**Module B – Continuity of Life**

The chart below offers guidance for scoring the PBA. The scoring guide is to be used as a guide. Tutors may develop their own scoring guide that will fit their situation. Students may answer questions differently than the examples provided in this document. Since students may use online resources, they may copy and paste the answers to questions and not be penalized. Students do not need to complete questions with complete sentences, but must ensure that they have answered the questions. If the question asks for a response, students may respond with one of multiple responses. If it asks for three, students must provide three responses. If there is a *right answer*, it is provided below. If there is a narrative, direction for evaluating whether or not it is satisfactory is also provided.

<table>
<tr><th></th><th colspan="2">Scoring Guide</th></tr>
<tr><td>TASK 1:<br>Where do puppies come from?</td><td colspan="2"></td></tr>
<tr><td>Activity 1:</td><td colspan="2"><table>
<tr><td>Mitosis</td><td>Meiosis</td></tr>
<tr><td>Asexual reproduction</td><td>Sexual reproduction</td></tr>
<tr><td>Genetically identical daughter cells</td><td>Genetically different daughter cells</td></tr>
<tr><td>Results in Diploid Cells</td><td>Results in Haploid Cells</td></tr>
<tr><td>2 cells produced</td><td>4 cells produced</td></tr>
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| | | |
|---|---|---|
| | | |
| | Produces somatic (body) cells | Produces gametes |
| | | |

| | | |
|---|---|---|
| **Activity 2:** | Interphase | Cell grows, replicates organelles, replicates DNA, carries out normal metabolic functions |
| | Cell division | • Prophase: nuclear membrane breaks down, chromosomes condense, spindle fibers form<br>• Metaphase: chromosomes line up along the cells equator<br>• Anaphase: sister chromatids are separated, becoming chromosomes, and are pulled by spindle fibers to opposite poles of the cell<br>• Telophase: chromosomes have reached opposite poles, 2 nuclear membranes form, spindle dissolves, chromosomes begin to unravel |
| | Cytokinesis | Cytoplasm divides, resulting in two identical daughter cells.<br>In plant cells, a cell plate forms between the nuclei, and develops into a new cell wall<br>In animal cells, a cleavage furrow forms, pinching the cytoplasm in half |

| | |
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| **Activity 3:** | 1.Anaphase I<br>2. Anaphase II<br>3. Prophase I<br>4. Metaphase I<br>5. Metaphase II<br>6. Telophase I<br>7. Prophase II<br>8. Telophase II and/or cytokinesis<br>1. Prophase I, Metaphase I, Anaphase I, Telophase I, Prophase II, Metaphase II, Anaphase II, Telophase II/cytokinesis<br>2. #3 (prophase I)<br>3. Gametes (sex cells) |
| **Activity 4:** | 1. 78 diploid 39 haploid<br>2. 78<br>3. 39<br>4. Various:<br>Mitosis is the basis for asexual reproduction, requires only one parent results in genetically identical offspring, low genetic diversity<br>Meiosis creates gametes for sexual reproduction. Requires two parents, each one contributing one haploid gamete. Produces genetically unique offspring, high genetic diversity |
| **Activity 5:** | 1a. To make an exact copy of the DNA so that each daughter cell ends up with the correct amount of DNA following cell division<br>1b. A cell with two copies its DNA (sister chromatids, double-stranded chromosomes) |

<table>
<tr><td></td><td>2. Thymine, guanine<br>3. Genetic mutation<br>4. Nondisjunction</td></tr>
<tr><td>Task 2:</td><td></td></tr>
<tr><td>Activity 1:</td><td>
<table>
<tr><td>DNA</td><td>A C C G G T T A T | A G C C G A G G G | T T T A A C A A A | G G A C G C C G A | G G G A G G A A A | A T C A T C C T A</td></tr>
<tr><td>mRNA</td><td>U G G C C A A U A U C G G C U C C C A A A U U G U U U C C U G C G G C U C C C U C C U U U U A G U A G G A U</td></tr>
<tr><td>tRNA</td><td>A C C G G U U A U A G C C G A G G G U U U A A C A A A G G A C G C C G A G G G A G G A A A A U C A U C C U A</td></tr>
<tr><td>A.A.</td><td>20 – 12 – 13 16 – 2 – 5 9 – 4 – 8 11 – 3 – 2 5 – 7 – 8 6 – 6 - 10</td></tr>
<tr><td>Trait</td><td>brown coat long leg short tail brown eyes not heavy male</td></tr>
</table>
<u>Questions:</u><br><br>1. The process in which the messenger RNA (mRNA) molecule on a ribosome is decoded to produce a sequence of amino acids for protein synthesis.<br>2. The process in which amino acids are arranged in a linear sequence through the processes of transcription of DNA and to RNA and the translation of RNA to a polypeptide chain.<br>3. The process in which a strand of messenger RNA (mRNA) is synthesized by using the genetic information found on a strand DNA as a template.<br>4. Brown<br>5. Long legged</td></tr>
</table>

