr>
<tr>
<td>Dogs snarl and growl when they feel threatened</td>
<td>A cat’s fur will stand up on end when the cat is frightened. This makes the cat appear larger than it really is.</td>
<td>Birds fly south for the winter to avoid the cold weather.</td>
</tr>
</tbody>
</table>
## Natural Selection

**A Charade of Adaptations**

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<table>
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</table>
Adaptations

An adaptation is a structure or behavior that helps an organism better survive in its environment. When an organism is better equipped for survival then it has a better chance of reproducing. When this reproduction happens, it is likely that the beneficial genes can be passed down. Because the trait is beneficial to the survival of the organism, it will accumulate in the population. Over time, this can cause a species to evolve.

Define each type of adaptation and provide an example of each.

<table>
<thead>
<tr>
<th>Adaptation</th>
<th>Definition</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Structural</td>
<td></td>
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<tr>
<td>Behavioral</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physiological</td>
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</tbody>
</table>

Directions:

Write a caption for the porcupine to express her delight with her inherited adaptations.

1. Click on instructions and read the rules for the game.
2. Click on the projector button.
3. Read the clue to learn about the animal’s adaptation.
4. Determine which need the adaptation helps the animal to obtain.
5. Click on the card for that survival need.
6. As you are working, complete the graphic organizer below.

### Animal Adaptations!

<table>
<thead>
<tr>
<th>Animal</th>
<th>Adaptation</th>
<th>How it helps the animal to survive</th>
<th>Structural, behavioral, or physiological</th>
</tr>
</thead>
<tbody>
<tr>
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<tr>
<td>Animal</td>
<td>Adaptation</td>
<td>How it helps the animal to survive</td>
<td>Structural, behavioral, or physiological</td>
</tr>
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</tbody>
</table>
Adaptations homework

Directions: Using your family pet (or your favorite animal if you do not have a pet), record at least one behavioral adaptation, one physiological adaptation, and one structural adaptation. Identify the adaptation and then state why it is a valuable adaptation (how does it help the animal survive).

Use previous pages in your Natural Selection Unit Packet to help you.

Example

**Structural**

My horse has large ears that can swivel around to hear potential threats.

**Behavioral**

My pet is a(n) ________________________

**Structural**

---

**Physiological**
Genetic Variation

Directions:

1. Go to this web address. There is a link on the 7th grade website under the Natural Selection Unit, Natural Selection tab. http://evolution.berkeley.edu/evolibrary/article/4_0_0/evo_17

2. Complete the questions below for each section of the website. (This will make more sense once you get to the website).

3. Explore further if you have time!

Genetic variation

1. Match the three primary sources of genetic variations with their descriptions. Draw a line to connect the matches!

<table>
<thead>
<tr>
<th>Mutations</th>
<th>Introduces new gene combinations into a population. This genetic shuffling is another important source of genetic variation.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gene Flow</td>
<td>Random changes in the DNA of an organism.</td>
</tr>
<tr>
<td>Sexual Reproduction</td>
<td>Any movement of genes from one population to another and is an important source of genetic variation.</td>
</tr>
</tbody>
</table>

2. Which one of the three does this diagram represent?
Mutations

1. Mutation is a change in ___________, the hereditary material of life. An organism's DNA affects __________________________, how it _____________________, and its __________________________ — all aspects of its life. So a change in an organism's DNA can cause changes in __________________________________________________________.

2. Mutations are _______________________. Mutations can be ____________________, __________________________, or _________________________ for the organism.

3. Circle True or False: Mutations do not "try" to supply what the organism "needs."

4. Circle True or False: Only mutations in sex cells can be passed on to offspring.

Mutations II

1. Mutation can have a range of effects. They are:

   ________________________________________________________________________

   ________________________________________________________________________

   ________________________________________________________________________

2. What is a “lethal?”

   ________________________________________________________________________

   ________________________________________________________________________

   ________________________________________________________________________

3. Circle True or False: Mutations can cause really noticeable changes OR no noticeable changes.

4. Circle True or False: Mutations can help an organism, harm an organism, or cause no affect on an organism.

Vocabulary Alert

Phenotype
the physical appearance of an organism

Take a side trip to Mutations are random before hitting next.
Mutations are Random

1. Circle **True or False**: Mutations are random.

2. Circle **True or False**: Whether a particular mutation happens or not is generally **unrelated** to how useful that mutation would be.

3. Circle which explanation, Hypothesis A or B, is accepted by scientists. Put an X through the explanation that is not accepted by scientists.

