Name _____ Teacher _____ Date _____

4.4: Grading Global Computer Model Worksheet

*This tool 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 X points total on this worksheet.

A. Collect and record results for Global Computer Model

Try using the Global Computer Model (http://carbontime.bscs.org/sites/default/files/simulations/HES_Simulation/index.html) to predict how changes in fluxes will affect the Atmospheric Carbon Pool. You can refer to the Global Computer Model Handout for directions about how to control the initial settings and read the results for each run.

Run #1: Continue the current pattern

Check first to see what the model predicts if the fluxes all stay about the same as they were in 2017 for the next 50 years.

Initial Settings	Results of Run	
Time of change: **2018-2068** (the whole period of the model) Photosynthesis: **120** GtC/yr Cellular respiration: **119** GtC/yr Combustion: **10** GtC/yr	Size of the Atmospheric Carbon Pool In 2023 __***874***____ In 2043 __***1054***___ In 2068 __***1279***___	Will the size of the Atmospheric Carbon Pool pass 1100 GtC? Before 2068? ***Yes*** No After 2068? Yes ***No*** About what year? ***2048***

1 point for each correct answer: 6 points total. NOTE: There might be small discrepancies between students' results and the numbers above.

Run #2: Reduce fossil fuel combustion

Try seeing what will happen if humans immediately reduced our use of fossil fuels. Choose a lower setting for the Combustion flux, then see what happens.

Initial Settings	Results of Run	
Time of change: **2018-2068** (the whole period of the model) Photosynthesis: **120** GtC/yr Cellular respiration: **119** GtC/yr Combustion: ____***2.5***____GtC/yr	Size of the Atmospheric Carbon Pool In 2023 ____***849***_____ In 2043 ____***879***_____ In 2068 ____***934***_____	Will the size of the Atmospheric Carbon Pool pass 1100 GtC? Before 2068? Yes ***No*** After 2068? ***Yes*** No About what year? _***2150***_

NOTE: The numbers above show results for one choice of reduced combustion flux: 2.5 GtC/yr. Other choices will show other patterns. ALL choices above 0.5 GtC/yr should show that the size of the Atmospheric Carbon Pool continues to grow, so it will eventually pass 1100 GtC. 1 point for each correct answer: 6 points total.

Run #3: Reduce fossil fuel combustion after 10 years

Suppose humans waited for 10 years before reducing our use of fossil fuels. Choose a lower setting for the Combustion flux and delay the start of the change until 2028, then see what happens.

Initial Settings	Results of Run	
Time of change: **2028-2068** (starting after 10 years) Photosynthesis: **120** GtC/yr Cellular respiration: **119** GtC/yr Combustion: ___*2.5*__GtC/yr	Size of the Atmospheric Carbon Pool In 2023 ____*874*____ In 2043 __*939*_____ In 2068 ___*977*_____	Will the size of the Atmospheric Carbon Pool pass 1100 GtC? Before 2068? Yes ***No*** After 2068? ***Yes*** No About what year? ***2125***

NOTE: The numbers above show results for one choice of reduced combustion flux: 2.5 GtC/yr. Other choices will show other patterns. The key result is that the atmospheric pool will be larger and the date when the Atmospheric Carbon Pool passes 1100 GtC will be sooner than in Run #2. 1 point for each correct answer: 6 points total.

Run #4: Keep the size of the Atmospheric Carbon Pool below 1100 GtC

Find some values for the initial settings that will keep the size of the Atmospheric Carbon Pool from *ever* getting above 1100 GtC. What would it take to accomplish that goal?

Initial Settings	Results of Run	
Time of change: _____**-2068** (you choose the starting time) Photosynthesis: _____GtC/yr Cellular respiration: _____ GtC/yr Combustion: _____GtC/yr	Size of the Atmospheric Carbon Pool In 2023 _____ In 2043 _____ In 2068 _____	Will the size of the Atmospheric Carbon Pool pass 1100 GtC? Before 2068? Yes No After 2068? Yes No About what year? _____

NOTE: Some combination of three choices for keeping the Atmospheric Carbon Pool below 1100 GtC:

- *Reduce the combustion flux to 0.4 GtC/yr or less*
- *Increase the photosynthesis flux to 126.1 GtC/yr or more*
- *Reduce the cellular respiration flux to 113.5 GtC/yr or less*

The total reduction needs to add up to the current combustion flux: 6.5 GtC/y. 3 points for identifying a correct combination.

B. Questions about Patterns

1. What determines if or when the Atmospheric CO_2 Pool passes 1100 GtC—the estimated size of the "dividing line" between moderate and severe climate change?

The balance of fluxes into and out of the Atmospheric Carbon Pool needs to be 0 GtC/yr or negative.

3 points for identifying a correct solution.

2. In the long run, the photosynthesis and cellular respiration fluxes will probably stay close to balanced. What does that mean that humans need to do to keep the Atmospheric CO_2 Pool less than 1100 GtC?

The Fossil Fuel Combustion Flux needs to be very close to zero.

3 points for identifying a correct solution.