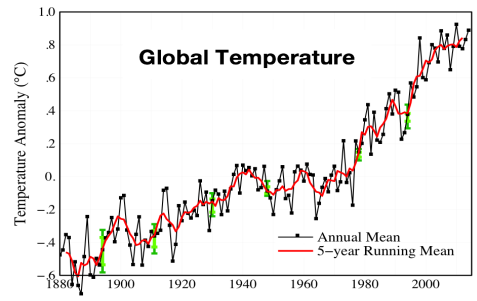
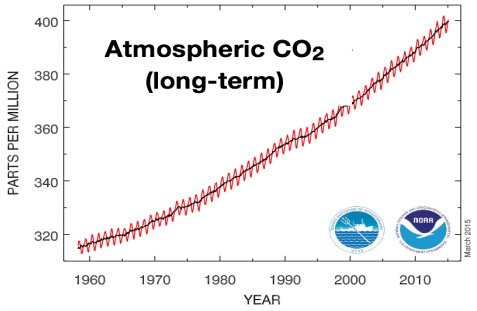
Name _____ Teacher _____ Date _____

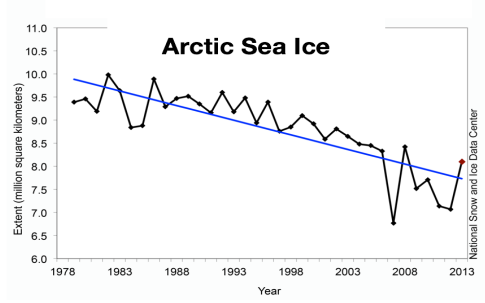
3.3 Grading the Explaining Relationships Between Earth Systems Worksheet

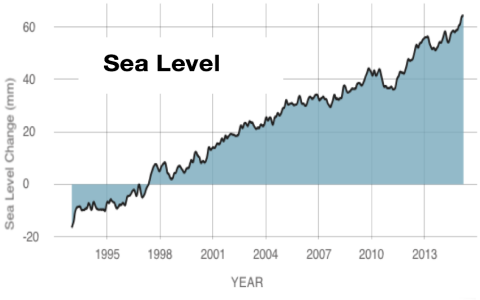
*This tool has "grading" in the title because at this point, students can be held accountable for correct answers. Level 4 (correct) responses to the questions are in **blue bold italics** below. Look to see if students have identified "increase in atmospheric CO_2" as the driver of all other systems, which is the main causal mechanism they should be able to identify and explain at this point in the unit.*

Red italics suggest ways to grade student responses by giving them points for correct or partially correct answers. There are 11 points total on this worksheet.







