How well do you know water and the ocean? Why do belly flops hurt? What happens to oceans as the planet warms? Try these fun activities and discover the answers to these questions!

**Why Do Belly Flops Hurt?**
Water molecules have a property that makes them stick together and resist being separated. This property (or force) is called “surface tension”. When you do a belly flop, your body meets this force. Experiment with the effects of surface tension at home by filling a sink, tub or pot with several inches of tap water. First, position your hand so it’s perpendicular to the water (fingers pointing down) and push your fingers into the water. That probably didn’t hurt at all! Now, slap the water with the flat of your hand (fingers pointing straight out). That probably hurt a little more. Why? Because more surface area is in contact with the water. Now, imagine jumping into the water with a belly flop and the whole front of your body hitting the water at once! All of the surface area of your body meeting all the surface tension of the water is guaranteed to hurt a lot more! On the other hand, a head-first dive into deep enough water shouldn’t hurt at all. Like pushing fingers into water, a graceful dive is a streamlined position with only minimal surface area (the width of your head) hitting the water.

To further experiment with surface tension, you’ll need a penny, a medicine dropper, a small dish and a cup of water. How many drops of water do you think can pile up before the water spills off the penny? Is there any way to increase or decrease the amount? Before you begin this experiment, make a prediction or “hypothesis”. Making a prediction or hypothesis is important because that’s how you know if you learned anything! We predict you’ll be surprised by the number of drops that can fit on the penny’s surface, and it’s all because of surface tension: that property that makes water molecules stick together.

First, put a penny on a dish. Then drop water (one drop at a time) onto the center of the penny. Count the number of drops that can pile up before the water spills off the penny. How many drops can the surface of the penny hold? Do you think you would get the same answer if you did it again? Why not try it again and find out? Then, compare your results to your prediction, just to see if you learned anything new!

**What happens to the ocean as the planet warms?**
Driving cars, heating buildings, and otherwise burning fossil fuel releases carbon dioxide into the atmosphere. All that carbon dioxide acts like a blanket, trapping the Earth’s heat in the atmosphere and making our planet warmer. In the 20th century (that is, from 1901 to 2000), the global average temperature increased between 1 and 2°F. How much will the Earth’s temperature rise in the 21st century? That depends largely on human activities that involve burning fossil fuels, and those activities are difficult to predict. Experts from the Intergovernmental Panel on Climate Change (IPCC), an international organization created to measure changes in the climate, predict that the global average temperature will rise somewhere between 2 and 12 °F by 2100. That temperature increase is a lot more than what our planet experienced in the 20th century!

**How does this ‘global warming’ or ‘climate change’ affect the ocean?** There are many, many answers to this question! To understand more about some effects of climate change on the oceans, let’s do an experiment! You’ll need a map, a sturdy paper plate with a raised rim, crayons, white modeling clay, 14 houses (or objects representing houses) and at least 10 ice cubes. The paper plate represents the Earth, the modeling clay represents land, and the ice represents glaciers.

First, consult a world map and find the major land masses: Africa, Asia, Europe, North and South America, Australia, Antarctica, and Greenland. Now, draw this map onto your plate. Next, color the areas between these land masses blue to represent the ocean. Use your modeling clay to cover the land masses, and press the edges of the clay down around each land mass to show that the coastlines meet the ocean. If you’re feeling creative, research these land masses and find out where the big mountain ranges lie. Feel free to shape the modeling clay into mountain ranges to add relief to your map. At this point,
your entire plate should be covered with either blue crayon (ocean) or white modeling clay (land).

The next step is to put the houses on the continents. Look at Table 1 to determine where to place the houses. Table 1 shows the population of each major land mass, rounded to the nearest billion people. Each house will represent about 500 million (or half a billion) people. For example, Asia has four billion inhabitants, so Asia’s population would be represented by eight houses. Africa, the Americas, and Europe each have approximately 1 billion inhabitants, so each of these continents would be represented by two houses. The remaining land masses would have no houses. About half of the Earth’s population lives near the coast, so let’s put half of the houses near the coast and the other half inland.

The final step is to add ice cubes to the landmasses that have glaciers – such as Antarctica and Greenland. If you want, you can do a little research to find other places with glaciers, and put some ice cubes there as well. Now comes the hardest part! You have to leave the experiment alone for at least a couple hours, to let climate change take its course. So go ahead and do something else and come back in a couple of hours. If you are interested in doing more fun ocean science activities, check out http://oceanfest.soest.hawaii.edu/program.htm during this time.

When the ice cubes have all melted, what do you notice? Perhaps you noticed rising sea levels, caused by the melting of ice. Rising sea levels can cause the coastal areas, and the houses they contain, to become fully or partially submerged. Depending on the type of modeling clay you used, you may also notice coastal erosion and sedimentation (the modeling clay may have started to erode away and become deposited in the ocean).

Scientists have predicted all of these physical effects as a result of global warming. Sea levels will also rise due to thermal expansion of warmer ocean water, which would make the effects demonstrated in your experiment to be even greater.

### Table 1: Population estimates of Earth’s major land masses

<table>
<thead>
<tr>
<th>Land Mass</th>
<th>Map Symbol</th>
<th>Population (nearest billion)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asia</td>
<td>AS</td>
<td>4</td>
</tr>
<tr>
<td>Africa</td>
<td>AF</td>
<td>1</td>
</tr>
<tr>
<td>North &amp; South America</td>
<td>NA &amp; SA</td>
<td>1</td>
</tr>
<tr>
<td>Europe</td>
<td>EU</td>
<td>1</td>
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<tr>
<td>Antarctica</td>
<td>AN</td>
<td>0</td>
</tr>
<tr>
<td>Australia</td>
<td>AU</td>
<td>0</td>
</tr>
<tr>
<td>Greenland</td>
<td>GR</td>
<td>0</td>
</tr>
</tbody>
</table>

### What can I do to help minimize global warming?

Each of us can do our part to minimize the effects of climate change by limiting our use of fossil fuels (such as coal, oil, gas). How can you reduce the amount of fossil fuels that you use? Some ideas include:

- Use less heat in the winter and/or less air conditioning in the summer;
- Use renewable energy whenever possible;
- Walk, bicycle or take the bus more often;
- Drive less, and carpool whenever possible;
- Support companies that use renewable energy;
- Eat food produced locally (transporting foods requires a lot of fossil fuels);
- Don’t waste energy: shut off lights, computers and televisions when not in use. Remember, most of our electricity is generated from fossil fuels.

All of these actions will not only help reduce your ‘carbon footprint’, but they’ll also save you money! What other ideas can you come up with? If you talk with your friends and family, we bet that you will be able to come up with many other ways to save energy!

### After doing these experiments, do you understand the ocean a little better?

One thing you learned is that water molecules tend to stick together; that’s why water forms drops and why belly flops hurt. You also learned that burning fossil fuels (like oil, coal and gas) causes sea levels to rise, which can cause problems for coastal communities. You can help by minimizing your carbon footprint. Some ideas are listed above, but you can probably come up with a lot more.

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We’d love to hear about your ideas to save energy! Please email us at fest@soest.hawaii.edu.