Teacher Guide for ODYSSEY, *The Carbon Connection*

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GETTING READY:

Hold up the front cover of the magazine and ask, "What is a carbon footprint?" to start a discussion of carbon and the environment.

Chart:
THINGS WE KNOW QUESTIONS WE HAVE

Use this chart as a guide to manage further discussions about the issue.

If you have internet access, a classroom computer and screen visible to all students, visit www.carbonfootprint.org and explore the site together.

READING FOR INFORMATION: Scrubbing Air, pp.2-3; Coral Reefs in Danger, p. 5; If You can Read This, You're Made of Carbon, pp. 6-9.

Working in whole class or small groups, read the articles above and discuss:

1. How does the University of Calgary carbon scrubber work? (*It takes in air and passes it through filters soaked with caustic soda which absorb the CO^2 and then releases the filtered air.*)
2. What problems does the carbon scrubber face? (*How to store safely the captured carbon; how to power the scrubber without releasing more carbon into the atmosphere; the relatively small amount of carbon that is caught in the filters.*)
3. What two problems face the world's coral reefs? (*bleaching; more acidic seawater*)
4. How are these problems related to carbon? (*Carbon bleaching is related to ocean warming, which stems from the greenhouse effect – the increase of carbon dioxide and other gases into the atmosphere; the increase in ocean acidity is caused by the mixing of additional atmospheric CO^2 into the ocean water.*)
5. Why is "carbon responsible for all life forms on Earth"? (*A carbon atom can bind to four other atoms at a time, creating many types of molecules. Genetic DNA, made of carbon molecules, tells each living organism how to create the many different types of carbon molecules which make up the organism.*)
6. Scientists originally thought that carbon couldn't exist without living organisms. Who disproved this theory and how? (*In 1828, Friedrich Wohler produced urea, a carbon molecule excreted by animals, in a laboratory experiment combining ammonium chloride and silver cyanide.*)
7. What did scientists then learn to synthesize? (*Many types of carbon molecules that could produce synthetic foods, medicines, textiles, and building materials. Much later they moved into plastics and then into nanotechnology by manipulating carbon molecules.)*
8. What problems do the artificial carbon molecules in plastics pose? (*Organic carbon is digested or decomposed by living organisms and then it recombines, but often living*

organisms cannot digest/recycle artificial carbon molecules, such as those in plastics. This is a problem because governments have to figure out how to dispose of plastics.)

9. How do scientists suggest an explanation for the origins of life on earth? (*Chemists Stanley Miller and Harold Urey filled a glass vessel with atmospheric gases – hydrogen, methane, water vapor, and ammonia. When they shot an arc of electricity through the gases, they obtained a dark goo that contained carbon molecules. Those carbon molecules may have been the building blocks for living organisms.)*
10. Why would silicon not be as good a building block for living organisms? (*Silicon chains are more fragile, breaking apart easily so that they can't make long chains and reacting with water and eventually turning into silicon dioxide or sand.)*

A CAMPFIRE TALE, pp. 10-13.

Creative Arts: Enjoy this story as a read-aloud or silent reading. Then challenge students to take one of the concepts in the story and explore it in another art form or a tale of their own. Students who are more research-oriented may want to explore the life and/or experiments of one of the scientists on page 13 or to diagram the decay process of carbon.

DIAMONDS ARE FOREVER, pp. 14-17.

Discuss: What major new information did the discovery of the eclogitic micro-diamonds of Shark Bay, Australia, reveal?
Associated Questions: What is an eclogitic diamond? What is C-13? What does it indicate in science? How are C-12 and C-13 different from C-14? What further question is the Curtin University research team pursuing on the Shark Bay diamonds?

SUPERHEROES OF THE CARBON WORLD, pp. 21-23.

Discuss in small groups or whole class format:

1. How would you describe Philip Streich's character and personality?
2. How did he become so interested in science?
3. What does he consider the most fun in science?
4. What caused a breakthrough for him in his own research?
5. Describe his research.
6. How has his research rewarded him?
7. How are you like Philip Streich and how are you different?
8. How would you like to be more like him?

THE CARBON CYCLE, pp. 24-25.

Review the diagram, pictures, and text. Challenge students to connect this cycle to some of the issues discussed in other parts of the magazine. Can they figure out some practical solutions to these issues? What about things they themselves can do?

CARBONATED OCEANS, pp. 26-29.

Chemistry in Action:

1. Perform the experiment of the disappearing eggshell using vinegar in the classroom. You might want to encourage students to also try this at home.
2. List specific organisms with shells that might be destroyed by oceans that increase in acidity.
3. Ask the class which of the actions listed on p. 28 they would like to take, either as a whole class or as small groups.
4. Have the whole class or small groups

a. Set a goal
b. Assign tasks
c. Perform
d. Report.

BEETLE ATTACK, pp.30-31; HOW BIG IS YOUR CARBON FOOTPRINT, pp. 38-39

Outside Speaker:
Invite a local environmentalist to speak to the class on current issues in the local environment. Ask him to explain the impact that individuals can have on their local environment and why and how they can make the negative impact smaller and the positive impact larger.

As a follow-up, students might like to take up the Odyssey project on p. 31 or write a letter to their families and friends asking them to take one specific step toward protecting the environment from carbon overload.

SCIENCE UNDERGLASS, pp. 32-34; SUCKING CARBON, pp. 35-37.

Have students choose one of the following short projects:

1. Write a specific science research question and show how using Biosphere 2's facilities could help solve it.
2. Create a poster encouraging visitors to come to Biosphere 2 to understand how the earth's biosphere works.
3. Write an advertisement persuading people to undertake one of the proposed CO^2 sequestration activity or CO^2 storage activity

WRAP-UP:
Have an open discussion of what actions would be important in your local community in the light of the "carbon connection".