

4.4: Grading the Computer Model for Seasons and Disturbances

Worksheet

This worksheet has “grading” in the title because at this point, students can be held accountable for correct answers. Level 4 (correct) responses to the questions are in **blue bold italics** below. There are also comments about common Level 2 and Level 3 responses to help you with grading and making decisions about what to emphasize in future lessons.

Red italics suggest ways to grade student responses by giving them points for correct or partially correct answers. There are 46 points total on this worksheet.

See the directions in 4.4: Computer Model for Seasons and Disturbances Handout to complete this worksheet.

A. Investigate how seasons affect pools and fluxes

1. Model 3 without seasonal variation. Follow the directions in Steps 1-6 of the handout to complete the table below.

	Year 14.0	Year 16.0
Photosynthesis flux	150	150
Cellular respiration flux	145	149
Organic matter pool	726	745

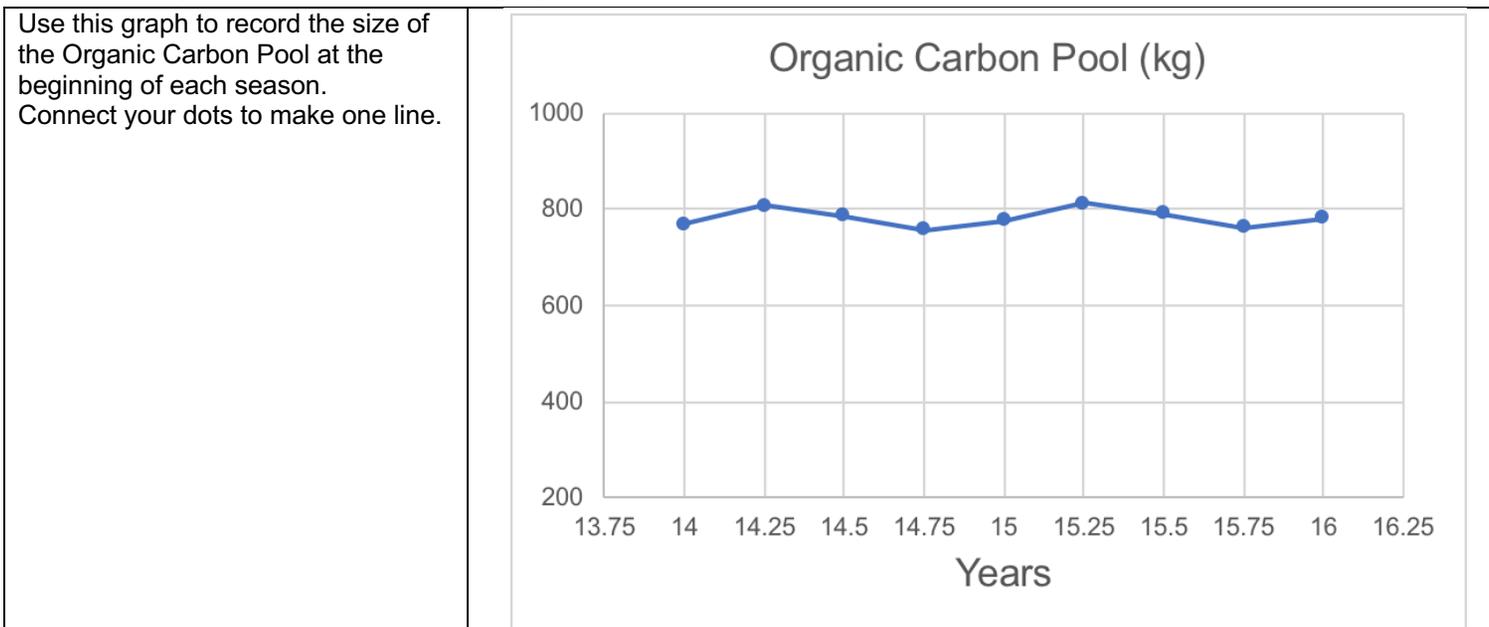
1 point for each answer; 6 points total.

2. Model 3 with seasonal variation. Use results from the three-turtle model (Handout questions 7 to 8) to report pool sizes, flux rates, and net fluxes (by filling in blanks) in the table below and then think about explanations for the seasonal patterns that you find.

