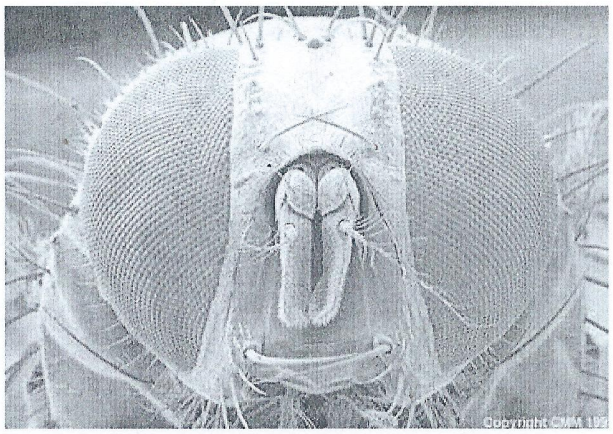
Science Club



portrait of a housefly

a galaxy - millions of stars

Rob and Sarah Higley
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Amherst, MA 01002
(413) 549-5804
MatrixSensors@compuserve.com

9 November 1997

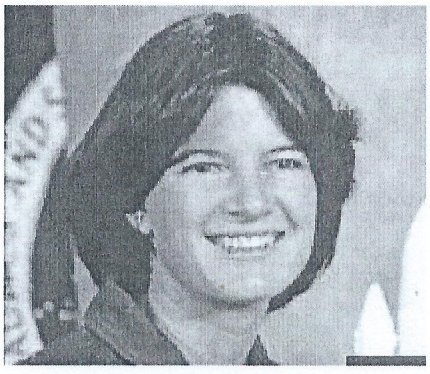
Dear classmate of Sarah Higley:

Sometimes Sarah and I (Sarah's dad) do little science projects together. Lizzie's parents suggested to me that other girls in Sarah's grade might like to join us. We think that this is a nice idea. Sometimes, as girls are growing up and go through school and on to college, they feel discouraged from studying science because there are more men scientists than women scientists. But doing science is really just trying to understand how nature works - observing, thinking, and doing experiments (which is how people ask nature questions, to see if their ideas are right). Anyone who thinks that this sounds like good fun should go ahead and do some science!

Our next project is growing crystals. Crystals are molecules stuck together in a pattern, like tiles on a floor. We'll look at crystals in rocks, make pretend crystals with marbles, grow crystals on microscope slides and look at them with microscopes, and take home materials to grow larger crystals that need a few days. Along the way, you may think of some ideas you would like to try out.

Marie Curie, who
investigated radioactivity

Sally Ride, astronaut



Science Club

Directions for Growing Crystals

Bigger crystals take longer to grow. You can grow crystals right in the test tube at home. The test tube contains monoammonium phosphate and food color. This chemical is not very poisonous, but the package warns to avoid skin contact and not to ingest. You may prefer to experiment with sugar or salt instead.

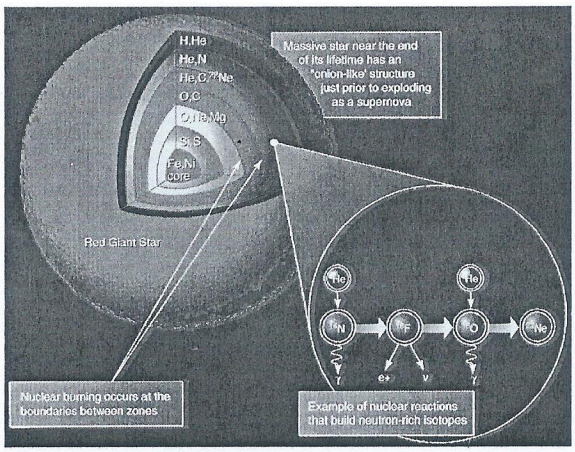
Save a few of whatever material you choose to use to make crystals, and entrain them into the string to serve as seeds for growing crystals. Have your Mom or Dad boil some water in a cup and fill the test tube up nearly to the top. Then it should be stirred, say with a chopstick, until all the powder is dissolved, just as you would mix jello. Set the test tube upright in a place where it can remain undisturbed for several days. (An inverted yogurt cup with a hole, or similar contrivance can hold the test tube.)