   **Hypothesis A:**
   
   Resistant strains of lice were always there — and are just more frequent now because all the non-resistant lice died a sudsy death.

   **Hypothesis B:**
   
   Exposure to lice shampoo actually caused mutations for resistance to the shampoo.

   Circle **True or False**: An organism that needs to adapt to a changing environment will get a mutation in response to the changing environment to help it adapt.

The Causes of Mutations

1. Of the two reasons listed as causes of mutations, which one does the diagram at the right represent?

   ________________________________

2. What are two EXTERNAL causes of mutations?

   • ________________________________
   
   • ________________________________
Gene Flow

1. Using the picture as an example, explain how the movement of the brown bug into the green bug’s populations might lead to **genetic variation** in the green bug population.

_______________________________________________________________________________
_______________________________________________________________________________
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_______________________________________________________________________________

Sex and Genetic Shuffling

1. Sexual reproduction can introduce new _______________________ combinations into a population and is an important source of ____________________________

_______________________________________________________________________________
_______________________________________________________________________________

2. When organisms reproduce __________________, some genetic "_________________" occurs, bringing together new ___________________ of ____________________________.

3. In the example to the right, how were the genes shuffled?

4. This shuffling is important for evolution because it can introduce new ___________________ of genes every generation. However, it can also break up "_________________" ____________________________ of genes.
Natural Selection – A Big Idea

**Competition:** The effort of 2 or more __________________________
acting independently to get __________ that are in ________.

**Variation:**
- Differences in _________________, _________________, or _________________.
- Caused by ___________ ________________ or ______________________________

**Adaptation:** a useful __________ that helps an organism
to __________________, and which gives it an ________________ in its ________________.

**Overpopulation:**
- Too many ________________ in one ________________
- Can lead to ____________________
1. **Overpopulation** can lead to ________________________________

2. Due to ___________________, some organisms (with ______________) will live on, but others _______________.
   Also called ______________ of the ______________.

   The ______________ of a trait depends on the ______________ and ________________.

   - brighter stripes
   - skinny body
   - speedy swimmer

3. Organisms that have ________________ will _______________ and then _________________.
   They pass the _________________ on to their _________________.

4. **END RESULT:** The ______________________________ now has a lot more organisms that have _________________.

   This is ______________. (Nature ______________ the traits that will _______________.)
Because of **overpopulation**, some offspring will die due to predators, lack of food, disease, and other varying reasons.

The beneficial traits will accumulate in the population so that most organisms will have this trait. This is known as **inheritance**.

There is natural **variety** in all populations due to **mutations** AND the genetic shuffling of **sexual reproduction**.

Too many organisms and not enough resources lead to **competition** for resources such as food, water, a mate, shelter, etc.

Beneficial mutations (adaptations) make organisms better suited to their environment. This is called “**survival of the fittest**”.

**Directions:**
Read the information in each details box below, and examine the diagrams at the right. Cut out the boxes and place them under the appropriate step on the following page. **After you have had a teacher check, glue them in place.**
## Darwin’s Theory of Natural Selection

1. Each species produces many more offspring than can survive and reproduce.

   *DETAILS GO HERE*

   *DIAGRAM GOES HERE*

2. The overproduction of offspring leads to a struggle for survival.

   *DETAILS GO HERE*

   *DIAGRAM GOES HERE*

3. All organisms of the same species are somewhat different from one another.

   *DETAILS GO HERE*

   *DIAGRAM GOES HERE*

4. Individuals with certain traits have a better chance of surviving and reproducing.

   *DETAILS GO HERE*

   *DIAGRAM GOES HERE*

5. Those organisms that survive and reproduce pass their traits on to their offspring.

   *DETAILS GO HERE*

   *DIAGRAM GOES HERE*
Mystery Moths

In Manchester, England in the 1800's, a population of moths occupied the trees. The Peppered moth is typically a white moth covered with black spots. This coloration provided an effective **camouflage** for the moths as they rested on birch trees which are a white color. Like humans, these moths can be found in a range of colors from very black to very white and all shades in between.

This range of color in the moths is a genetic **variation**. Variations are the differences in a trait. Genes control them. Organisms that survive will pass their genes on to their offspring. This is how a trait accumulates in a population. If an organism is born with a variation (mutation) that harms it, most likely the organism will NOT survive and the trait (mutation) will NOT get passed on.

