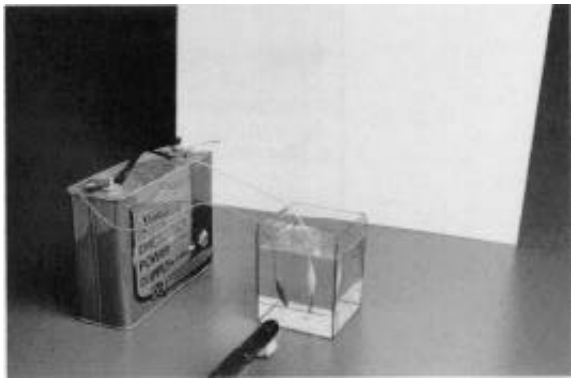
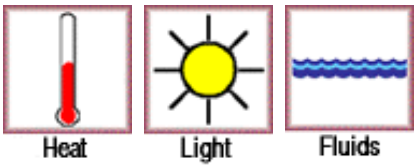
Convection Current

Make your own heat waves in an aquarium.





This demonstration gives you a simple and visually appealing way to show **convection currents** in water. Warmer water rising through cooler water creates turbulence effects that bend light, allowing you to project swirling shadows onto a screen.

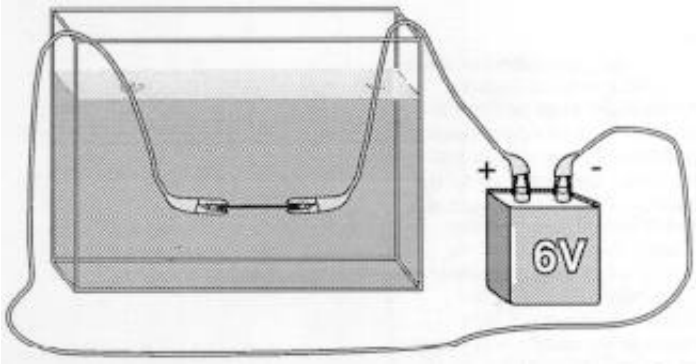
materials

- ✔ **One 6- or 12-volt lantern battery** or a suitable low-voltage battery eliminator or power supply.
- ✔ **A pencil lead.**
- ✔ **A clear plastic or glass container** with rectangular flat sides. (A small aquarium works fine.)
- ✔ **A light source.** (Slide projectors, filmstrip projectors, or flashlights work well. A point-source flashlight, such as a MiniMaglite™ flashlight with the reflector removed, will produce sharp images.)
- ✔ **Food coloring** (in a small dropper bottle or an eyedropper).
- ✔ **A projection screen** or white posterboard.
- ✔ **2 electrical lead wires** with alligator clips at both ends (available at Radio Shack).
- ✔ **Tap water.**
- ✔ **Optional:** Switch or dimmer switch (both available at hardware stores) or any sort of rheostat or variable resistor.
- ✔ **Adult help.**

assembly

(15 minutes or less)

Use one clip lead to attach the positive terminal of the battery to one end of the pencil lead, and the second clip lead to attach the negative terminal to the other end of the pencil lead. If you like, you may connect a simple switch, or a dimmer switch, in series. The switch makes using the device more convenient; the dimmer switch lets you vary the amount of current going through the carbon rod.



Fill the container with water and place the wires and pencil lead in it so that the pencil lead is positioned horizontally. Connect the two wires to the terminals of the battery, and allow the heating to start. Shine the projector through the liquid, projecting the light onto the screen or white posterboard.

to do and notice

(15 minutes or more)

Observe the convection currents. If you have a dimmer switch, vary the current and observe the effects of the various settings. If you are using a rheostat or variable resistor, you may have to try several settings to find which one works best. You can also vary the orientation of the pencil lead to see if this has any significant effect on the convection pattern. Add a few drops of food coloring and observe the effects.

what's going on?

Like air, water expands as it gets warmer and so becomes less dense. Since the water warmed by the current flowing through the carbon rod is less dense than the surrounding colder water, the warm water rises through the colder water to the surface, causing the food coloring to move along with it.

Since the cold and warm water have different densities, they have different *indices of refraction*. Light *bends* (refracts) as it passes from warmer to colder or colder to warmer. When light is bent onto an area of the screen, that area becomes brighter. When light is bent away from an area of the screen, that area becomes darker. The positions of warm and cold water are constantly changing, so the images projected on the screen shimmer and flow like heat waves in air.

etcetera

A simpler method of doing this Snack, which allows people to perform it themselves, is simply to place a candle on a table and project this image onto a screen with a flashlight. The point source of a MiniMaglite™ projects clear images of convection when used on a small-scale desktop experiment. Changing the distance from a point light source to the candle will change the magnification of the image of the convection currents projected on the wall.

Questions? Comments? Want to share your results?
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Snack Discussion Group

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