Name _____ Teacher _____ Date _____

1.2 Assessing the Expressing Ideas and Questions Tool: What do *you* think is happening to Arctic sea ice?

These two pictures show ice that covers the sea on the Earth's north pole. Each picture is from the same month 36 years apart. Look at the images and write your ideas about what is happening to Arctic sea ice.

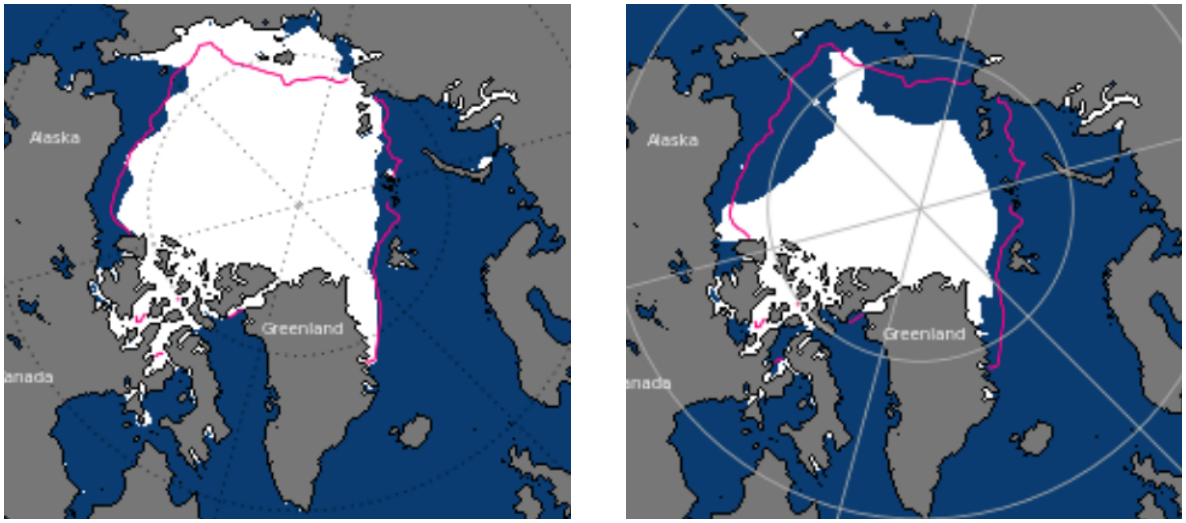
This Expressing Ideas Tool should be part of a brainstorming and elicitation session: the goal is to get students to express a wide range of ideas, even if they are incorrect. Ideally, students will come to recognize that they have many different ideas about what happens when ethanol burns, as well as unanswered questions.

Carbon TIME Discourse Routine around the Expressing Ideas and Questions Tool:

1. *Introduction: Establish the purpose for completing the tool as eliciting a range of ideas and questions about the unit phenomenon.*
2. *Private thinking and writing: Students complete the Expressing Ideas and Questions Tool individually with a range of responses, some of which may be incorrect.*
3. *Partner or small group work: Students share and compare ideas in pairs/small groups, with the goal of hearing a variety of ideas.*
4. *Sharing ideas in whole-class discussion: Class discussions serve to elicit, clarify, and compare ideas and questions from individual students and/or student groups.*
5. *Consensus-seeking discussion accompanied by public writing: Class discussions focus on coming to consensus about similarities and differences among students' ideas, issues and points of disagreement, and wondering questions about the system. You may highlight hypotheses and questions that students will be able to investigate and explore later in the unit.*

*Level 4 responses are in **bold blue italics** below. Remember Level 4 is the eventual learning goal; we do NOT expect most, possibly any, students to produce these responses at this point in the unit. This worksheet has "assessing" in the title because we do NOT recommend giving your students a grade based on the scientific accuracy of their responses at this point in the unit. It is designed to be used as a tool for formative assessment.*

September 1979 → September 2018



Image/photo courtesy of the National Snow and Ice Data Center, University of Colorado, Boulder

Your ideas. There is less ice in 2018 than in 1979. Why do you think that there is less ice, even though it is the same time of year?

Increased carbon emissions to the atmosphere due to human combustion of fossil fuels has caused in increase in greenhouse gases in the atmosphere. Long-wave radiation emitted from the Earth's surface then interacts with greenhouse gases in the atmosphere, which produces heat, also known as the greenhouse effect. This increased temperature as a result of emissions and the greenhouse effect caused the ice to melt.

Level 3 responses may suggest that this is due to the greenhouse effect or due to global warming but may not be able to identify a causal relationship between combustion of fossil fuels, increased GHGs, increasing temperatures, and ice melt. Level 2 students may suggest that the melting is due to warmer temperatures, "pollution," or other actions that are generally harmful for the environment (e.g., cutting down trees).

Your Questions. What questions do you have about why there was less ice in 2018 than in 1979?

Students may have a variety of questions at this point. When reading their ideas, look to see if they are asking questions that would provide evidence of a causal mechanism. Do they know which pieces of evidence they need in order to explain the ice melt? If not, you may want to have another class discussion about what additional information they may need to understand why arctic sea ice is melting. You might also try displaying their questions in a public space in the classroom and revisiting them if they come up later in the unit.