After it has cooled for a ten minutes or so, place the string so that it dangles down into the test tube to the bottom or so, and then leave everything alone except for peeking to see what is happening. The crystals, we hope, will grow for several days. If they stop growing after a few days, you may want to pour out the solution and set your crystals on a paper towel to dry. Show us what you got next time we meet.

Happy experimenting! Call if you want to ask advice.

Science Club News

3 December 1997



Next Meeting: Sunday, 7 December, 2-4 p.m., at 80 Presidential Apartments

Summary of Previous Meeting:

Last Sunday our group learned about what we are made of and where it came from:

- ☆ atoms;
- ☆ what's inside an atom;
- ☆ how the stuff inside is held together;
- ☆ how atoms stick together to make molecules;
- ☆ how atoms heavier than hydrogen were made inside stars.

Illustration of the ideas of this basic stuff every kid should know is not accessible to hands-on activities for kids using the real materials (so far as I could think up). Therefore, we resorted to making models. We used marshmallows for atoms, with very heavy (theatrical effects applied) cookie jimmies poked into the centers as protons and neutrons. By additional theatrical effects during assembly of atoms with more than one proton inside, we noticed how hard it was to push two jimmies together, but that if we got them close together enough to touch, the glue (imagined to be on their surface) held them together. Bits of uncooked spaghetti bonded atoms to make molecules of H_2 and H_2O. Additional, uneaten, models were made with a molecular model kit.

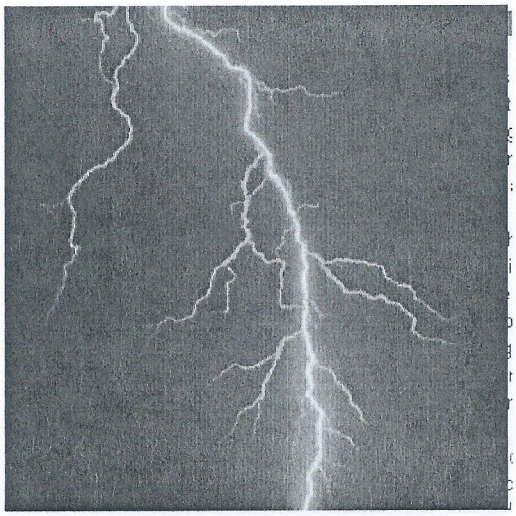
To get a better feel for atoms sticking together to make molecules, we did a little dance with parts for hydrogen and oxygen. Without using fancy words, the ideas of covalent and ionic bonding got shown.

We led into the question of where these atoms came from by the apparently preposterous claim that I have been not just to Boston or California, but *inside* a star. We extended our dance to include the assembly of atomic nuclei inside stars. We are working our way up to carbon. Our dance is evolving into a play, *Dance of the Atoms*, modestly encompassing these essential ideas for understanding the history of the universe.

In our next meeting, we will continue with our play. Choice parts are still available for anyone who missed last week's meeting. The script can benefit from everyone's imagination.