<table>
<tr><td></td><td>6. Short tail</td></tr>
<tr><td>Activity 2:</td><td>
<table>
<tr><td>mRNA from Step 2</td><td>UUA ACU UGU GUA CGC GGG</td></tr>
<tr><td>Protein Sequence from Step 3</td><td>Leu – Thr – Cys – Val – Arg - Gly</td></tr>
<tr><td>Protein Sequence from Step 4</td><td>Leu - Ser - Cys – Val – Arg - Gly</td></tr>
<tr><td>MRNA from Step 5</td><td>UUA CAC UUG UGU ACG CGG G</td></tr>
<tr><td>Protein Sequence from Step 5</td><td>Leu – His – Leu – Lys – Thr – Arg -</td></tr>
</table>
Conclusions:
1. Point mutation – protein sequence from step 4<br>Frameshift mutation – protein sequence from step 5
2. Amino acid Ser instead of Thr was shown.
3. Five amino acids were changed His, Leu, Lys, Thr, and Arg
</td></tr>
<tr><td>Task 3:</td><td></td></tr>
</table>

<table>
<tr>
<td>Activity 1:</td>
<td>
1. B (black) or b (brown)<br>
2. 50%<br>
3.<br>
<table>
<tr><td></td><td>B</td><td>b</td></tr>
<tr><td>B</td><td>BB</td><td>Bb</td></tr>
<tr><td>b</td><td>Bb</td><td>bb</td></tr>
</table>
4. 75% or ¾<br>
5. 25% or ¼<br>
6. Bb<br>
7.<br>
<table>
<tr><td></td><td>B</td><td>b</td></tr>
<tr><td>b</td><td>Bb</td><td>bb</td></tr>
<tr><td>b</td><td>Bb</td><td>bb</td></tr>
</table>
</td>
</tr>
<tr>
<td>Activity 2:</td>
<td>
1. 2<br>
2. 2<br>
3.
</td>
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</table>

<table>
<tr><td></td><td>
<table>
<tr><td>Phenotype</td><td>Black</td><td>Brown</td><td>yellow</td></tr>
<tr><td>genotypes</td><td>BBEE, BbEE, BBEe, BbEe</td><td>bbEE, bbEe</td><td>BBee, Bbee, bbee</td></tr>
</table>
4. Yellow is the absence of pigment.<br>
5. Heterozygous. The only way for two black parents to have offspring with brown coats is if they both carry the recessive allele for brown color. The only way for two black parents to have offspring with yellow coats is if they both carry the recessive allele for color not deposited. Two parents who are homozygous for both black color and color deposition can only have black offspring.<br>
6. Both parent genotypes would have to be bbEe<br>
7. bbEE</td></tr>
<tr><td>Activity 3:</td><td>1. Codominance<br>2. Incomplete dominance</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Task 4:</td><td></td></tr>
<tr><td>Activity 1:</td><td>1. 7.5<br>2. B</td></tr>
</table>

<table>
<tr><td>Activity 2</td><td></td></tr>
<tr><td>Part 2:</td><td>
1. Neither very aggressive, nor very tame in the initial population, and neither very aggressive nor very tame after 20 generations.<br>
2. Neither very aggressive, nor very tame in the initial population, low aggressiveness/very tame after 20 generations.<br>
3. It changed from neither aggressive nor very tame to low aggressiveness/very tame.<br>
4. Group A represents wolves in the wild. Selective pressure in the wild favors wolves that are neither very aggressive nor very tame. Group B represents dogs. The selective pressure favors individuals that are very tame. Dogs, surviving in the vicinity of humans benefit from being tame.<br>
5. In real life isolation means that the individuals from the two groups would not interbree.<br>
6. If wolves and dogs were allowed to regularly interbreed, one prediction might be that the dog's tameness would be reduced and the wolf's tameness would be increased. In terms of real life, it would mean the two groups would be prevented from breeding (e.g., exchanging genes) with each other.<br>
7. If dogs and wolves had not been isolated, the small number of "tameness" genes that arose in the population evolving into dogs would likely have been lost in the much larger wolf gene pool, where they would be selected against by the wolf's way of life. This would have made it very unlikely for dogs to ever evolve. Dogs could possibly lose the "tameness" gene.<br>
8. Answers will vary but must include an application of one of the following concepts: isolating mechanisms, genetic drift, founder effect, and migration.
</td></tr>
<tr><td>Task 5:</td><td></td></tr>
<tr><td>Activity 1:</td><td>
<table>
<tr><th>Task</th><th>Which Breed is Best Suited</th><th>Evidence</th></tr>
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| | | | |
|---|---|---|---|
| Digging and tunneling to hunt for small mammals | B | Short legs, large paws, large lung capacity<br>Long snout |
| Running at great speeds | D | Large heart, long legs, flexible spine, large amount of fast-twitch muscle |
| Pulling sleds in cold snowy conditions | E | Strong, good endurance, thick coat |
| Using scent to track down prey | A | Long ears, neck folds, huge nasal chambers |

