Georgia Performance Standards Framework for Biology 9-12

Unit: Growth and Heredity
Differentiated Task

IS WILDLIFE MANAGEMENT TOO MUCH TO “BEAR?”

Overview: Students will use their knowledge of Mendel's laws and sexual reproduction (meiosis) to manage a population of wild bears. This activity will also incorporate the principles of natural selection. As a result of this activity, students will gain knowledge concerning population genetics and conservation, natural selection, the effects of humans on wild populations, and the Mendelian laws at work within sexually reproducing populations.

Standards (Content and Characteristics):

SB2. Students will analyze how biological traits are passed on to successive generations.
   a. Distinguish between DNA and RNA.
   b. Explain the role of DNA in storing and transmitting cellular information.
   c. Using Mendel’s laws, explain the role of meiosis in reproductive variability.

SB4. Students will assess the dependence of all organisms on one another and the flow of energy and matter within their ecosystems.
   d. Assess and explain human activities that influence and modify the environment such as global warming, population growth, pesticide use, and water and power consumption.

SB5. Students will evaluate the role of natural selection in the development of the theory of evolution.
   d. Relate natural selection to changes in organisms.

SCSh1. Students will evaluate the importance of curiosity, honesty, openness, and skepticism in science.
   a. Exhibit the above traits in their own scientific activities.
   b. Recognize that different explanations often can be given for the same evidence.
   c. Explain that further understanding of scientific problems relies on the design and execution of new experiments which may reinforce or weaken opposing explanations.

SCSh4. Students will use tools and instruments for observing, measuring, and manipulating scientific equipment and materials.
   a. Develop and use systematic procedures for recording and organizing information.
SCSh5. **Students will demonstrate the computation and estimation skills necessary for analyzing data and developing reasonable scientific explanations.**
   b. Recognize the relationship between accuracy and precision.

SCSh6. **Students will communicate scientific investigations and information clearly.**
   c. Use data as evidence to support scientific arguments and claims in written or oral presentations.
   d. Participate in group discussions of scientific investigation and current scientific issues.

SCSh7. **Students will analyze how scientific knowledge is developed.**
   Students will recognize that:
   a. The universe is a vast single system in which the basic principles are the same everywhere.
   b. Universal principles are discovered through observation and experimental verification.

SCSh8. **Students will understand important features of the process of scientific inquiry.**
   Students will apply the following to inquiry learning practices:
   e. The ultimate goal of science is to develop an understanding of the natural universe which is free of biases.

**Enduring Understandings:**

- Using the DNA code the cell manufactures needed proteins that determine an organism’s phenotype.
- Cells in sexually reproducing organisms contain two copies of each chromosome; therefore, two copies of each gene explain many features of heredity such as how variations that are hidden in one generation can be expressed in the next.
- Hereditary information, coded by DNA, is passed down from generation to generation in a predictable way.
- Explain the adaptations of an organism that enable the organism to be successful within an ecosystem through the action of natural selection
- Diversity among organisms is due to adaptations to changing environmental conditions
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**Essential Question(s):**

1. By what mechanisms is heredity transmitted from generation to generation?
2. How do human activities alter mutation rate in populations of organisms?
3. How can mutation adversely affect a population? Enhance the viability of a population?
4. How can adaptations and mutations in a population become more prevalent by processes such as natural selection?

**Pre-Assessment:**
Have students answer 3-5 questions from the list below:
- What is a monohybrid?
- What are alleles?
- What is a Punnett square?
- What are some of the human activities that can affect a wild population?
- How can mutations be favorable in a population?

Have students “grade” each others' quiz and discuss answers given by the classmates.

Have students complete the following word problem: A dihybrid bear for Black fur and Long whiskers is test crossed. What would be the phenotypic and genotypic ratios in the F1? *(Teacher note: students would need to see the chart of alleles for the bears as given in this task so they would know what the letters were. However, you could use a monohybrid cross or a different type of dihybrid cross using Mendel’s peas or something else familiar.)*

Organize them into groups according to their knowledge of the subject matter.

