Name: _____ **Date:** _____

Unit 1 Assessment

SCENARIO: EFFECTIVE USE OF PESTICIDES

Use the information below, as needed, when you respond to the prompts.

Pesticides. Pesticides play an important role in food production. They protect or increase the amount of a crop that can be grown because they kill the insects that harm the crops.

Unfortunately, many pests like the Colorado potato beetle are becoming resistant to more types of pesticides.

Colorado potato beetle. The Colorado potato beetle is an insect known for eating the leaves of plants and killing them. These beetles have been harming crops since the middle of the 1800s. They are especially dangerous to potatoes, tomatoes, and eggplants.

Key characteristics of Colorado potato beetles:

- Colorado potato beetles live for about 1 year.
- Females lay about 300 eggs when they mate in the spring.
- Adults can walk and fly, and with the help of wind they can travel up to 100 km (62 miles), which allows them to move to other fields of crops.
- There is a large amount of variation in heritable traits within Colorado potato beetle populations.

Respond to the questions below to explain how and why the Colorado potato beetle population has continued to be such a problem for farmers and gardeners.

PROMPT 1: WHAT HAPPENS WHEN A COLORADO POTATO BEETLE COMES IN CONTACT WITH A PESTICIDE?

1a. Like many animals, Colorado potato beetles have nerve cells that send messages throughout their bodies to communicate and help them function. The text below explains how this process happens normally.

Nerve cell functioning
Nerve cells have receptors that accept messages from other nerve cells in the form of signal molecules. One signal molecule is called acetylcholine. To send a message, the "sender" nerve cell releases acetylcholine in the space between nerve cells called the synaptic cleft. Then the "receiver" nerve cell receives the message when acetylcholine binds to its receptor and causes a chain of events. When it is done binding, acetylcholine floats around the synaptic cleft and is able to bind again to more receptors and to other "receiver" nerve cells. To prevent too much acetylcholine from building up and causing dysfunction, there is an enzyme that breaks down extra acetylcholine so it can no longer bind to receptors. The nerve cells then have the right amount of acetylcholine floating around to function properly.

List the components and interactions in the model. In your list, make sure to include the key aspects of how this process maintains homeostasis.

1b. Develop a model of the process that keeps the nerve cell functioning properly before any pesticide is introduced.

1c. Pesticides are designed to kill insects by disrupting their body functions. Let's look at one particular pesticide that interrupts nerve function.

Pesticide A
Pesticide A binds to the enzyme that breaks down acetylcholine in nerve cells. Pesticide A makes the enzyme unable to do its job.

Revise your model using a different colored pencil to explain how introducing the pesticide would affect nerve function.

Self-check: In my model and my revised model I …

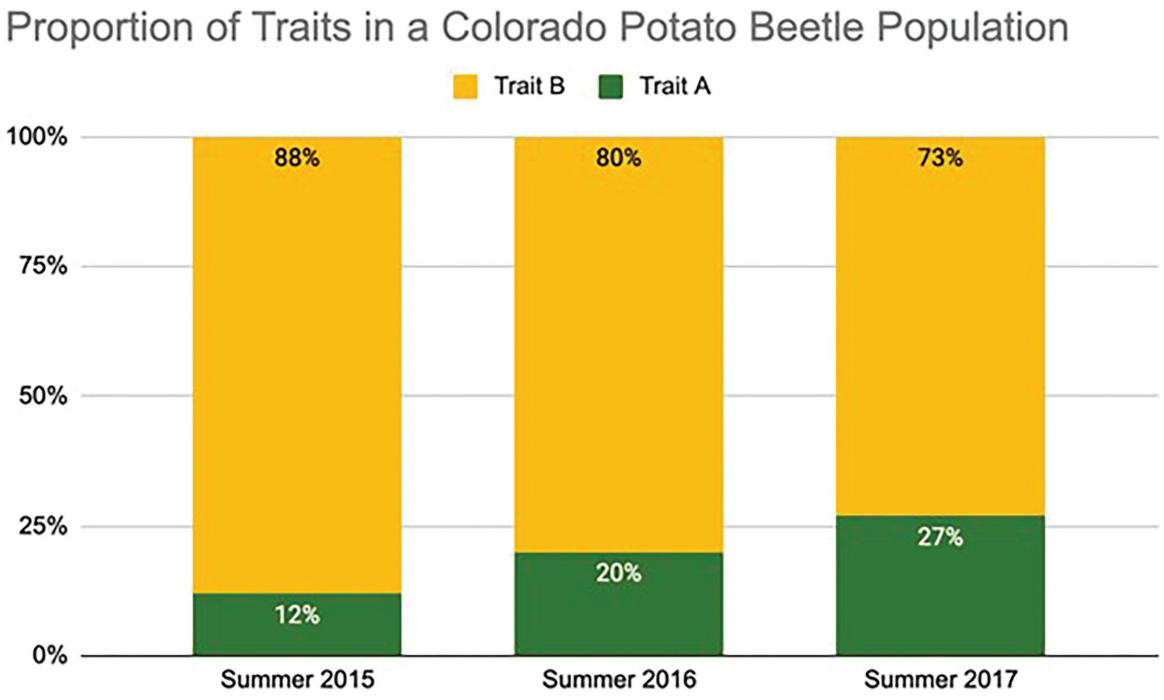
✓ Identified all the components my model needs.