During the Industrial Revolution (1850's), sooty smoke from coal burning furnaces darkened the bark of the birch trees. When moths landed on these trees, the light colored moths were more visible to **predators**. Over generations, the environment continued to favor the darker moths and because the darker moths were camouflaged, they more often lived long enough to reproduce. By 1900, 98% of the moths in the vicinity of cities like Manchester were showing the darker variation, black.

**Important vocabulary:** camouflage, variation, predator
To really understand natural selection, you must realize that natural selection can only occur when a genetic variation is already present in a population before the environmental change. Since there were already some dark moths in the population in Manchester, natural selection could happen.

In the 1950's, air pollution controls significantly reduced the amount of pollutants reaching the trees. As a result the trees became lighter in color.

What might have happened to the moth population during the Industrial Revolution if there were no variations and all the moths were white? Explain.

What do you think happened to the moth population? Why?

Can you do this?

Look around the classroom. Observe the variations you see in your classmate's clothing, hair color, footwear, method to carry books, gender, or other trait. Select one trait that has several variations. Be prepared to share!

Change of Pepper Moths over Time

Reading Graphs:
1. How many light moths were there in year 2? _________
2. How many dark moths were there in year 2? _________
3. How many light moths were there in year 10? _________
4. How many dark moths were there in year 10? _________
5. What caused this change?
**Evolution Extravaganza**  
**Essential Question**

**Directions:** Read each statement carefully and decide if it is true or false.

<table>
<thead>
<tr>
<th>Statement</th>
<th>True or False</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Humans evolved from monkeys.</td>
<td>True or False</td>
</tr>
<tr>
<td>2. Organisms evolve by getting mutations <em>when they need them.</em></td>
<td>True or False</td>
</tr>
<tr>
<td>3. The amount of time it takes for an organism to evolve depends on how quickly it reproduces.</td>
<td>True or False</td>
</tr>
<tr>
<td>4. Extinction occurs when species do not have the right adaptations to survive environmental changes.</td>
<td>True or False</td>
</tr>
<tr>
<td>5. Individual species evolve as they grow and get older.</td>
<td>True or False</td>
</tr>
<tr>
<td>6. There is a great deal of evidence that supports the theory of evolution.</td>
<td>True or False</td>
</tr>
<tr>
<td>7. Evolution is happening when a population gets larger in size.</td>
<td>True or False</td>
</tr>
<tr>
<td>8. Evolution is the process of change in a species over time.</td>
<td>True or False</td>
</tr>
<tr>
<td>9. Organisms that are <strong>different species</strong> (such as a cat and dog) can mate to produce a new species which leads to evolution.</td>
<td>True or False</td>
</tr>
<tr>
<td>10. A tadpole changing over time into a frog is an example of evolution.</td>
<td>True or False</td>
</tr>
<tr>
<td>11. As the rate of mutations increases, so does the chance of evolution occurring.</td>
<td>True or False</td>
</tr>
<tr>
<td>12. An organism can acquire (get) a better trait (like growing a long neck) because it needs it and can then pass it on to its offspring.</td>
<td>True or False</td>
</tr>
</tbody>
</table>
1. In science, a theory is ____________________.
   a. An educated guess (hypothesis)
   b. A known fact
   c. Absolute and unchangeable
   d. The best explanation for data/observations

2. What is some evidence to support the Theory of Evolution?

3. Organisms that can mate and produce **fertile** offspring are the same ________________.
   a. What does **fertile** mean? _________________________________________________________

4. Why do scientists use a **TREE** (to show evolutionary relationships) instead of something else?
   ____________________________________________________________
   ____________________________________________________________

5. What are some examples of organisms with a common ancestor?

6. Which of the following involves evolution? *(check all that apply)*
   - [ ] A tadpole turning into a frog
   - [ ] A seed growing into a tree
   - [ ] A caterpillar changing to a butterfly
   - [ ] Bacteria colonies growing in numbers
   - [ ] The DNA of humans and monkeys is very similar
7. Put the steps of evolution by natural selection in order.

____ Over time, a variety of beneficial mutations accumulates in the species.
____ Mutations randomly occur to produce variations. Sexual reproduction also creates variations.
____ The accumulation of many changes over time can lead to the production of a new species!
____ Organisms with beneficial variations (adaptations) are better able to survive.