During Spring (Time 14.0)	During Summer (Time 14.25)	During Fall (Time 14.5)	During Winter (Time 14.75)
How much carbon moves into or from the organic carbon pool during the spring? 19 kg	How much carbon moves into or from the organic carbon pool during the summer? 37.75 kg	How much carbon moves into or from the organic carbon pool during the fall? -21.25 kg	How much carbon moves into or from the organic carbon pool during the winter? -29.25 kg

<p>During spring, the size of the organic carbon pool: <input type="checkbox"/> increases <input type="checkbox"/> decreases</p> <p>Explain what you think is happening that causes the organic pool to change size this way over the spring:</p>	<p>During summer, the size of the organic carbon pool: <input type="checkbox"/> increases <input type="checkbox"/> decreases</p> <p>Explain what you think is happening that causes the organic pool to change size this way over the summer:</p>	<p>During fall, the size of the organic carbon pool: <input type="checkbox"/> increases <input type="checkbox"/> decreases</p> <p>Explain what you think is happening that causes the organic pool to change size this way over the fall:</p>	<p>During winter, the size of the organic carbon pool: <input type="checkbox"/> increases <input type="checkbox"/> decreases</p> <p>Explain what you think is happening that causes the organic pool to change size this way over the winter:</p>
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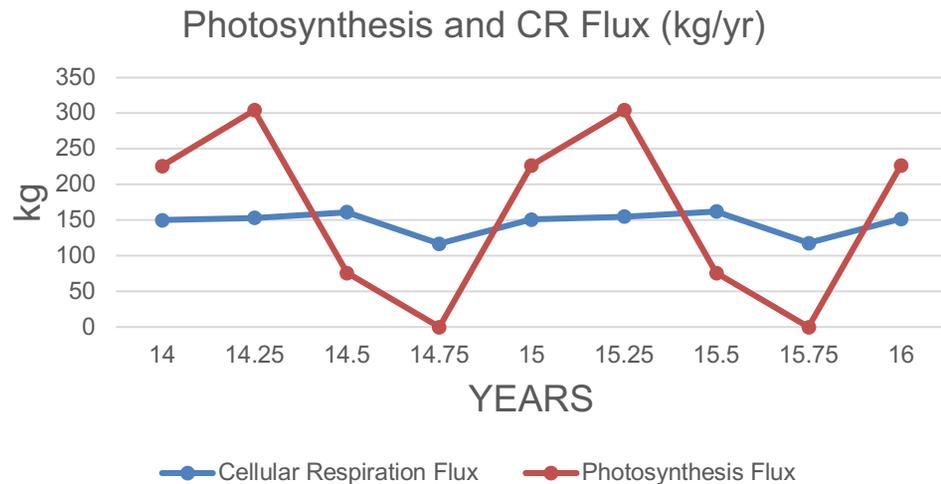
3. Follow the directions in Steps 9-12 to complete the graphs below



Use this graph to record the Photosynthesis and Cellular Respiration Fluxes during each season.

Connect the dots to make two lines:

- The photosynthesis line will go sharply up and down each year
- The CR line will vary less each year



B. Patterns in how seasons affect pools and fluxes

1. Compare your data for data for the same model without seasons (Step 7) and with seasons (Step 11). Circle your choices for the questions below:

- Which variable is affected most by seasons?

Organic Matter Pool **Photosynthesis Flux** *Cellular Respiration Flux*

- What has the largest effect on the size of the Organic Matter Pool during Years 14-16?

Seasons *Photosynthesis Limit*

1 point for each; 2 points total.

2. Why does the organic carbon pool size go down during the winter? (Think about the balance of fluxes during the winter.)

The organic carbon pool goes down in the winter because the photosynthesis flux decreases to almost 0 during the winter months. This is because in most places, plants are dormant, thus they are not photosynthesizing. This results in a larger cellular respiration flux moving out of the organic pool into the atmospheric pool, resulting in an overall loss from the organic pool

1 point for correct explanation

C. Investigate how disturbances affect pools and fluxes

4. Report the results of your investigation of press disturbances below.

- What settings did you investigate?

Answers will vary

1 point for description

b. What patterns did you notice in how press disturbances affect ecosystems?

During this time, the photosynthesis flux never exceeds the cellular respiration flux. A press disturbance affects the carrying capacity of the simulated ecosystem. Depending on the settings, it can increase or decrease the photosynthesis limit.

1 point for correct explanation

5. Report the results of your investigation of pulse disturbances below.

a. What settings did you investigate?

Answers will vary

1 point for description

b. What patterns did you notice in how pulse disturbances affect ecosystems?

The pulse disturbance causes the atmospheric pool to abruptly increase and the organic pool to abruptly decrease in a short time frame. After the pulse disturbance, the system eventually returns to its previous state, pre-disturbance, but it takes a few years to get to this point.

1 point for correct explanation

D. Types of disturbances in real ecosystems

6. List some of your ideas about different types of disturbances that affect the ecosystems around you, including natural ecosystems and ecosystems such as farms and gardens that are managed by humans.

a. Press disturbances: *Answers will vary: Ex. Droughts, climate change, fertilizing a farm, irrigation, pollution, loss of costal wetlands, overfishing, "dead zones" in rivers, invasive species,*

b. Pulse disturbances: *Answers will vary: Ex Oil spills, fires, hurricanes, tornados, logging, windstorms, volcanic eruptions, insect outbreaks*

1 point for reasonable responses in each section; 2 points total.