✓ Showed the interactions between the components in my model and included any initial conditions, inputs, outputs, and boundaries of the system(s).

✓ Used my model to provide a description of how and why the phenomenon works.

PROMPT 2: PESTICIDES AND THE COLORADO POTATO BEETLE POPULATION

2a. The graph below shows the percent of the Colorado potato beetle population having each of two versions of a heritable trait at three time points: Summer 2015, Summer 2016, and Summer 2017. The same pesticide was applied to the potato crops in that area each year.



Consider the system that includes the Colorado potato beetle population, the pesticide, and the potato crops. From Summer 2015 to Summer 2017, what stays the same? What changes?

2b. Which trait (Trait A or Trait B) is more likely to make the Colorado potato beetles resistant to the pesticide that was applied each year?

2c. Referring to your Class Consensus Model, construct and support an explanation to answer the question: Why do we see Trait A increasing over time in the Colorado potato beetle population?

Claim (answers the question with a *how* or *why* explanation):

2d. Support (relevant evidence and how the evidence links to science ideas):

Check:

✓ The claim answers the question

✓ The support includes evidence from labs, readings, videos, or other sources

✓ The support includes science ideas that we agree on

✓ Each piece of evidence is linked to a science idea

PROMPT 3: VARIATION IN THE COLORADO POTATO BEETLE POPULATION

3a. Researchers studying insects similar to the Colorado potato beetle have noticed that the Colorado potato beetle has a lot more variation in traits among individuals compared to other insect species. Other insects are not as big of a problem for farmers because they are less likely to develop resistance to pesticides as quickly.

Referring to your Class Consensus Model, construct and support an explanation that answers the question: Why would these other insect species be less likely to develop resistance to pesticides than the Colorado potato beetle?

Claim (answers the question with a *how* or *why* explanation):

3b. Support (relevant evidence and how the evidence links to science ideas):

Check:

✓ The claim answers the question

✓ The support includes evidence from labs, readings, videos, or other sources

✓ The support includes science ideas that we agree on

✓ Each piece of evidence is linked to a science idea

PROMPT 4: MULTIPLE PESTICIDES APPROACH

4a. Some people suggest that the best way to combat the Colorado potato beetle is to rotate different pesticides with different ways of killing the beetles in a specific order. This is called rotating the "mechanisms of action" used.

A gardener is currently using Pesticide A, which used to work for many years. Recently, they are noticing more damage to their plants from Colorado potato beetles. Two other options are Pesticide B and Pesticide C. A pesticide expert recommended they try Pesticide C, and not Pesticide B. The table below describes the mechanism of action for each pesticide.

Pesticide	Mechanism of action
Class 1	
Pesticide A	• Pesticide A binds to an enzyme. • The enzyme's job is to break down a molecule called acetylcholine, which can bind with nerve cells and stimulate them. • Pesticide A makes the enzyme unable to do its job. • When it can't do its job, there will be too much acetylcholine, and the nerve cells will be overstimulated. • The organism will become paralyzed or die.
Pesticide B	• Pesticide B binds to the same receptor on a nerve cell as acetylcholine. • Once the pesticide binds to a nerve cell receptor, nothing can break down the pesticide. • When there is too much pesticide (or acetylcholine) binding to the receptor, the nerve cell will be overstimulated. • The organism will become paralyzed or die.
Class 2	
Pesticide C	• Pesticide C stops the molecule that makes adenosine triphosphate (ATP) from doing its job. • ATP is an important molecule that provides needed energy for cellular processes. • When the cells cannot make ATP, they can no longer function and the organism will die.

4a. Construct and support an explanation to answer the question: Why did the pesticide expert recommended Pesticide C instead of Pesticide B?

Claim (answers the question with a *how* or why explanation):

4b. Support (relevant evidence and how the evidence links to science ideas):

Check:

✓ The claim answers the question

✓ The support includes evidence from labs, readings, videos, or other sources

✓ The support includes science ideas that we agree on

✓ Each piece of evidence is linked to a science idea