<table>
<thead>
<tr>
<th>Outcome/Performance Level Indicator</th>
<th>BASIC</th>
<th>INTERMEDIATE</th>
<th>ADVANCED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Describe the role and mechanisms of DNA in genetic inheritance.</td>
<td>Explain the role of meiosis in reproductive variability.</td>
<td>Explain how mutation may produce adaptations that are the basis of natural selection.</td>
<td>Identify the effects of mutations and natural selection that have an influence on the survival rates of species.</td>
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</table>
**Performance Task:**

(Title: Detailed Description)

**Teacher role?**

**Student role?**

<table>
<thead>
<tr>
<th>Performance Task: (Detailed Description)</th>
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</table>
| **Student:** You are a wildlife manager for the DNR of Georgia or Concerned citizens for the survival of the Chattahoochee bear Committee, or Bear Population geneticists. You have been studying the wild Chattahoochee bear found in the mountains of North Georgia. After 20 years of successful management, these threatened bears are experiencing a rapid decline in their population due to unidentified environmental conditions and severe inbreeding and are close to being placed on the endangered species registry. Several mutations have also occurred within the population; one fatal reproductive gene (FRG) that prevents the cubs from reaching sexual maturity and leads to an early death, a second favorable one that has changed the bears' metabolism such that it can now digest and get nutrition from woody twigs and stems, and a third that gives the bears an albino coat (white) when a certain combination of alleles occur within the breeding population. You will be attending a conference on how to save the bears and must do the research and prepare your presentations for the conference. The basis for your bears and their habitat is found at the website: [http://www.bear.org/Kids/Black_Bear_Facts_Kids.html](http://www.bear.org/Kids/Black_Bear_Facts_Kids.html)

**Teacher note:** Student tasks are differentiated below. However, students will probably need to work in groups. The use of computers to generate charts, graphs and tables will enhance their presentations. Your job is as a facilitator – you can also assume the role of the DNR ranger, employee from the Georgia Wildlife Federation in charge of threatened species in Georgia or? You will need to “run” the conference at the end of the activity.

The website about black bears is used as the basis for this activity's facts about bears in general and other bare facts - [www.bear.org/Kids/Black_Bear_Facts_Kids.html](http://www.bear.org/Kids/Black_Bear_Facts_Kids.html)
### Student Task:

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| Using the chart given for the Chattahoochee bear phenotypes and genotypes, you will need to create the Punnett squares and determine the genotypes and phenotypes of the bears as indicated in both the monohybrid and the dihybrid crosses below:  
1. LL x ll  
2. Bb x Bb  
3. BbSs x BbSs  
4. Ssee x SsEE  
Assume that your bears produce 4 offspring per litter. Then answer the following questions:  
1. For the two monohybrid crosses, what are the ratios expected in the F1? | Using the chart given for the Chattahoochee bear phenotypes and genotypes,  
1. Do the following dihybrid crosses and determine ratios*:  
   1. Ssee x ssEe  
   2. LLBb x llBb  
   3. Rrff x rrFf  
2. List the possible gamete combinations for the trihybrid cross below. Either using a punnett square or the laws of probability, have students predict certain genotypic or phenotypic frequencies.  
   BbIlRr x BbLLRr  
   (Note: The cross given here only requires a 16 square punnett square, if other genotypes are chosen that are heterozygous for all three traits, it is recommended to calculate frequencies using rules of probability not by a punnett square.) | Using the chart given for the Chattahoochee bear phenotypes and genotypes,  
1. Create a selective breeding schedule for your bears over several generations such that the FRG mutation can be bred OUT of the population.  
2. Show the crosses (Punnett squares) with their results (phenotypic and genotypic ratios) for at least FOUR generations.  
3. Start with your population (100) as given in the table below. Assume that the mortality rate for your bears due to being killed on the road or poached is 10% yearly. Natural mortality for your bear population is about 5% yearly from the older offspring will be born to this population (both minimum and maximum values) over a 10 year period using |

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*Note: The cross given here only requires a 16 square punnett square, if other genotypes are chosen that are heterozygous for all three traits, it is recommended to calculate frequencies using rules of probability not by a punnett square.*
### Student Task (continuation):

