Why are Aquatic Beetles and True Bugs Found Only in Fresh Water?

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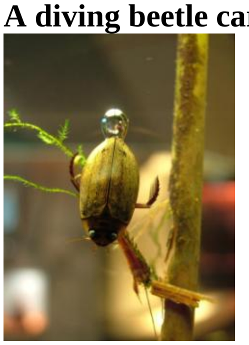
Observations:

There are several insect species that are well adapted to living in aquatic environments. These include water scavenger beetles, predaceous diving beetles, and whirligig beetles (Order: Coleoptera), as well as the true bugs, water striders, water scorpions, backswimmers, water boatmen, and giant water bugs (Order: Hemiptera). Water striders are able to move across the surface of water (Fig. 1). Giant water bugs and water scorpions have long breathing tubes that extend to the surface of water, enabling them to breathe. Backswimmers, water boatmen, and diving beetles trap oxygen from the water surface and carry a bubble of air on their body under water, allowing them to breathe under the water surface (Fig. 2). All of these species can be observed in fresh water ponds or slow moving streams, but rarely they are found in salt water or polluted water. Other insects, such as mayflies, mosquitoes, dragonflies, crane flies, and caddis flies have at least one aquatic life stage.

Fig. 1
Water strider moving across the surface of water

Fig. 2
A diving beetle carrying an air bubble beneath the water surface



Question: Why are diving beetles, giant water bugs, water striders, and water scorpions located in fresh water, as opposed to salt water or polluted water?
<u>Hints to form the hypothesis:</u>

The ability of an insect to adapt to aquatic environments depends largely on the surface tension of water. The surface tension of water is caused by water molecules being attracted to each other. This creates a “barrier” on which insects can walk. Surface tension also makes it possible for insects to gather oxygen at the water surface and carry a bubble of air under water. The higher the surface tension, the more efficiently insects can perform these actions.

Hypothesis:

Aquatic insects are better adapted to fresh water environments because the surface tension of fresh water is higher than that of salt water or water containing pollutants.

Materials:

- Drinking cups of the same size
- Paper clips of the same size
- Salt
- Dishwashing detergent
- Vegetable oil
- Water
- Measuring spoons
- Measuring cup
- A marker and tape for labeling, and a digital camera to take pictures for presentations

Experiment:

1. Label four drinking cups of the same size with one of the following titles each: “Plain tap water,” “Salt water,” “Oil and water,” and “Detergent and water.” (Fig. 3)
2. Add one tablespoon of salt in the cup labeled “Salt water.”
3. Add one tablespoon of vegetable oil to the cup labeled “Oil and water.”
4. Add one tablespoon of liquid dishwashing detergent to the cup labeled “Detergent and water.”
5. Add room temperature tap water to the cup labeled “Plain tap water” until the water reaches the rim of the cup. IMPORTANT: Make sure you measure how much water is added to the first cup with a measuring cup, as each cup needs to contain the same amount of water. For all subsequent cups, measure the water using the measuring cup before adding the water to the cup. Stir the salt, oil, and detergent with the water in the respective cups as you add the water.
6. Add paper clips, one at a time, to each cup until the water spills over the side of the cup. You will notice that the water will rise above the rim of the cup before it spills over the side. This is caused by surface tension.
7. Record the number of paper clips required to make the water spill over the side of the cup. This is known as the number of paper clips required to break the surface tension.
8. Repeat this experiment at least three times.

Fig. 3 Experiment set-up including cups, labels, detergent, salt, vegetable oil, and paper clips.

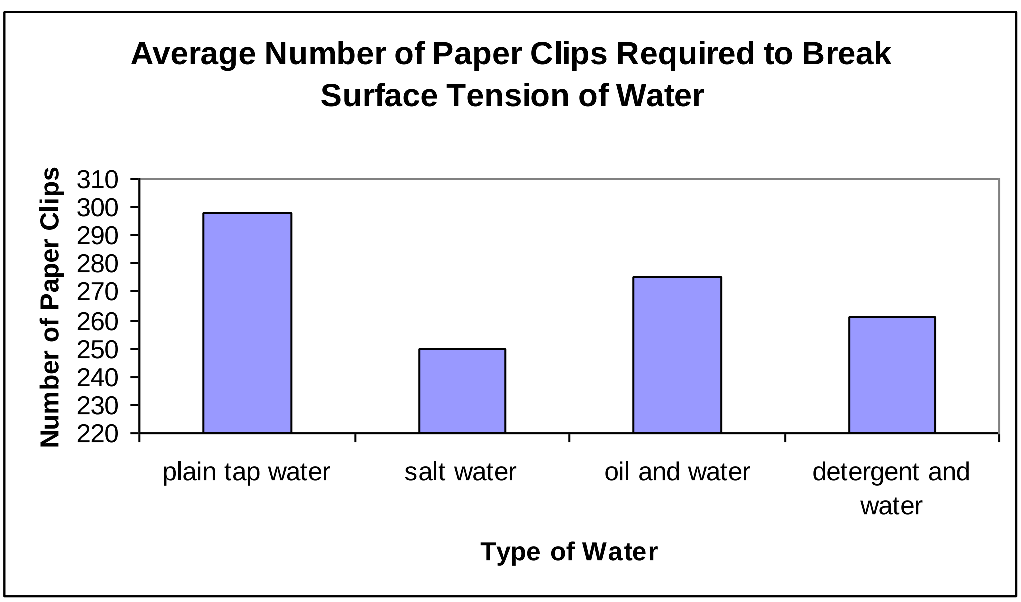
Results: Present your results in a table (Table 1).

Table 1. The number of paper clips required to break surface tension of water

	Plain Tap Water	Salt Water	Oil and Water	Detergent and Water
Trial 1	282	241	273	262
Trial 2	296	251	260	243
Trial 3	317	257	293	278

Calculate the average number of paper clips required to break the surface tension for each type of water tested and present your results in a graph (Fig 4).

Fig. 4. The average number of paper clips required to break surface tension of water



Discussion:

Explain why a greater number of paper clips required to break the surface tension of water represents a higher surface tension. Based on the results, explain for which type of water aquatic insects are best suited. Consider a fresh water pond or stream that experiences salt water intrusion, an oil spill, or addition of pollutants (such as solutions containing detergents) due to runoff water from urban areas. Explain the effects, if any, each of these occurrences would have on aquatic insects.

References:

- Bugs in the Pool

http://www.buginfo.com/article.cfm?id=23

- Identifying Aquatic Insects From Your Pond

USDA and the Penobscot Soil &Water Conservation District Natural Resources Conservation Service
http://www.penobscotswcd.org

- Respiration in Aquatic Insects

North Carolina State University
http://www.cals.ncsu.edu/course/ent425/tutorial/aquatic.html

- Sticky Water

http://www.exploratorium.edu/ronh/bubbles/sticky_water.html

Estimated time and cost:

This experiment can be conducted within one hour using household items. If not already in the home, the cost for the items will be less than $10.00.

Contact: For help with the project or questions concerning the project, please contact the author- Carrie Owens at cbowens@gmail.com