Science Club News

6 January 1998

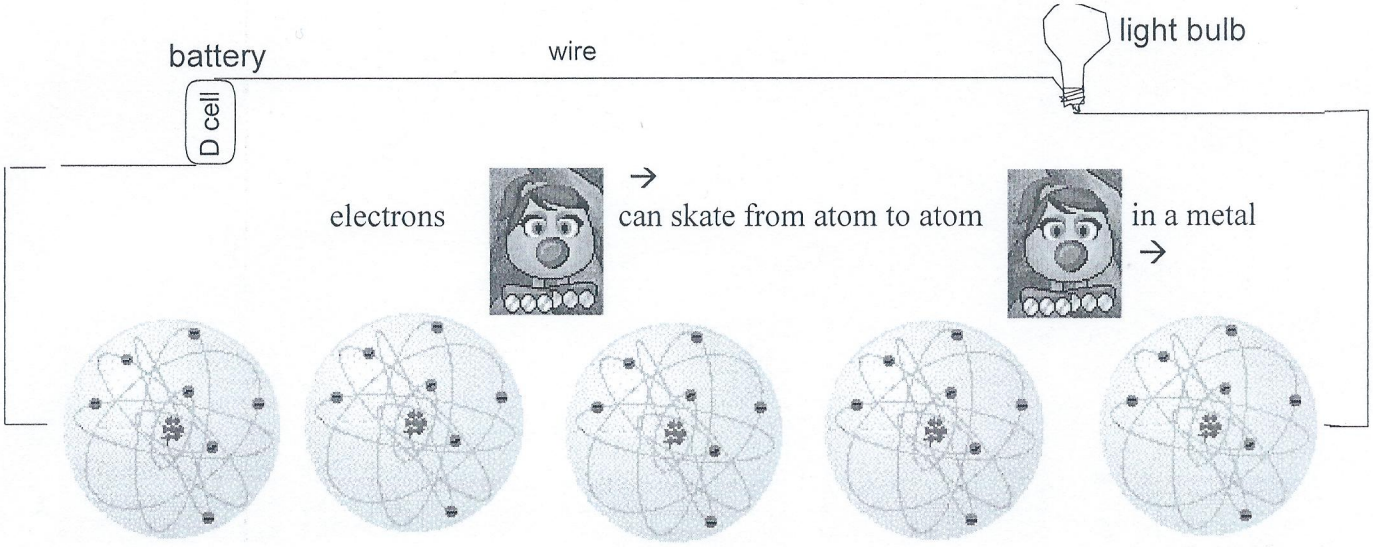


Happy New Year!
The Science Club resumes!

Next meeting: Sunday, 11 January, 2-4 p.m.,
at Sarah Higley's home, 80 Presidential Apartments, 549-5804.

We plan to start the new year with a new subject - electricity. Now that we know about atoms and their proton and electron charges, we'll explore the neat stuff you can do by moving these charges around:

- ☆ What is electricity, anyway?
- ☆ Amazing tricks.
- ☆ We build generators and make some electricity.
- ☆ We measure it,
- ☆ And learn how to buy it.



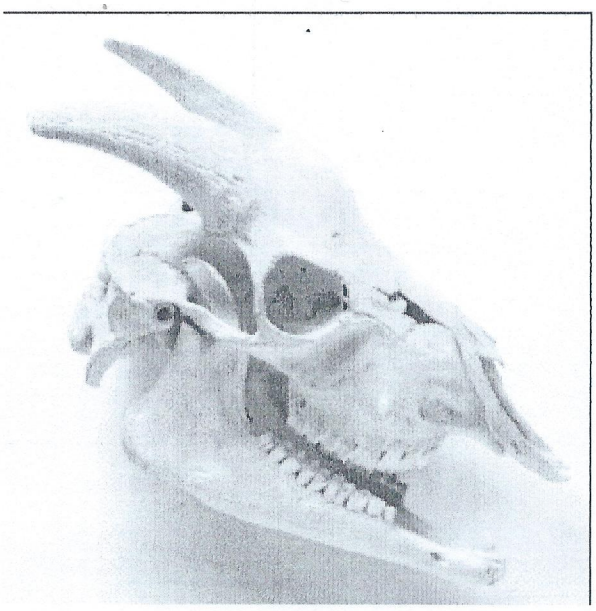
metal atoms in a wire (really magnified a lot)