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<tr>
<td>2. For the first dihybrid cross (#3), which set of genes is the results of multiple alleles? How did this affect your results of your ratios for your phenotypes? Looking at your Punnett square, how many bears would be affected by the FRG if 50% of each phenotype is female? What is the name for this type of gene? 3. What percentage of these bears (#4) would actually have white fur (albino?) How could you use a test cross to detect the recessive trait for the round shaped nose? 3. From the following list of possibilities, pick any 2 human activities and justify why these negatively impact your bear population – include how this affects natural selection. Then, include possible solutions for your</td>
<td>In all of these crosses, identify the type of allelic system and any mutations that occur with these alleles, and how they affect the population of bears (both negatively and positively.) <em>(Teacher note: * phenotypic and genotypic ratios – patterns for sex-linked genes, lethal, codominant and incomplete dominant alleles will emerge. These ratios also have patterns that are predictable.)</em> 3. Using the Internet and other sources, research the effects of DDT and the subsequent making of the endangered species act of 1973. Create a visual showing the effects of DDT and how the endangered species came to be determined. Be prepared to discuss your genetic results and the human impact on your bear population.</td>
<td>facts given at the website and the table below. The bear population must maintain a minimum of 100 to stay on the threatened list. To proceed to the vulnerable species list, your population would need to attain a stable (birth rate = death rate) population of 150 for 5 of your ten years. <a href="http://www.bear.org/Kids/Black_Bear_Facts_Kids.html">http://www.bear.org/Kids/Black_Bear_Facts_Kids.html</a> Graph your information concerning your population – birth, death total population... to present to the class. Create a management program to show how you are going to take care of your threatened species from 2007 through 2017. Present your program to the class as if you were at a conservation biologist seminar.</td>
</tr>
<tr>
<td>Student Task (continuation):</td>
<td>BASIC</td>
<td>INTERMEDIATE</td>
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<tr>
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<tr>
<td>bear population.</td>
<td>✓ a four lane interstate road was put in going through the middle of the habitat</td>
<td>Then, answer the following questions: 1. Not all characteristics which contribute to longer life become more common in the population. Some characteristics contribute to long life, but not more offspring. For example, a female bear which is sterile and cannot have any offspring may live longer because she will not experience the biological stresses of repeated pregnancies. Explain why a characteristic like this which contributes to a long life, but with few or no offspring, would not become more common as a result of evolution by natural selection. 2. Not all mutations have adverse effects on a population. Which of the mutations listed can provide for the growth and improvement of the bear population?</td>
</tr>
<tr>
<td>✓ a four lane interstate road was put in going through the middle of the habitat</td>
<td>✓ A new paper mill was built along the river that many of the bears use for water</td>
<td>✓ Illegal hunting of the bears out of season</td>
</tr>
<tr>
<td>✓ Illegal hunting of the bears out of season</td>
<td>✓ A new subdivision of 200 houses is placed next to the bears habitat</td>
<td>✓ A viral disease has evolved as a result of pesticide use by farmers that makes the female bears sterile</td>
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<td>✓ A viral disease has evolved as a result of pesticide use by farmers that makes the female bears sterile</td>
<td>✓ Cronic Wasting Disease (CWD), a prion disease, has been passed from the deer in the area to the bears.</td>
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</thead>
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<tr>
<td><strong>4.</strong> Put your information about your management results, (crosses) solutions and facts concerning the Punnett squares you did on a poster to be shared with the class. Assume that you represent concerned citizens for the survival of the Chattahoochee bear. Be prepared to give your information at the Bear Conference. <em>(Teacher note: you could have all three sets of presentations done at a “Conference” in which notable scientists and wildlife conservationists discuss the problems of the bears and possible solutions. A rubric will aid in assessment of the student presentations.)</em></td>
<td><strong>3.</strong> Create a NEW set of alleles that emerge in your bear population. The genes may or may not help the population. Describe the mechanism of transmission for this new phenotype and create a Punnett square to illustrate it. Remember to also list a possible CAUSE of this mutation. Compile this information in a graphic to present to the class as the Bear population geneticists. <em>(Teacher note: you could have all three sets of presentations done at a “Conference” in which notable scientists and wildlife conservationists discuss the problems of the bears and possible solutions. A rubric will aid in assessment of the student presentations.)</em></td>
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**3.** Create a NEW set of alleles that emerge in your bear population. The genes may or may not help the population. Describe the mechanism of transmission for this new phenotype and create a Punnett square to illustrate it. Remember to also list a possible CAUSE of this mutation. Compile this information in a graphic to present to the class as the Bear population geneticists. *(Teacher note: you could have all three sets of presentations done at a “Conference” in which notable scientists and wildlife conservationists discuss the problems of the bears and possible solutions. A rubric will aid in assessment of the student presentations.)* | *(Teacher note: you could have all three sets of presentations done at a “Conference” in which notable scientists and wildlife conservationists discuss the problems of the bears and possible solutions. A rubric will aid in assessment of the student presentations.)* | *(Teacher note: you could have all three sets of presentations done at a “Conference” in which notable scientists and wildlife conservationists discuss the problems of the bears and possible solutions. A rubric will aid in assessment of the student presentations.)* |
### Resources