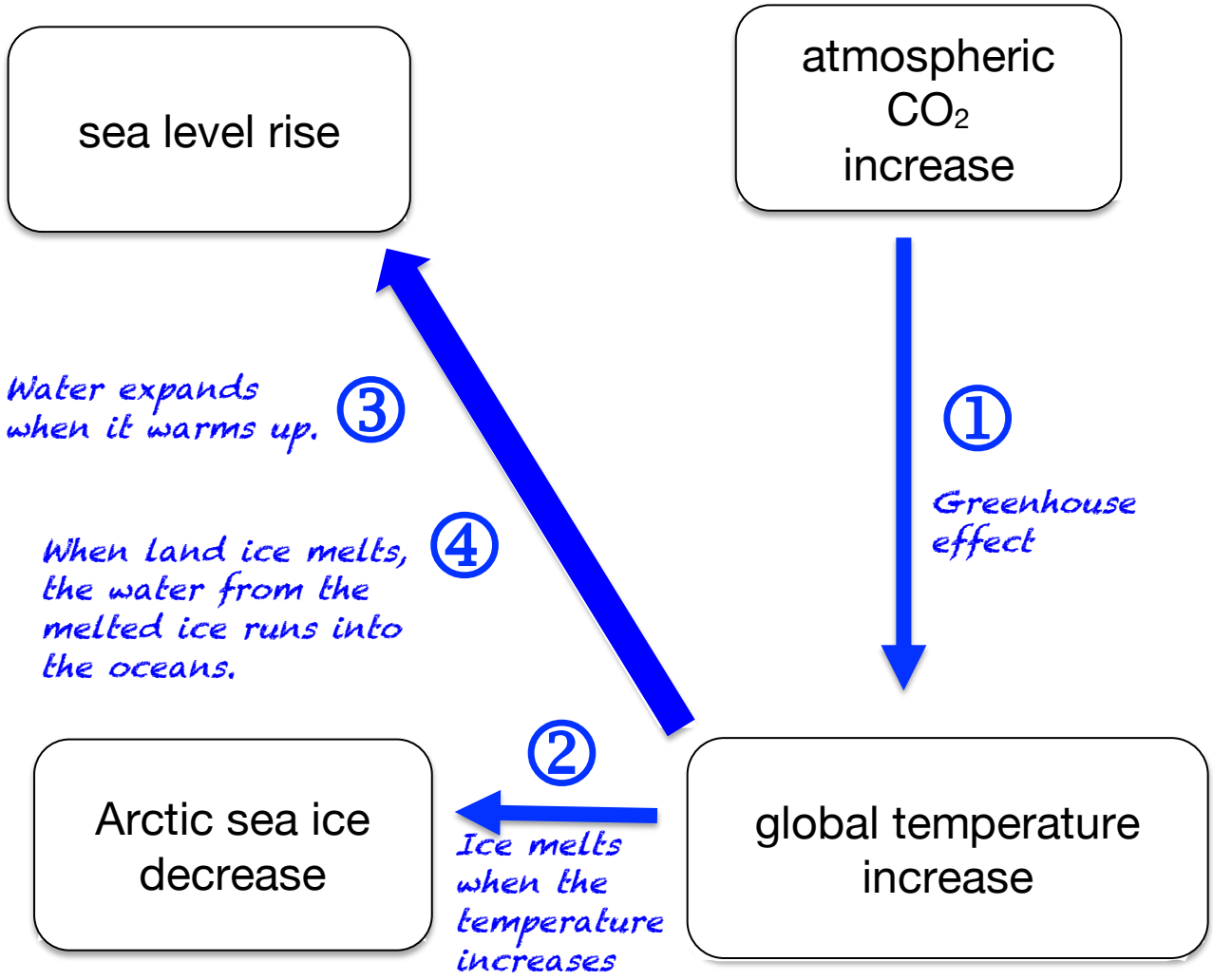


Explanations

Use each explanation only once.

1. Greenhouse effect.
2. Ice melts when air temperatures get warmer.
3. Water expands when it warms up.
4. When land ice melts, the water from the melted land ice runs into the oceans.

1. **Your Model.** Draw arrows to show how these four Earth systems (graphs on page 1) are related. Draw only three arrows. Label each arrow with an explanation from page 1. One of the arrows has two explanations. An arrow means that one box "causes" the other box.



1 point for each correct arrow. 1 point for each explanation. 7 points total.

2. **Your Explanation.** What is the "driver" in this system (in other words, which box causes the other boxes?)? How does this "driver" impact other systems? Include evidence to support your ideas.

Increasing atmospheric CO_2 is the driver in this system. Increased CO_2 levels cause the atmospheric temperature to increase (due to the greenhouse effect). This increase in global temperature (atmospheric and oceanic) then causes sea level to rise (because of land ice melting and also thermal expansion). This temperature increase also causes Arctic sea ice to melt (which does not raise the sea level).

Note: Some students may draw an arrow from Arctic sea ice decrease to sea level rise. If this happens you may want to dedicate class time explaining that melting land ice causes sea level rise (when new water flows into the oceans that wasn't there before), but that melting sea ice does not cause sea level rise (when sea ice melts, the sea level stays the same). Sea level rise is caused in part by thermal expansion (when water temperature increases, the volume of the water increases). Currently oceanic thermal expansion contributes to about 1mm/yr of sea level rise globally.

1 point for identifying the correct driver in this system. 1 point for describing how the driver impact each other system (temperature, sea level rise, Arctic sea ice melt). 4 points total.