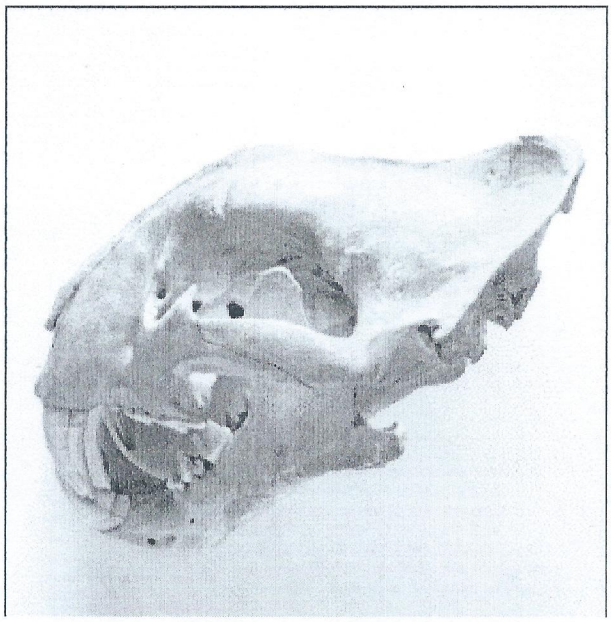
Are electrons actually Zoombinis? Come find out!

Science Club News

2 February 1998

Come meet us!





Hi, I was an herbivore. I ate plants. ***Hi, I was a carnivore. I ate other animals.***

Amy's dad, Professor ---, will show us his lab's mammal museum. Find out what you can learn about the way an animal lived by looking at its skeleton and imagining how it worked.

Next meeting:

Sunday, 8 February.
Please arrive before 2 p.m. at Sarah Higley's home, 80 Presidential Apartments.

We will leave Sarah's home at 2 p.m. for Professor ---'s lab, and plan to return by 4 p.m. Directions to his lab will be posted on Sarah's door for anyone who arrives after we have left.

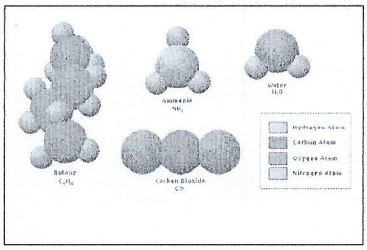
Call if you have any questions 549-5804.

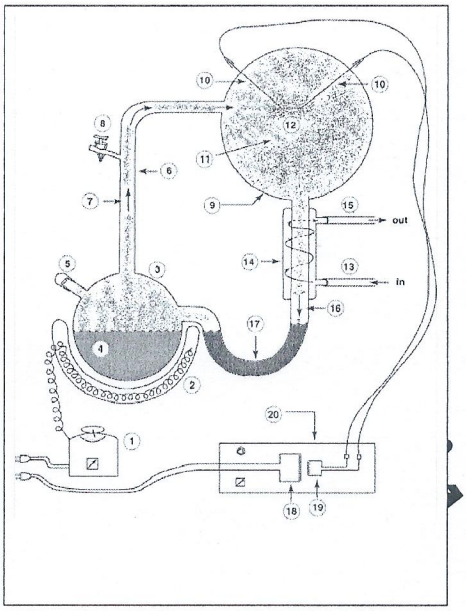
(name edited out 6Nov2022 for posting)

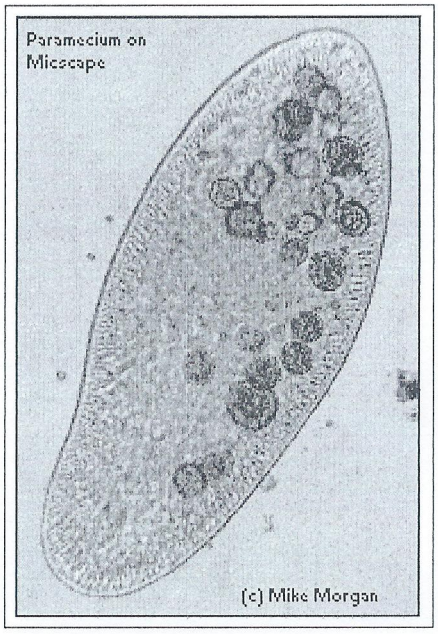
Science Club News

18 February 1998

How did a bunch of molecules combine to make living things? Before we try to answer that, we meet some of the smaller creatures among us.







We do some experiments in the kitchen...

We'll spy on Bug City in a drop of pond water, farm Petri Dish fields and see what's growing on our counter tops and under our fingernails.

Next meeting:

Sunday, 22 February.

→ 2 -4 p.m. at Sarah Higley's home, 80 Presidential Apartments.