- [www.bear.org/Kids/Black_Bear_Facts_Kids.html](http://www.bear.org/Kids/Black_Bear_Facts_Kids.html)
- *The following websites have additional activities and explanations concerning genetics:*
  - [http://serendip.brynmawr.edu/sci/waldron/](http://serendip.brynmawr.edu/sci/waldron/)
  - [http://www.wsu.edu/~omoto/papers/cointoss.html](http://www.wsu.edu/~omoto/papers/cointoss.html)
- Two good web sites with information and activities for teaching evolution:
  - [http://evolution.berkeley.edu/](http://evolution.berkeley.edu/)
  - [http://www.pbs.org/wgbh/evolution](http://www.pbs.org/wgbh/evolution)
- The following website is a directory that may become helpful on the homework extension: [http://www.nwf.org/conservationdirectory/](http://www.nwf.org/conservationdirectory/)

### Homework/Extension

- Using Internet sources look up the following conservation groups: Sierra Club, World Wildlife Fund, Audubon Society, Georgia Wildlife Federation, National Wildlife Federation, The Nature Conservancy or others. Research their history and mission statements. Create a chart to compare the major groups to each other. How are they similar and how are they different in their focus on nature and how would they use the data you have generated as a wildlife biologist?
- Investigate the bottleneck effect on the Florida Panther population. Describe the impact human activities have had on the gene flow of their total population and the programs that have been tried to prevent their extinction.

### Instructional Tasks

#### Accommodations for ELL Students

- Modify language requirements for written assessments
- Pair with more advanced native language speaking partner (allow for translation in native language for comprehension) as needed
- Provide bilingual support using word to word translation such as dictionaries, and glossaries
- Provide native language text books and support material whenever possible
- Post all new vocabulary on a word wall; allow student to interact with the word wall using yarn to make connections between vocabulary words
- Allow extended time for written tasks
- Give oral step by step directions; keep language simple
- Provide a graphic organizer that will provide for heads/tails tally

#### Accommodations for Students with Specific Disabilities

- **Review and Implement IEP accommodations for specific student needs**

Other accommodations may include:
Instructional Tasks
Accommodations for Gifted Students

- Allow extended time for written tasks
- Give oral step by step directions; check for understanding
- Provide a graphic organizer that will provide for heads/tails tally

$\bullet$ Compile and annotate a set of Internet resources that pertain to DNA and how it relates to heredity

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### Wild Chattahoochee Bear Phenotypes

<table>
<thead>
<tr>
<th>Traits</th>
<th>Homozygous dominant</th>
<th>Heterozygous</th>
<th>Homozygous recessive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Head Shape</td>
<td>Round head RR</td>
<td>Round head Rr</td>
<td>Square head rr</td>
</tr>
<tr>
<td>Eye Color</td>
<td>Brown eyes BB</td>
<td>Yellow eyes Bb</td>
<td>Green eyes bb</td>
</tr>
<tr>
<td>Nose shape</td>
<td>Square shape SS</td>
<td>Square shape Ss</td>
<td>Round shape ss</td>
</tr>
<tr>
<td>Whiskers</td>
<td>Long LL</td>
<td>Long LI</td>
<td>Short LI (*2 lowercase L's)</td>
</tr>
<tr>
<td>Ear Size</td>
<td>Big ears (4 or more centimeters)</td>
<td>Medium ears (2 or 3 centimeters)</td>
<td>Small ears (1 centimeter)</td>
</tr>
<tr>
<td>Fur Color</td>
<td>Black FF</td>
<td>Black Ff</td>
<td>Brown ff</td>
</tr>
<tr>
<td>Albinism (white fur color)</td>
<td>N/A</td>
<td>N/A</td>
<td>ssee</td>
</tr>
<tr>
<td>Fatal reproductive gene (FRG)</td>
<td>Found only on the X chromosome and is activated when in the presence of the alleles for green eyes (bb)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Metabolism gene</td>
<td>LLRR</td>
<td>L-R-</td>
<td>N/A</td>
</tr>
<tr>
<td>Sex</td>
<td>Male Genotype: XY</td>
<td>Female Genotype XX</td>
<td></td>
</tr>
</tbody>
</table>

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Reproductive facts and figures for the Chattahoochee bears
Population for Chattahoochee National Forest, GA

<table>
<thead>
<tr>
<th>SEX</th>
<th>Age: 0-1 year</th>
<th>Age: 1-2 years*</th>
<th>Age: 2-4 years</th>
<th>Age: 5-7 years</th>
<th>Age: 7+ years*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Females</td>
<td>7</td>
<td>11</td>
<td>12</td>
<td>10</td>
<td>11</td>
</tr>
<tr>
<td>Females that have given birth in 2007*</td>
<td>0</td>
<td>0</td>
<td>5</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>Males</td>
<td>5</td>
<td>6</td>
<td>5</td>
<td>15</td>
<td>10</td>
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</tbody>
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Georgia Department of Education
Kathy Cox, State Superintendent of Schools
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