Shakin' it up!

Purpose/Rationale:

The purpose of this activity is for students to investigate and understand the influence genes have on survival of an organism as well as a species, following the 5-E Learning Model. By participating in this activity, students will be able to describe biodiversity, as well as explain how natural selection favors the individuals that have genes that enable them to adapt to their environment best. Students will also explore the relationship between healthy populations and healthy gene diversity.

SOLs:

- LS 4 b and c – The student will investigate and understand that the basic needs of organisms must be met in order to carry out processes. Key concepts include: factors that influence life processes, and animal needs.
- LS 8 a – The student will investigate and understand that interactions exist among members of a population. Key concepts include competition, cooperation, social hierarchy, territorial imperative.
- LS 9 b, and c – The student will investigate and understand interactions among populations in a biological community. Key concepts include: the relationship between predators and prey, competition and cooperation.
- LS 10 c – The student will investigate and understand how organisms adapt to biotic and abiotic factors in an ecosystem. Key concepts include adaptations that enable organisms to survive within a specific ecosystem
- LS 11 b and c – The student will investigate and understand that ecosystems, communities, populations, and organisms are dynamic and change over time (daily, seasonal, and long term). Key concepts include: factors that increase or decrease population size; and eutrophication, climate changes, and catastrophic disturbances.
- LS 12 b, c, d, and e – The student will investigate and understand the relationships between ecosystem dynamics and human activity. Key concepts include: change in habitat size, quality, or structure; change in species competition, population disturbances and factors that threaten or enhance species survival; and environmental issues.
- LS 13 b, c, d and e – The student will investigate and understand that organisms reproduce and transmit genetic information to new generations. Key concepts include: the function or genes and chromosomes; genotypes and phenotypes; factors affecting the expression of traits; characteristics that can and cannot be inherited.
- LS 14 a and c – The student will investigate and understand that organisms change over time. Key concepts include: the relationships of mutation, adaptation, natural selection and extinction; and how environmental influences, as well as genetic variation, can lead to diversity of organisms

National Teaching Standards:

A – Plan an Inquiry-based Science Program

- Support the development of student understanding and nurture a community of science learners

B – Guide and Facilitate Learning

- Encourage skills of scientific inquiry, and skepticism that characterize science
- orchestrate discourse among students about specific ideas

National Teaching Standards Con't:

D – Design and Manage Learning Environment
- Structure the time available so that students are able to engage in extended investigations
- Ensure safe working environment;

E- Develop Science Communities
- Nurture collaboration among students and structure
- Facilitate ongoing formal and informal discussion based on a shared understanding of rules of scientific discourse.

National Content Standards (5-8):

A- Science as Inquiry
- Student should develop abilities necessary to do scientific inquiry by:
  - developing descriptions, explanations, predictions and models using evidence;
  - think critically and logically to make the relationships between evidence and explanations
  - recognize and analyze alternative explanations and predictions
  - communicate scientific explanations
  - use mathematics

C- Life Science
- Reproduction and Heredity
  - Heredity is the passage of instructions from one generation to another
  - Hereditary information is contained in genes
  - The characteristics of an organism can be described in terms of a combination of traits. Some traits are inherited and others result from interactions with the environment
- Regulation and Behavior
  - All organisms must be able to obtain and use resources, grown, reproduce, and maintain stable internal conditions while living in a constantly changing external environment.
- Populations and Ecosystems
  - The number of organisms an ecosystem can support depends on the resources available and abiotic factors.
- Diversity and Adaptations of Organisms
  - Species acquire many of their unique characteristics through biological adaptation, with involves the selection of naturally occurring variations in populations.
  - Extinction occurs when the environment changes and the adaptive characteristics of a species are insufficient t o allow its survival

F – Science in Personal and Social Perspectives
- Natural Hazards
  - Homan activities can induce hazards through resource acquisition, urban growth, land-use decisions, and waste disposal.

G – History and Nature of Science
- Nature of Science
  - Scientists formulate and test their explanations of nature using observation, experiments, and theoretical and mathematical models.
  - It is part of scientific inquiry to evaluate the results of scientific investigations, experiments, observations, theoretical models, and explanations proposed by other scientists.

Materials and Resources:

activity sheet   Project Wild Activity Guide
long necked bottle   environmental situation cards
key to characteristics   yarn
construction paper   paste
Jelly beans (yellow, black, orange, green, pink, purple, red, white)

Safety:
- Students will be running for the first part of the activity. Take care that students know not to push or pull each other. Make sure students are clear that to tag a student no excess force should be used. Make sure that there is a first aid kit available for any students that may trip and skin their knee.
- Ensure that no students are allergic to jelly beans. Also, that they do not place the jelly beans in their mouths while running. This promotes a choking hazard.
- Be careful with the long necked bottle. Plastic should be used over glass. Be sure that the teacher is the only person to "shake" the bottle to mix the "genes" if a glass bottle is all that can be found. Should the bottle slip out of their hands, be sure to take care when cleaning up the glass.

Procedures:
Class one:
Engage: (15 min) Modified version of "Oh Deer" (pg. 36-40)
1. An area will be marked out as the habitat. 3 students will be chosen to be wolves. The rest of the students will be deer. The wolves will line up on one end and the deer on the other. The deer are to run to the other side with out being tagged by a wolf. If a deer is tagged the student will become a wolf. If a wolf does not catch a deer, they will "die" and walk to the side and become environment.

