SCIENCE·3D

SEA TURTLE WORLD

In this packet, sample student answers are provided in red and notes to teachers are in blue.

In this **STEM Project**, students will explore the idea of trade-offs and identify them in their own lives. Then, they will explore trade-offs that are made by engineers and the tradeoffs that are important in solving environmental challenges.

Life is full of trade-offs. That means that you have to give something up to get something else. For example, if you want to spend the afternoon swimming and playing video games, every hour you spend swimming is one less hour available for video games.

Trade-offs are very important in just about everything we do in life, including in science and engineering. For example, when engineers build vehicles, they may have to choose between building a very efficient vehicle and a very powerful vehicle. They may have to make a trade-off between the quality and the price of parts.

Animals have to deal with trade-offs too. For example, dolphins in Australia can feed in places with many fish and dangerous sharks, or they can feed in places free of dangerous sharks but without many fish. They have to solve a trade-off between getting enough to eat and staying safe from predators.

We are going to explore trade-offs in studying turtles and solving environmental problems. But first, let's start closer to home.

Activity 1: Identify Trade-offs

This activity is meant to get students thinking generally about how trade-offs influence their everyday lives. It can be done as an individual written exercise or as a group discussion. For example, you might have students describe a trade-off that they have identified and have other students discuss similar issues they face.

Think about some trade-offs that you or other people have to make to answer the following questions.

1. **Describe** a trade-off that you have to make that involves how you spend your time when you are not in school.

   I have to choose between being in the soccer club and cooking club because they both meet at

   the same time.

2. **Describe** a trade-off that you have to make that involves how people choose to spend money.

People choose between spending money on going to the movies or going bowling.

3. **Describe** a trade-off in how a product in your school or house was designed.

Our school has many classrooms, but they are all very small.

Extend the lesson: This activity could be extended to enhance creative writing skills. Have students choose one of the trade-offs that they listed above. Then, have them write a short story based on making one choice in the trade-off (for example, playing video games in the introductory paragraph). Next, have them write a second story based on making the other choice (for example, going swimming).

Activity 2: Trade-offs in Designing a 360° Turtle Camera

For the first time in the world (that we know of), Dr. Beth and the team deployed a camera that collects video in all directions (360 degrees) on a sea turtle for scientific research. They also use many cameras that just record a normal image shape. These normal cameras record an area that is much smaller than the 360-degree camera. Scientists usually want the longest videos possible, with the biggest view, and the highest quality image (resolution). You might expect the team would only use 360-degree cameras, but it turns out that designing and analyzing data from cameras involves many trade-offs.

1. **Complete** the statements below using the following terms.

   size   **power**   **weight**   **data**

   memory   **bigger**   **recording time**   **image quality**

   a. Recording 360-degree footage requires more camera lenses than a normal camera. This means that there is a trade-off between the ____size____ of the 360-degree camera system and a normal camera system.

   b. Running multiple cameras takes more power than running one camera. If you are limited in the size of the camera you can put on an animal, you face a trade-off between the area you can see (360 degrees or normal video) and the __recording time____.

   c. Batteries are big and heavy. The more sensors you add to an instrument, the more power they take. The more cameras you add, the more power you need. This means there is a trade-off between the amount of data and video you can collect and the ____weight_____ of the instrument.

   d. Higher quality images require more data to be collected. But, some cameras only have space for a certain amount of computer memory. That means that you have a trade-off between recording time and ___image quality_____.

   e. Larger animals can carry larger instruments. That means that there is a trade-off between the size of animal you can work with and the amount of _____data_____ you can collect. Other answers here would also be acceptable even if not grammatically correct including recording time, image quality, and memory.

2. Imagine you are designing a study of sea turtles. **Describe** whether you would use 360-degree cameras or normal cameras. **Explain** why you made this decision and any trade-offs you considered.

   Accept reasonable answers. Students who choose the 360-degree cameras may focus on the desire to record the most data possible even if they have larger cameras that record for less time. Those that choose the normal cameras might say they want more data or to work with small turtles.

   Extend the Lesson: This question would work well as a class discussion.

Activity 3: Trade-offs and Solving Environmental Problems

Different communities use science and engineering to protect species and resources. For example, scientists and engineers worked with the fishing community to find ways to keep sea turtles from being killed in nets that boats pull behind them to catch shrimp. People who fish for a living were worried that changing their nets would cause them to lose too much of their catch. Saving turtles might mean they couldn't make money fishing anymore. However, scientists and engineers developed a part of a net, called a Turtle Excluder Device, or "TED", that can release turtles without losing too much of the catch. This allows people to continue to catch shrimp while ensuring that almost all turtles survive, even if they get scooped up in the net!

1. **Identify** the trade-off that existed before TEDs were developed.

   Catching more shrimp kills more turtles; reducing the number of turtles killed would reduce the

   amount of shrimp caught; fewer shrimp caught means less money earned for people who fish

   for a living.

There are many other environmental problems that communities are trying to solve. For example, people are trying to prevent rainforests from being cut down. People are trying to improve the quality of air and water in places that are polluted by industries or mines. They are trying to save species from extinction and reduce the effect of humans on the Earth's climate. All of these problems involve trade-offs, and multiple solutions have been implemented. It's time for you to explore and come up with some ideas of your own.

Choose one of the environmental issues that people are trying to solve described above. Then, complete the project based on this issue.

The issue I want to solve is _____ air quality in industrial areas _____.

2. **Define** the problem.

Industrial areas tend to have many factories, which produce goods that people use. These

factories often emit harmful pollutants into the environment that decrease air quality.

3. **Describe** a trade-off that makes solving the problem difficult.

Reducing the number of factories will improve the air quality but will decrease the amount of

goods the area produces.

4. **Describe** some solutions that people have proposed and any trade-offs that these solutions might create.

Some solutions include: 1) shutting down factories; 2) reducing the number of hours a factory

can be open, or opening the factory on alternating days; 3) finding greener production

methods, such as converting to solar power or biofuels; 4) decreasing the demand for

unecessary goods.

A trade-off might be: people would have to embrace a lifestyle movement that utilizes less

factory produced goods.

Extend the Lesson: Have students present their problem and solutions to the class in the form of a

digital presentation or poster. Have students provide feedback on the possible solutions.

Consider having students vote on the best solution and/or have presenters apply the feedback

they received from classmates