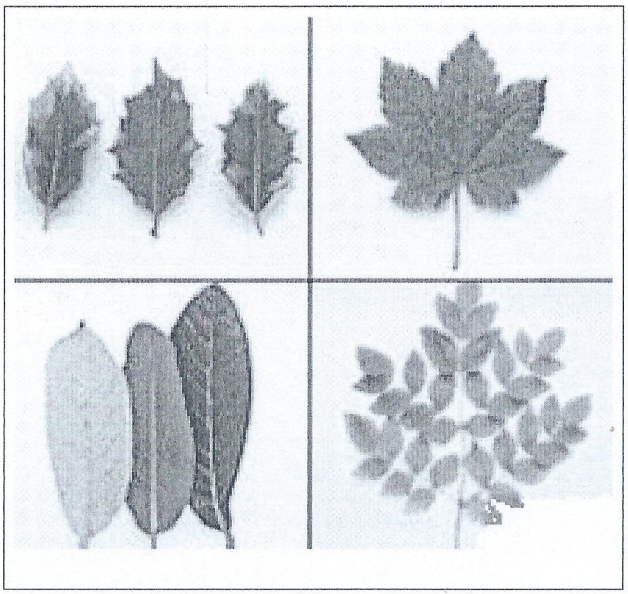
Science Club News

10 April 1998

Sim Earth Gets Real - We design a planet in a box.

Plants use energy from sunlight to change carbon dioxide (CO_2) and water (H_2O) into sugar ($C_6H_{12}O_6$), oxygen (O_2), and water. Animals eat sugar and breathe oxygen to "burn" the sugar back into carbon dioxide and water, and use the energy to run around.

$$\nearrow \; C_6H_{12}O_6 + 6\,O_2 + 6\,H_2O \; \searrow$$



$$\nwarrow \; 6\,CO_2 + 12\,H_2O \; \swarrow$$

Your mission, Science Club, is to determine the ratio of green plants to hamsters that will keep the air fresh in the miniature sealed HSS (Hamster Space Station). We'll use a spiffy new oxygen sensor to make sure that we have enough plants to make oxygen for the hamster. Can we scale our measurements to apply to the Planet Earth?

To avoid conflicts with the Easter Bunny, we will meet next on the Sunday after Easter. However, everyone is encouraged to take bud samples, either from trees by your homes or from the trees we sampled earlier. Feel free to stop by to pick up your lab books if you like.

Next meeting:

Sunday, 26 April.
2 -4 p.m. at Sarah Higley's home, 80 Presidential Apartments.

Science Club News

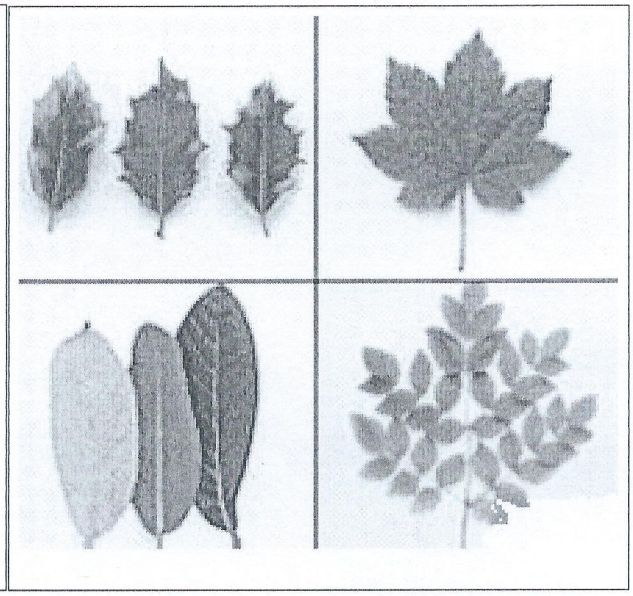
29 April 1998

>> Part II <<

Sim Earth Gets Real - We design a planet in a box.

