Incorporating Instruction about Trade-offs in the *Chemistry – Fueling the World*

The analysis of trade-offs is an essential skill incorporated in several *Science in Global Issues* (SGI) Activities. Below are suggestions for a class discussion and opportunities for reinforcement we suggest you incorporate into your instruction to support students' ability to identify and analyze trade-offs.

Discuss the role of trade-offs in the decision making process

One of the goals of *Science in Global Issues* is to teach students that decisions often involve trade-offs and to consider evidence when making a decision.

Explain that a **trade-off** is something that is given up or "traded off" to gain something else. As is the case with selecting and recommended an energy option in Activity 22, it is important for students to understand that a perfect choice does not exist. What is possible is an identification of the trade-offs and an analysis of what is being traded-off with each decision. For example, the choice of "Paper or plastic?" at a store check-out counter can be answered quickly. But a consideration of the trade-offs of the choices leads to an evidence-based informed decision. A shopper who chooses paper may do so to avoid throwing away the plastic bags, or because they would prefer to use a bag made from natural materials. In choosing the paper bag though, they are accepting the trade-off of using a heavier bag that is made from trees to carry groceries home. In comparison, the shopper who chooses the plastic bag because it has stronger handles is accepting the trade-off that the plastic bag is made from petroleum-based materials. Neither answer is perfect. Both choices involve trade-offs.

To establish and explore the concept of trade-offs with your class, brainstorm with students decisions they encounter in their daily lives that involve trade-offs. Choose one or two and talk through possible decisions and their associated trade-offs. This practice will familiarize students with the process of identifying and considering trade-offs.
Explain to students that evidence is an observation or data that supports a decision or idea. In this unit, students will be asked in the culminating activity to recommend one of the six energy options. The evidence they will use to support this decision will come from information collected on students' "Comparing Energy Criteria" charts. In making a recommendation, it is important that students identify and analyze the trade-offs of their decision.

Opportunities to reinforce the consideration of trade-offs in *Fueling the World*

Activity	**Learning Opportunity**
Activity 1, "Alternative energies for Transportation"	Introduce the concept of trade-offs, and conduct a class discussion as detailed above. Students will identify and explain trade-offs in Analysis Questions 1 and 2.
Activity 15, "Energy in Fuels"	Revisit the concept of trade-offs before students begin work on Procedure Step 11.
Activity 17, "Comparing Catalysts"	Analysis Question 8 asks students to make a decision about a catalyst. Reinforce that their response should include a discussion of the trade-offs associated with their choice. This is an opportunity to revisit the concept of trade-offs.
Activity 20, "The Ethanol Alternative"	Revisit the concept of trade-offs with the class before students answer Analysis Question 4.
Activity 21, "Rating Fuels and Energy Sources"	In Teaching Step 2 you will introduce two different sneaker-rating systems to the class. Begin the discussion by asking students, Which sneaker would you buy? What trade offs are

	involved in choosing one type of sneaker over the others? When discussing the sneaker rating systems discuss the trade-offs involved in using System A versus System B. Ask the class, ***What are the trade-offs associated with Sneaker Rating System A? With System B?*** This discussion will assist later when students identify the trade-offs of the rating systems they construct in Part B of the Activity.