

Boggs Biology Period 5A Off-Site Learning Packet Day 5

Name: _____ Period: ____ Date: _____ Score: ____/10

ALLELE AND PHENOTYPE FREQUENCIES IN ROCK POCKET MOUSE POPULATIONS INTRODUCTION

The tiny rock pocket mouse weighs just 15 grams, about as much as a handful of paper clips. A typical rock pocket mouse is 172 millimeters long from nose to rump, which is shorter than an average pencil. Its impact on science, however, has been enormous. What's so special about this little mouse?

Populations of rock pocket mice are found all over the Sonoran Desert in the southwestern United States. Two varieties occur widely in the area—a light-colored variety and a dark-colored variety. Similarly, there are two major colors of substrate, or surface material, that make up the rocky desert floor. Most of the desert landscape consists of light-colored sand and granite. Here and there, however, separated by several kilometers of light-colored substrate, are patches of dark volcanic rocks that formed from cooling lava. These areas of dark volcanic rock range in age from 1,000 to more than 1 million years old.

Dr. Michael Nachman of the University of Arizona and his colleagues have spent many years researching the genetics of fur color in rock pocket mice. In particular, they were interested in understanding the forces that shape genetic variation in natural populations.

Investigating the adaptive value of different coat colors in rock pocket mice is an example of how scientists are attempting to connect genotype with phenotype for fitness-related traits. In this type of research, investigators try to find the underlying gene or genes for a given adaptation. Examples of other fitness-related traits that researchers are currently investigating are resistance to the pesticide warfarin in rats, tolerance to heavy metals in plants, and antibiotic resistance in bacteria.

PROCEDURE

1. Watch the short film *The Making of the Fittest: Natural Selection and Adaptation*. The video can be found at <https://youtu.be/sjeSEngKGrg>. As you watch, record the following information.

a. What specific trait did researchers study in this investigation?

b. How does this trait affect the survival of the mice in different environments?

c. What is the genetic basis of the trait?

2. According to the film, what environmental change gave a selective advantage for one coat color over another? (2pts)

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3. In a separate study, 76 rock pocket mice were collected from four different, widely separated areas of dark lava rock. One collecting site was in Arizona. The other three were in New Mexico. Dr. Nachman and colleagues observed no significant differences in the color of the rocks in the four locations sampled. However, the dark-colored mice from the three New Mexico locations were slightly darker than the dark-colored mice from the Arizona population. The entire *Mc1r* gene was sequenced in all 76 of the mice collected.

The mutations responsible for the dark fur color in the Arizona mice were absent from the three different populations of New Mexico mice. No *Mc1r* mutations were associated with dark fur color in the New Mexico populations. These findings suggest that adaptive dark coloration has occurred at least twice in the rock pocket mouse and that these similar phenotypic changes have different genetic bases.

How does this study support the concept that natural selection is not random? (3pts)

4. To determine if the rock pocket mouse population is evolving, explain why it is necessary to collect fur color frequency data over a period of many years. (2pts)