Plants use energy from sunlight to change carbon dioxide (CO_2) and water (H_2O) into sugar ($C_6H_{12}O_6$), oxygen (O_2), and water. Animals eat sugar and breathe oxygen to "burn" the sugar back into carbon dioxide and water, and use the energy to run around.

$$C_6H_{12}O_6 + 6\ O_2 + 6\ H_2O$$



$$6\ CO_2 + 12\ H_2O$$

Having measured oxygen consumption of hamsters and candles, we next try to measure oxygen production by plants. Bioshelters is providing us with hydroponically growing basil to put in our miniature sealed HSS (Hamster Space Station). This spares us the uncertainty we would face if we just threw in a clump of sod (rotting roots? panting platyhelminthes?). How much basil makes enough oxygen for one hamster? Can we scale our measurements to apply to the Planet Earth?

Bioshelters can give us a tour of their own version of a planet in a box after school. If you are interested, please let me know which day is preferable. We would car pool from Wildwood School, and return to Sarah's home for parents to pick up kids anytime after 5:30.

Next meeting:

Sunday, 3 May 1998.
2 -4 p.m. at Sarah Higley's home, 80 Presidential Apartments, 549-5804.

Science Club News

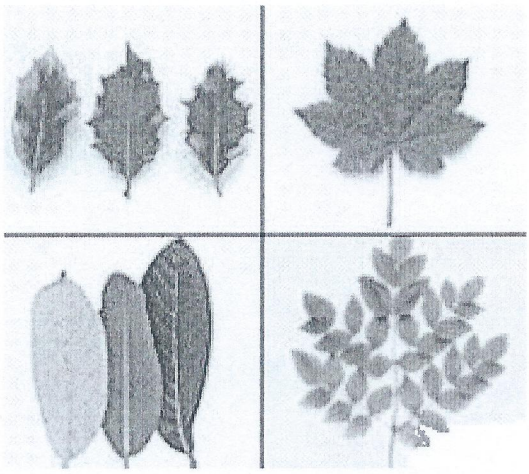
12 May 1998

Part 3

Sim Earth Gets Real - We design a planet in a box.

Plants use energy from sunlight to change carbon dioxide (CO_2) and water (H_2O) into sugar ($C_6H_{12}O_6$), oxygen (O_2), and water. Animals eat sugar and breathe oxygen to "burn" the sugar back into carbon dioxide and water, and use the energy to run around.

$$C_6H_{12}O_6 + 6\ O_2 + 6\ H_2O$$



$$6\ CO_2 + 12\ H_2O$$

Our attempts at the previous meeting to measure oxygen production by the hydroponically growing basil that Bioshelters gave us were hampered by the very cloudy weather. If the sun is shining at our next meeting, we'll try again to see how much basil makes enough oxygen for one hamster. If it's another dark cloudy day, we'll do an alternative experiment.

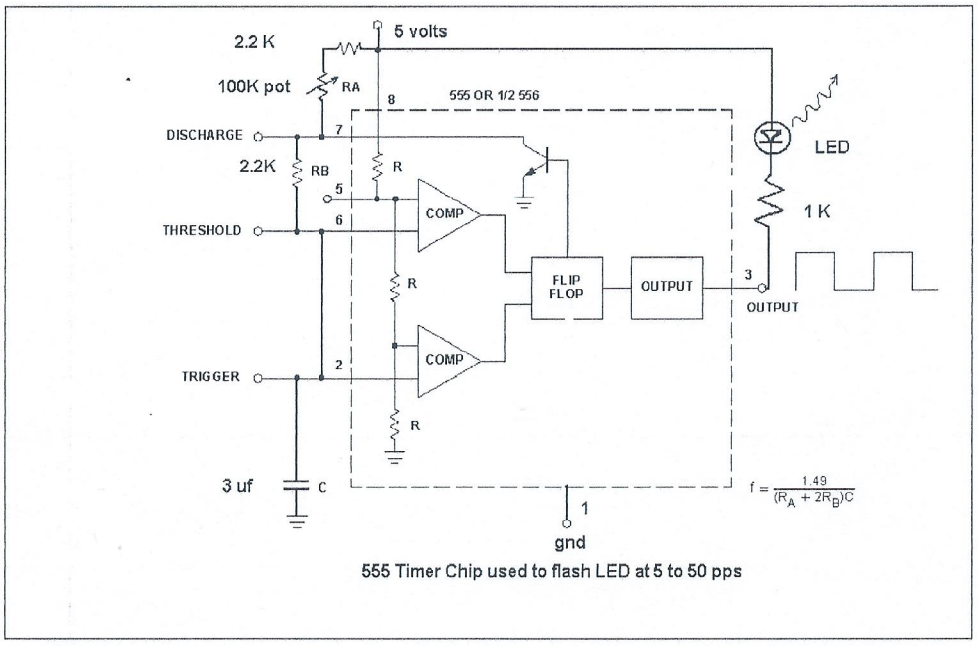
Bioshelters, it turns out, ***can*** give us a tour, but would prefer that it be after their peak growing season, so we'll postpone further planning for that trip until fall.