Explore: (15 min)
2. Question students to probe their knowledge of the situation they demonstrated in the "Oh Deer" activity and what might happen if situations change (see activity sheet). The topic of genetic diversity will be introduced.
(This step could be expanded by having the students act out the changes (such as increased shelter (hula hoop safety zones), wolves with decreased sense of smell (blindfold wolves), etc)

Explain: (10min)
3. Students will elaborate and brainstorm the different adaptations and environmental factors that would be beneficial to the deer and list these on their activity sheet in the chart provided.   The characteristics listed in the "adaptation" column will be defined as phenotypes that are defined by genes and how they may be affected by the environment. Students will also define vocabulary words. This section may be done for homework.

Class two:
Elaborate: (45min) Modified version of "Bottleneck Genes" (pg. 172-176)
    4. After a short (~5 min) review of the previous class, the students will complete the activity "Bottleneck Genes" modified to include traits of deer instead of Black-Footed Ferret.

        Divide the students into groups (2-4 students/group). Put the colored Jellybeans in a bottle and mix them up and provide student groups with random assortments of "genes" (be sure that no group gets all 8 of the colors). Provide students with Environmental Cards (these can be printed and pasted onto construction paper). See attached environmental conditions sheet.

        Discussion questions can be assigned as homework or a project. At the beginning of next class period allow the students to present the situations, genetic make up and predictions of their population to the class.

Evaluate (assessment):
    5. Students will provide the following evidence for understanding the activities:

Performance Criteria	Evidence	Points or Rating*
Students should understand the predator prey relationship.	Participation in "Oh Deer" activity, and completed questions in Part I on the activity sheet.	
Students should be able to define vocabulary words and use them correctly in context.	Completion of the vocabulary section in Part II of the activity sheet and proper use of vocabulary in Parts III and IV	
Students should be able to determine the difference between genetic and environmental factors that influence populations.	Completion of Part II chart	
Students should understand the genetic makeup of a population affects the total population of a species.	Completion of Part III cart on advantages and disadvantages	
Students should be able to discuss how different environmental factors affect a deer population	Completion of question six in Part III	
Students should be able to demonstrate their knowledge on how genetic diversity and population size affects the survival of a species in a given habitat.	Completion of Part IV discussion questions	

*2 = completes activity and explanation without mistakes
 1 = completes activity but offers incomplete explanation
 0 = does not complete activity or explanation

EDCI 5724
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Shakin' it up!
(Activity Sheet)

Purpose: In this activity, you will investigate and understand the influence genes have on survival of an organism as well as a species population. By participating in this activity, you will describe biodiversity, as well as explain how natural selection favors the individuals that have genes that enable them to adapt to their environment best. Students will also explore the relationship between healthy populations and healthy gene diversity.

Part I: "OH DEER!"
1. Describe what happened to the deer population throughout the activity.

2. a)   What do you think would happen to the deer population if there was an area of shelter that the deer could hide from the wolves?

   b) What do you think would happen to the wolf population?

   c) Would this be considered an environmental factor or a genetic factor?

3. a) What do you think would happen do the deer population if the wolves had an increased sense of smell?

   b) What would happen to the deer population?

   c) Would this be considered an environmental factor or a genetic factor?

Part II: Vocabulary and Deer Brainstorming

4. Define the following words:
   - Adaptation:

   - Genotype:

   - Phenotype:

   - Natural Selection:

   - Genetic Variability:

   - Biodiverstity:

   - Population Bottleneck:

5. Fill in the following cart with different adaptations and environmental factors that you think would have an impact on the deer population.

Adaptation	Environmental

Part III: Bottle Neck Genes Lab

Genetic Key:
Yellow - camouflage
Black – precise vision
Orange – heavy antlers
Green - agility   (ready ability to move with quick easy grace)
Pink – strong muscular legs
Purple – acute hearing
Red – healthy rate of reproduction
White – immunity to some poisonous plants

1. Circle the genes that your group's deer population have. These are the genetic characteristics (colors) that your population received through the bottle neck.

2. Calculate the percentage of genetic diversity of your population.
   (Eight genes (colors) represent 100 percent genetic diversity in the original population)

   _____ genes (colors) received / 8 original genes (colors) = _____(Decimal) x 100 = _____%

3. List the genetic characteristics that your population received through the bottleneck.

4. In the chart provided list the disadvantages and advantages that these adaptations provide for your deer population.

Advantages	Disadvantages

5. Choose 2 Environmental Condition Cards. List the environmental conditions that your populations has been exposed to:

6. What do you think will happen to your population during a period of a year. Address the following questions:
   - Is the populations genetically equipped to survive in this environment? How well or how poorly?

   - How does a high or low percentage of genetic diversity affect the population's survival?

   - How do random changes in the environment affect the population?

   - How do human interactions with habitat affect the population?

Part IV: Discussion Questions
1. Why does gene diversity help protect a population?

2. Why would a smaller population have a higher risk of being eliminated than a large population?

3. Why do you think smaller populations have a harder time surviving disease?

Environmental Conditions:

- The wolf population has increased. Does your population have the gene for agility and strong legs to avoid being captured?

- The spring has been very rainy and there is a surplus of grass and other plants.

- An interstate highway has been built near your forest.

- Ranchers are allowing their dogs to run loose. Does your population have the gene for acute hearing to avoid this predator?

- Hunting season has started.

- There has been a season of extreme drought and most of the plants have shriveled up and died.

- Humans who are building homes have wiped out a 10 mile across and 5 mile deep section of woods.

- A new generation of captive-born deer have been preconditioned to live in the wild and are ready to be released in your forest.