Evolution of Fur Color in Mice – Mutation, Environment and Natural Selection

Rock pocket mice live in a desert where many areas have light-colored sand or rocks and other areas have dark rocks. The dark rocks are cooled lava from volcanic eruptions.

Some of the rock pocket mice have light fur and some have dark fur.

1a. Which of the following do you think describes populations of rock pocket mice that live on light-colored rocks?
   a. About half of these mice have dark fur and about half have light fur.
   b. All or most of these mice have dark fur.
   c. All or most of these mice have light fur.

1b. Which of the following do you think describes populations of rock pocket mice that live on dark rocks?
   a. About half of these mice have dark fur and about half have light fur.
   b. All or most of these mice have dark fur.
   c. All or most of these mice have light fur.

1c. Explain your reasoning. What biological processes could influence the fur color of the rock pocket mice that live on light-colored rocks vs. dark rocks?

Next, you will view Pocket Mouse Film with Quiz (http://www.hhmi.org/biointeractive/pocket-mouse-film-quiz) and answer and discuss the multiple-choice questions in the video.

2a. The video begins with the title “The Making of the Fittest: Natural Selection and Adaptation”. What does “fittest” mean in this title?
   a. can run the fastest
   b. can win fights with other mice
   c. most able to survive and have offspring

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1 By Ingrid Waldron, Department of Biology, University of Pennsylvania, © 2017, with helpful input from Ray Howanski, Ridley School District. Teachers are encouraged to copy this Student Handout for classroom use. This Student Handout and Teacher Notes with instructional suggestions and background information are available at http://serendip.brynmawr.edu/exchange/bioactivities/NaturalSelectionMice.
2b. What is the adaptation that increases the survival of the rock pocket mice on dark rocks?

This figure shows the rock pocket mice that lived on one little part of a much larger area with light-colored rocks next to a new lava flow that was too hot for mice to live on.

This figure shows the mice in the same area a year after the dark volcanic rock had cooled enough for mice to live there.

3. What changes occurred between the first and second figures? What caused these changes? Include “migrated” and “total number of mice” in your answer.

In the following years the numbers of mice on the dark rock increased. Even though predators are more likely to catch mice with light fur on the dark rock, the mice have so many babies that there is a large population.

4a. Figures A-C show what the population looked like at different times over the next ten centuries. Indicate the actual time sequence for these figures. _____ would be observed first; this would be followed by _____; and _____ would be observed last.

4b. Explain what is happening. Include “mutation”, “natural selection” and “predator” in your answer.
5. Suppose that, instead of a mouse with dark fur, a mouse with white fur was born in the population of mice on the dark rock. What do you think would happen during the years after the white mouse appeared? Would you expect that white mice would become increasingly common in the population of mice on the dark rock? Explain why or why not.

6. There are multiple different lava flows of dark rock, due to the eruptions of multiple different volcanos. Researchers have found that:
   - Most of the rock pocket mice that live on these different lava flows have a similar phenotype (dark fur).
   - However, different mutations are responsible for the dark fur in two populations of mice that live on two different lava flows.

   Explain why the mice on these two different lava flows have similar phenotypes but different genotypes.

7. Researchers have found an exception to the observation that populations of rock pocket mice that live on dark rocks generally have dark fur. On one lava flow of dark rock, all the mice have light fur. This lava flow of dark rock is relatively young (<800 years old) and is far from any population of rock pocket mice that have dark fur. What is a likely reason why dark fur has not evolved in the population of mice that live on this lava flow?
**Challenge Question.** Complete this table to analyze the evolution of dark fur color in rock pocket mice.

<table>
<thead>
<tr>
<th>Answer these questions.</th>
<th>Describe the evidence for A, C and D.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A.</strong> How has mutation contributed to the evolution of dark fur color in rock pocket mice? (A mutation is a change in a DNA molecule.)</td>
<td>How did the researchers establish that a mutation had occurred?</td>
</tr>
</tbody>
</table>

**B.** How does natural selection affect individual mice? Does an individual mouse change its characteristics as a result of natural selection?

The video describes the effects of natural selection on individuals, but does not present any supporting evidence (probably because the supporting evidence is indirect and somewhat complex).

**C.** How does natural selection produce change in a population of mice?

What evidence supports the conclusion that natural selection has occurred?

**D.** How does variation in the environment affect natural selection?

What evidence supports effects of the environment on natural selection?

Next, review the video and revise your answers to this question to be more complete and accurate.