Next meeting:

Sunday, 17 May 1998.
2 -4 p.m. at Sarah Higley's home, 80 Presidential Apartments, 549-5804.

Science Club News

15 June 1998



555 Timer Chip used to flash LED at 5 to 50 pps

Back in January in Science Club, we waved a magnet next to an oscilloscope and saw that a magnet pushes on electrons moving past it. We used that idea to make a hand-cranked generator that pushed electrons along a wire, across the room to a fan motor, and back.

People use electricity for lots more than turning fan motors, so at our previous meeting we confronted a pile of electronics and some breadboards (into which chips and devices may be inserted and connected by pre-trimmed pieces of wire, to try circuits easily without soldering).

Everybody's favorite gadget turned out to be an LED (light-emitting diode), whose circuit illustrates Ohm's law: a resistor was used to limit current through the LED. We saw that increasing the resistance reduced the brightness of the LED, analogous to kinking a garden hose to reduce the flow of water.

At our next meeting, we plan to use a chip (i.e., 555 Timer) to make our LEDs flash at rates we can set. How many flashes per second are needed to make the LED seem to be on continuously? Does it matter whether our eyes are adapted to bright light, or to a dark room? An interesting investigation awaits.

Next meeting:

Sunday, 21 June 1998.

2 -4 p.m. at Sarah Higley's home, 80 Presidential Apartments, 549-5804.

