Evolution and the Rock Pocket Mouse

A typical rock pocket mouse is about 170 millimeters long from its nose to the end of its tail, shorter than an average pencil. And at just 15 grams, this tiny mouse weighs about as much as a handful of paper clips. You can find populations of rock pocket mice all over the Sonoran Desert in the southwestern United States.

There are two common varieties—a light-colored variety and a dark-colored variety. There are also two major colors of substrate, or surface materials that make up the desert floor. Most of the landscape consists of light-colored sand and rock, but patches of dark volcanic rocks that formed from cooling lava flows are found, separated by several kilometers of light colored substrate.

Activity 1

1. View the images of the rock pocket mouse populations in each location and record the numbers for each color.
   Card 1
   Location A: Number of mice with light-colored fur ______   Dark-colored fur ______
   Location B: Number of mice with light-colored fur ______   Dark-colored fur ______
   Card 2
   Location A: Number of mice with light-colored fur ______   Dark-colored fur ______
   Location B: Number of mice with light-colored fur ______   Dark-colored fur ______
   Card 3
   Location A: Number of mice with light-colored fur ______   Dark-colored fur ______
   Location B: Number of mice with light-colored fur ______   Dark-colored fur ______
   Card 4
   Location A: Number of mice with light-colored fur ______   Dark-colored fur ______
   Location B: Number of mice with light-colored fur ______   Dark-colored fur ______

2. Arrange the cards in what you think is the correct order from the oldest to the most recent.
Write the order you chose: _______________________________________

3. What are the two types of substrate that these mice live on? _______________________________________

Activity 2

Watch the video at biol.co/rockpock and answer the questions.

1. How caused the unusual landscape at the Valley of Fire?
   a. flooding
   b. volcanic eruptions
   c. human activities
   d. forest fires

2. Predators of the pocket mice hunt using what sense?
   a. smell
   b. sound
   c. vision
   d. heat

3. Why did dark-colored rock pocket mice first appear in a population of light-colored rock pocket mice?
   a. Individuals change color to blend in with the environment.
   b. There is dark lava rock in the area where they live.
   c. They have a genetic mutation that affects their fur color.
   d. Predators eat light-colored rock pocket mice.

4. Why do dark-colored rock pocket mice on dark lava flows have white bellies?
   a. There is no selection for dark bellies by visual predators.
   b. White bellies protect them from insects found in the desert
   c. There is a reproductive advantage to having a dark belly.
   d. White bellies are an important part of camouflage.

5. Mutations are always
   a. good
   b. bad
   c. neutral
   d. a change in an organism’s DNA
6. Dark pocket mice are found in locations that have dark substrate. Genetics revealed what surprising fact about mice in different locations?

   a. they had different mutations
   b. they had the same mutations
   c. they were not related

7. Now that you have watched the video, go back to your set of cards and arrange them in the order you think they happened, starting with the oldest. You may change your order from your original idea. Once you are satisfied with the order, complete the table.

   Sequence (oldest to newest)

<table>
<thead>
<tr>
<th></th>
<th>1&lt;sup&gt;st&lt;/sup&gt; (Oldest)</th>
<th>2&lt;sup&gt;nd&lt;/sup&gt;</th>
<th>3&lt;sup&gt;rd&lt;/sup&gt;</th>
<th>4&lt;sup&gt;th&lt;/sup&gt; (Most recent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location A</td>
<td># of Light Mice</td>
<td># of Dark Mice</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Location B</td>
<td># of Light Mice</td>
<td># of Dark mice</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

8. How did you revise your sequence from your initial idea? Explain how you decided on the sequence.

**Activity 3: Data Analysis**

Use colored pencils to make a BAR GRAPH showing the numbers and colors of mice at each location. **Be sure to label the X and Y axis and each of the bars on the graph.**
Activity 4: Summarize the Data

1. Compare how the graph looks at Location A to how it looks at Location B. What is the obvious difference between the two?

2. Explain why a rock pocket mouse color influences its overall fitness. Remember that “fitness” is defined by an organism’s ability to survive and produce offspring.

3. Explain the presence of dark-colored mice at location A. Why is this phenotype (appearance) not more common in the population at that location?

4. What is meant by this statement: “Mutation is random, but natural selection is not random.”

Additional Discussion Questions

1. Consider the dark and light colored rock pocket mice. Human skin color also comes in different shades. One hypothesis is that dark skin protected humans from intense UV radiation (sunlight). Based on this hypothesis, where do you think more darker skinned people lived? Suggest a reason why light skin may be an advantage for people living in other regions.
2. What happens to organisms that have adaptations that no longer work for their environment?

3. Animals develop many types of defenses to avoid being eaten. Camouflage is just one type of defense. What are other types of defenses that prey species might use?

4. Predators must be able to obtain food and overcome the defenses of prey. How do predator species in the desert survive? What adaptations do they have to make them good hunters?

5. Sometimes animals have traits that don’t seem to make sense, like the long tail feathers of a peacock. Suggest a reason for traits that don't help an animal survive. Hint: those features might help them do other things.

**Other Animals that Model Natural Selection - For discussion in Class**

- Peppred moths in polluted forests
- Stickleback fish and armored plates
- Bacteria (antibiotic resistance)
- Humans and lactase persistence

Evolution by Natural Selection - VIDA Chart - In the evidence section, write a list of ways in which the rock pocket mouse illustrates the idea posed in the description. Use what you have learned in the activity and the film we watched on rock pocket mice. ~ 5-10 min

<table>
<thead>
<tr>
<th>Condition</th>
<th>Description</th>
<th>Evidence from Species Studied</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variation</td>
<td>Variations can be physical features, behavior, bodily functions, or resistance to disease.</td>
<td></td>
</tr>
</tbody>
</table>
The trait is **inherited** (passed from parents to offspring).

**Inheritance**

The variation comes from random mutations and recombination of genes during sexual reproduction.

More offspring are born than can survive.

**Differential Survival and Reproduction**

Some individuals with a trait are more likely to survive and reproduce than those without the trait.

**Selection** depends on the environment. Traits that are beneficial in one environment may not be beneficial in another.

The **frequency** of the trait that helps individuals survive or leave more offspring will increase in the population over time, as will the alleles that affect the trait.

This process can take many generations and extend over very long periods of time.

**Adaptation**