8. How has the horse changed over time?

____________________________________________________________________________
____________________________________________________________________________

9. Check all conditions that can affect the rate of evolution:

☐ Type of reproduction ☐ Number of offspring ☐ Pollutants in the environment
☐ Reproduction rate ☐ Rate of mutation
☐ Gestation period ☐ Environmental changes

10. Rank in order the rate of evolution of the 3 species shown in the slideshow:

____________________________________________________________________________

fastest ___________________________________________ ____________________________

slowest

11. What is it called when there are NO members of a species alive? ____________________________

12. What are some species that are extinct?

____________________________________________________________________________
____________________________________________________________________________
____________________________________________________________________________

13. What does it mean to be an endangered species?

(a) No members of the species left
(b) Very few members of the species left
(c) The species may become extinct
(d) Both (b) and (c) are correct

14. Name three endangered species

____________________________________________________________________________
____________________________________________________________________________
____________________________________________________________________________
The Theory of Evolution

In 1859 an English scientist named Charles Darwin published a very important book. It was entitled “On the Origin of Species”, and it was based on his many years of research all around the world studying both fossils and living organisms. Darwin’s book contained two very big ideas, such as:

1. **species** change over time by a process of evolution through natural selection.
2. all species on life can be traced back to a common ancestor

Because of this book, Darwin is the name that usually pops to mind when the “Theory of Evolution” is mentioned, but he was actually not the first scientist to use the term “evolution” to describe the idea of species changing over time.

Way back in 1809, a French scientist named Jean Baptiste Lamarck proposed a theory that organisms change over time, due to forces or situations in their environment. His work inspired many other scientists (including Darwin!) but there were some major problems in his ideas, which Darwin and later scientists greatly improved on.

**Thought Experiment #1:** Lamarck’s 1st idea is like saying the following: a deer that eats leaves from bushes can just wish for a long neck to get more food, and this will gradually increase the length of its neck. Do you see problems with this idea?

**Lamarck’s theory had two main problems:**

- **Flawed Idea #1:** an organism can undergo a change in its body just because it wants to change
- **Flawed Idea #2:** if an organism changes because of the environment during its lifetime, then that change will be passed on to its offspring

**Thought Experiment #1:** Lamarck’s 2nd idea is like saying the following: an animal that loses a paw by accident during its life will have offspring missing one paw, or a person who dyes their hair blue will have blue-haired kids. What problems do you see with this idea?
According to the current theory of **evolution by natural selection**...

What causes organisms to have variations?

Why are some variations “favored” by the environment?

How do useful variations get passed down to future generations of an organism?

How does this change a species over time?
Changing Times
It's time to think about "the time needed for changes in a species."

In the activity "Battle of the Beaks", the population "evolved" in just a few generations. Do you think this is possible in the real world?

Why or why not?
When the monster came, Lola, like the peppered moth and the arctic hare, remained motionless and undetected. Harold, of course, was immediately devoured.

Explain how the cartoon illustrates the term “survival of the fittest.” USE COMPLETE SENTENCES and at least four of the following vocabulary words in your response. Underline each word that you use.

◊ Competition ◊ Environment ◊ Mutation ◊ Adaptation ◊ Survival of the fittest ◊ Variation ◊ Inheritance ◊ Evolution ◊ Natural Selection
1. Through the use of camouflage, many species have evolved elaborate disguises to protect themselves from hungry predators.

3. The clever camouflage of the leaf-wing butterfly... is equalled only by that of the branch-tongued toad.

4. Oh, sure, to you it's just an innocent walk on the beach, but millions of years from now, it'll be at the center of a raging controversy that divides science and religion!
Population Changes

Directions: Below you will find four situations that describe different types of population changes. Carefully read each of the situations. For each of the situations, you will need to do the following:

1. Briefly describe the situation you read about. Be prepared to explain it to your classmates.

2. Describe the reason(s) for the population change. Refer back to the Major Understandings at the beginning of this unit to help you.

3. Describe how these changes might lead to or already have lead to evolutionary change.

Situation 1:

Wetlands are one of the world’s most threatened ecosystems. More than half have already been destroyed. Some have disappeared from natural causes, such as rises in sea level, drought, and violent storms. But many more have been destroyed by people. If they are drained, floods and insects can be controlled to make it safer for people to live nearby, but then the wildlife has nowhere to go. Mangrove swamps are a type of wetland on tropical coasts. Birds are especially at risk from the destruction of the wetlands. If the wetlands are drained or destroyed, birds will lose their homes as well as their primary food source of insects. There are approximately 60 species of birds in danger of extinction in mangrove swamps around the world today.

