temperature measurements. They did this to *simulate* what might happen when the climate changes in the future, since the general trend is for the Earth to be getting warmer.

Reflection Section

- What are the advantages of using a computer program to simulate the emergence of the beetles? Could the scientists have done the calculations by hand? Why or why not?

- What do you think will happen to the beetle population if the temperature rises by 2.5 °C?

Findings

The scientists found that temperature was the most important factor affecting the emergence of beetles from pine trees. The scientists predicted that if global warming occurs (represented by the addition of 2.5 °C to the temperatures), mountain pine beetles could move farther north and into higher mountains. This means that their range could expand. The scientists also predicted that if mountain pine beetles live in warmer climates, they may produce a larger number of eggs. Changes in temperature could also change the timing of their life cycle. The beetles would probably not always emerge from the trees at the same time. Unfortunately for the beetles, this would mean that the teamwork they use to lay their eggs in pine trees would not be as strong.

Reflection Section

- If global change creates warmer temperatures in the future, what do you think might happen to the population of mountain pine beetles? Why?

- If the population of mountain pine beetles begins to increase, what might happen to the population of pine trees? Could any changes be balanced by the lack of beetle teamwork? Why or why not?

Discussion

It is clear that global climate change would cause a change in the ecosystem that includes mountain pine beetles and pine trees. The scientists believe that studying mountain pine beetles may help people understand if and how the global climate is changing. If populations of beetles living in high mountain environments are monitored, any change in their patterns of emergence, egg laying, or range might indicate a change in climate. The scientists believe that the mountain pine beetle is a good *indicator species* for environmental change.

Reflection Section

- From what you have observed and learned from school, newspapers, and other places, do you think the global climate is changing? Why or why not?

- What other ways might global climate change be monitored?

- What can humans do to reduce the possibility of global climate change?

FACTivity

Did you know that beetles are one of the most numerous types of life forms on Earth? Beetles live everywhere across the Earth, except in the open ocean. And, beetles are even older than the dinosaurs! To be so successful, beetles have many advantages that help them survive. In this FACTivity, we are going to get to know beetles close up! Get a bug box (a clear plastic box with plenty of room for air). Look outside in your school yard or at home for beetles. Find a beetle, and gently put it in the bug box. After you observe the beetle, you should release it back outside, in the same place where it was found.

We will examine three parts of the beetle: the back legs, the wings, and the mouth. See

When Scoring Zero Wins

As the pine beetle research shows, climate change will change conditions for the living creatures of the Earth. One way to slow climate change is to reduce the production of carbon dioxide, or CO_2. Carbon dioxide is produced by cars, buses, and any other thing that burns fossil fuels. The Olympic Winter Games of 2002, or any event with many people, requires a lot of vehicles. Can you guess what that means? Right! Lots of carbon dioxide! Planners of the 2002 Games wanted to find a way to keep carbon dioxide emissions from the 2002 Games at zero. It sounds impossible, doesn't it? This is how they did it. Along with using the latest in emissions-reducing technologies, they asked large companies and individuals to reduce their energy consumption equal to the amount the Olympic Winter Games of 2002 would produce.

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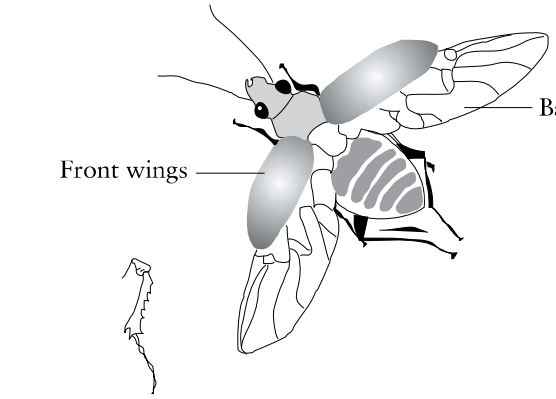
the illustrations below and compare them with the beetle you are observing. Let's start with the back legs. Can you see how they are constructed? What do you think the beetle does with its back legs? Beetle legs are designed for digging into wood or soil. Which do you think this beetle digs into? Now look at the wings. Beetles have two sets of wings. The back wings are similar to those of many other flying insects. You may not be able to see the back wings when the beetle is not flying. The most unusual thing about a beetle is its front wings. They are hard, and when folded create a hard shell around the beetle's body. Can you see the hard front wings? What purpose could the hard wings serve? (Hint: Think about what the beetle has to do to get its food or lay its eggs.) Finally, look at the beetle's mouth. A beetle's mouth is made for chewing. Other things that a beetle can do with its mouth are grasp, tear, and crush. Think about the mountain pine beetle. You can see that it is well designed to dig into the bark and phloem of trees.



Grasshopper mouth. A grasshopper is not a beetle, but its mouth looks the same as a beetle.

Now, get a large piece of paper and draw the beetle you are observing. Use crayons to complete the drawing. You may want to focus your drawing on one of the three parts that we examined below. When you have finished drawing the beetle, don't forget to release it back into the same place where you found it!

FACTivity adapted from: Hogan, K. (1994). Eco-Inquiry: *A guide to ecological learning experiences for the upper/elementary/middle grades*. Dubuque, Iowa: Kendall/Hunt. 1-800-228-0810. Reprinted with permission.

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Websites:

http://www.usu.edu/~beetle/