**Activity 2:**

| Traits | Desired Value |
|---|---|
| Sight | 5 |
| Smell | 5 |
| Speed | 5 |
| Hearing | 5 |
| Trainability | 5 |
| Friendliness (1 =aggressive, 5 = friendly) | various |

Part 1

1. Traits that are determined by the interaction of more than one gene
2. Average or 'medium' temperament. Polygenic traits show continuous variation. If two extreme genotypes are crossed, the offspring will inherit genes of both extremes, and an intermediate phenotype will be expressed

Part 2

1. Parent 1: Various, but must be consistent with the breed chosen
2. Parent2: Various, but must be consistent with the breed chosen
3. Offspring: Various, but each trait value must be an average of the parent values

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<tr><td></td><td>
4. No, because the trait values of the two parents will “blend” together to result in an intermediate value, and none of the dogs are ‘perfect’<br>
5. Cross the fastest individuals of your existing breed with one another, or cross the fastest individuals of your breed with a different, fast breed (such as breed D)<br>
6. The answer is dependent upon what the students selected. Many will say to select Breed E
</td></tr>
<tr><td>Activity 3:</td><td>
1. Parasitism<br><br>
2.
<table>
<tr><th>Interaction</th><th>Type of symbiosis</th><th>Explain HOW/WHY the interaction demonstrates the relationship you identified</th></tr>
<tr><td>Heartworms enter a dog's bloodstream from the bite of an infected mosquito. The worms mature in the dog's heart, growing in length and clogging the heart. This causes illness and even death to the dog</td><td>Parasitism</td><td>The dog is harmed (but not consumed) by the heartworms. The heartworms benefit from the relationship</td></tr>
<tr><td>Dogs and humans live closely together and help one another. The dogs get shelter and food, while humans get companionship, protection, and other services</td><td>Mutualism</td><td>Both the dog and human benefit from the relationship</td></tr>
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| | On a hot sunny day, many dogs will seek the shade provided by a nearby tree. The dog gets to cool off in the shade, but the tree is unaffected | Commensalism | The dog benefits, the tree is unaffected |

**Task 6:**

**Activity 1:**

One of the following:

1. They were concerned that the wolves might attack the public, rancher's livestock and the public's pets.
2. The wolf reduced the mainly the elk population to healthy levels which increased the willow, which increased the beaver, which created aquatic habitats.
3. No, the wolf did not decrease the beaver population.
4. When the wolf population declined the songbird, beaver, and willow tree population also declined.

**Activity 2:**

1.
   a. Grass _____biotic_____
   b. Water _____abiotic_____
   c. Glucose _____abiotic_____
   d. A worm _____biotic_____

2.
   a. Organism – Population – Community – Ecosystem – Biome – Biosphere

3.
   a. Producer: _____willow, vegetation_____
   b. Consumer: ____elk, bison, beaver_____ , _____herbivores_____
   c. Consumer: _____song bird, fish_____, _____omnivores_____

d. Consumer: _____wolves_____ , _____carnivore_____

e. Consumer: _____

(*answers can vary but must pertain to video/article of Yellowstone National Park)

**4.** Trophic levels are the feeding position in a food chain such as primary producers, herbivore, primary carnivore, etc. Green plants form the first trophic level, the producers. Herbivores form the second trophic level, while carnivores form the third and even the fourth trophic levels.

**5.** Two laws of physics are important in the study of energy flow through ecosystems. The **first law of thermodynamics** states that energy cannot be created or destroyed; it can only be changed from one form to another. Energy for the functioning of an ecosystem comes from the Sun. Solar energy is absorbed by plants where in it is converted to stored chemical energy. The **second law of thermodynamics** states that whenever energy is transformed, there is a loss energy through the release of heat. When one animal feeds off another, there is a loss of heat (energy) in the process. Additional loss of energy occurs during respiration and movement. Hence, more and more energy is lost as one moves up through trophic levels.

**6.** The amount of energy available to one trophic level is limited by the amount stored by the level below. Because energy is lost in the transfer from one level to the next, there is successively less total energy as you move up trophic levels. In general, we would expect that higher trophic levels would have less total biomass than those below, because less energy is available to them. So, in order to support the wolves in Yellowstone, So the mass of wolves should be less than the mass of other consumers and producers, and the mass of consumers are less than the mass of plants.