Situation 2:

In 1833, the Welland Ship Canal was completed. This canal opened a path from the Atlantic Ocean to Lake Erie and the other Great Lakes. Sea Lampreys swam through the canal into the lakes. Without natural predators, the lamprey population multiplied out of control. By 1960, the large lamprey population had killed off other fish and caused a decline in the populations of whitefish, sturgeon, and trout. Eventually, scientists had to use chemicals to control the lamprey population.
**Situation 3:**

The Triassic and Jurassic periods stretched from 250 million to 146 million years ago. Dinosaurs were beginning to evolve on Earth. Pangaea, a giant landmass, started to break up, and deserts gave way to forests and swamps. By the Cretaceous period, which lasted from 146 million to 65 million years ago, the Earth was home to dinosaurs. Most of the modern continents had split away from the large landmass, Pangaea, by this time. During the Tertiary period, 65 million to 1.64 million years ago, the dinosaurs became extinct. There are many theories for how this occurred, but the most widely accepted involves a giant meteor crashing to Earth. The impact of the meteor sent a thick cloud of dust into the air, which eventually surrounded the entire Earth. Once the dinosaurs were gone, mammals and birds evolved to take their place.

**Situation 4:**

In 1859, 24 European rabbits were introduced into one area of Australia. These rabbits had no natural enemies in their new environment. There were no predators, parasites, or diseases to affect their population. The rabbits quickly became a pest, destroying all plant life in the area. Within just six years, over 20,000 of the rabbits had to be killed in an effort to control their growth.
Objectives for Unit 2 - Part 2: Fossils

You will **UNDERSTAND** the following concepts...

- **Species** change over time.
- Genetic **diversity** between parents and offspring can lead to changes in future generations.
- Changes in environmental conditions can affect the survival of individual organisms.
- The usefulness of a trait depends on the **environment**.
- In the history of the Earth, **extinction** is a common event.
- Over time, Earth’s **environment** has changed dramatically.
- **Fossils** are evidence that a variety of species existed in the past which is support for the process of **natural selection** which leads to **evolution**.

You will **KNOW** the following ideas and concepts...

- A **fossil** is a trace or remains of an organism from the past.
- Most organisms do not become fossils when they die.
- Most fossils are found in **sedimentary rock**.
- More recently deposited sedimentary rock is usually found at the top; older rock layers are lower.
- **Fossilization** is more likely to form if there is a quick burial, they are frozen in ice, or trapped in tree sap (amber).
- Fossils can be destroyed by forces of nature such as erosion, earthquakes, etc. or human impact.
- **Extinction** means there are NO organisms left of a certain species.
- Sedimentary rock layers are formed when particles of rock accumulate and are compacted and hardened into solid rock. This takes millions of years.
- The fossil record can provide evidence of past climates.
- Earth’s geologic events can disrupt sedimentary rock layers and can also expose fossils.

You will **BE ABLE TO DO** the following activities...

- Interpret/analyze data/graphs and draw conclusions.
- Distinguish between fossils and non-fossils (artifacts).
- Identify types of fossils (trace, body, impression, etc.)
- Complete the Paleontology Probe Inquiry activity.
- Research a geologic event and determine its place in Earth’s history.
- Utilize Earth Science Reference tables.
- Complete “Stories from the Fossil Record” webquest.
Fossils Power Point Guided Notes

A fossil is...
- The remains or traces of an organism from a previous time

A fossil is NOT...
- ____________________________
- ____________________________
- ____________________________
- ____________________________
- ____________________________

What is biodiversity?
- ____________________________
- ____________________________
- ____________________________
- ____________________________
- ____________________________

Why do we only see bones, but no soft tissues?
- ____________________________
- ____________________________
- ____________________________
- ____________________________
- ____________________________

Which is most complex? Explain.
- ____________________________________
- ____________________________________
- ____________________________________
- ____________________________________
- ____________________________________

What percent of living things will fossilize?
- ________ %

Reference Table Question
Table K

Compare the age of the skull and the frog. Explain your answer.
- ____________________________________
- ____________________________________
- ____________________________________
- ____________________________________
- ____________________________________

Which rock type is best for fossil formation?
- ____________________________________
- ____________________________________
- ____________________________________
- ____________________________________
- ____________________________________

Look at the picture. Why is it difficult to find the age of the rocks and the fossils within the rocks?
- ____________________________________
- ____________________________________
- ____________________________________
- ____________________________________
- ____________________________________

Reference Table Question
Table J

Which fossil would you find during the Triassic period?
- ____________________________
- ____________________________
- ____________________________
- ____________________________
- ____________________________

Which fossil formation type would work best to fossilize soft tissue?
- ____________________________
- ____________________________
- ____________________________
- ____________________________
- ____________________________

Which fossil formation type turns the organism to stone?
- ____________________________
- ____________________________
- ____________________________
- ____________________________
- ____________________________
12. What percent of everything that was once alive is now extinct? ________ %

13. What has happened to the continents over time?
   a) They moved closer together
   b) They spread apart

   Fossils found on the East coast of South America are the same as those found on the West Coast of Africa. What have scientists concluded because of this?
   a) Organisms swam/flew across the ocean from South America to Africa
   b) The continents were once connected

14. What has caused 90% of past life to become extinct? Use the word “adaptations” in your answer.

   __________________________________________
   __________________________________________
   __________________________________________
   __________________________________________
   __________________________________________
   __________________________________________

15. Why do you think extinctions have become so much more common since 1900?

   __________________________________________
   __________________________________________
   __________________________________________
   __________________________________________
   __________________________________________
   __________________________________________

16. Check the boxes which indicate evidence for the theory of evolution.
   - Similar DNA among organisms
   - Homologous structures
   - Vestigial parts (like a tailbone)
   - Similar embryonic development

17. True or False
   1. Extinction is common. _____________
   2. Fossil production is common. _____________
   3. All parts of an organism have an equal chance of becoming fossilized. _____________
   4. The fossil record is complete. _____________
   5. Most fossils are found in igneous rock. _____________
   6. An arrowhead is a fossil. _____________

If time permits...

Write a question about fossils that you think will stump your classmates?
Fossil Study

Part A

1. Choose a fossil and bring it to your desk.
2. Examine the fossil and the rock that it is in very closely.
3. Based on your observations (and any previous knowledge that you might have), come up with a hypothesis about this fossil.

Your quick-write should include several of the following:
(check them off as you include them)

☐ What type of organism is it? What is it called?
☐ How long ago was it alive?
☐ Some evidence or reasoning for your hypothesis (based on observations)

☐ What type of environment did it live in?
☐ How did it live? (What did it eat? How did it move? What did it do all day long?)

My Hypothesis: ________________________________________________________________
____________________________________________________________________________
____________________________________________________________________________
____________________________________________________________________________
____________________________________________________________________________
____________________________________________________________________________
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____________________________________________________________________________
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____________________________________________________________________________

### Part B – Complete the following investigations for at least 3 fossils. Use the **fossil reference guide** AND your **7th Grade Science Reference Tables** to help you in your investigation.

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Part C – Questions

1. Examine the front cover of your fossil guidebook (Common Fossils of the Northeast United States). Identify by name at least 3 of the organisms in the drawing:

_____________________________   _____________________________   ______

2. Are trilobites still alive today?   YES / NO

3. Are crinoids still alive today?   YES / NO

4. Are eurypterids still alive today?   YES / NO

5. What is the environment of most of the fossil organisms in your guidebook? _____________________
   (HINT: Look at “Where did they live” for each fossil in the guidebook.)

6. All the fossils that you examined today were found in New York State.
   a. What is one big change that must have occurred to the environment around NY since these species were living around here? (HINT: look back at the previous question.)

   __________________________________________________________________________
   __________________________________________________________________________

   b. Could an environmental change of this nature lead to the extinction of some species?

   YES / NO   Explain: __________________________________________________________________________
   __________________________________________________________________________

7. Use your answers to the previous 3 questions to write a statement (1 or more full sentences) about extinction and environmental change and evolution (or rate of evolution).

   __________________________________________________________________________
   __________________________________________________________________________
   __________________________________________________________________________
   __________________________________________________________________________
**Part D – Timeline**

Using your 7th Grade Science Reference Tables, put the following events on the Earth timeline below *(one has been done for you)*:

Be sure to: (a) Check off as you go!  
(b) Use the oldest age (of the 2 ages in your reference table)

- [✓] First single-celled organisms  
- [ ] First dinosaurs  
- [ ] First humans  
- [ ] First fish  
- [ ] First plants with flowers

**IMPORTANT:** 1000 million years = 1 billion years (So 4500 million years ago = 4 ½ billion years ago. This is the approximate age of the planet Earth.)

**Bonus Questions:**

1. What did trilobites eat? _______________________________________________________

2. What did crinoids eat? _______________________________________________________

3. What are some living creatures that are related to eurypterids? ________________

4. How did cephalopods move through the water? _________________________________

5. How do we know ammonites were sometimes prey? ____________________________
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