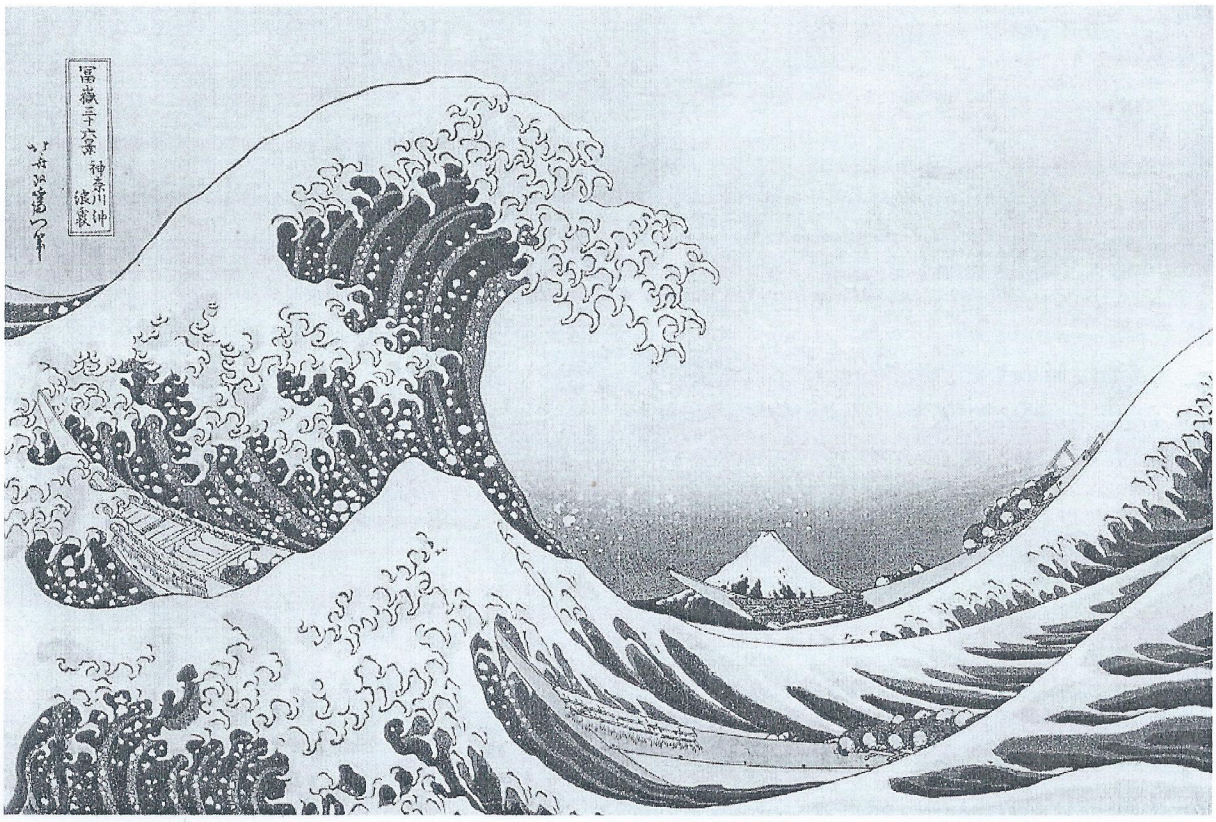
Science Club News

26 October 1998

Science Club resumes!

Next meeting: Sunday, 8 November, 2-4 p.m.,
at Sarah Higley's home, 80 Presidential Apartments, 549-5804.

On our next meeting, we plan to continue our exploration of the subject of waves and oscillations by making slinky sound waves and rippley ripple tank waves. We'll measure the speed of sound in air. On the following meeting, we will note that a wave plus its reflection can make a standing wave. We'll make an organ pipe and a one string guitar, in which we can install different types of wire on an old lathe bed and vary the length and tension.



What we do for future projects is open to suggestions. We may adapt our blinking LED sets to fiber optic communicators. A project or two on heat transfer would fill a gap in Wildwood's present offerings, and provide an excuse to set up a pretty Rayleigh-Bernard convection cell demo that could lead into an extended kid-led exploration seeking out patterns in nature and trying to figure out what makes them.

This fall, I do not plan to send out flyers for each meeting. Please feel free to telephone to ask for details of the upcoming meeting, and play hooky or not accordingly. Parents are welcome to participate in any of the above projects or to invent and conduct their own. Our meeting times will continue to be Sundays 2-4 p.m., and will include:

8 Nov.;
15 Nov.;
20 Dec.

We may also meet on 22 Nov., 6 Dec., or 13 Dec., but these are gymnastics meet weekends, and which day Sarah's level will compete has not yet been determined, so we will have to wing it. Please call if in doubt.

Rob Higley

Science Club News

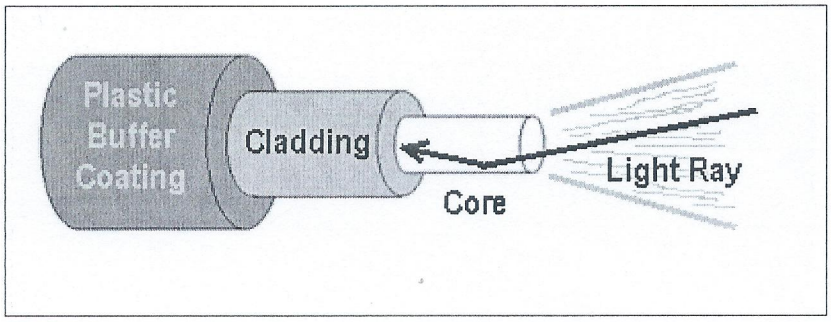
13 January 1999

Science Club resumes!

Next meeting: Sunday, 17 January, 2-4 p.m.,
at Sarah Higley's home, 80 Presidential Apartments, 549-5804.

In our previous meeting, we played with a laser pointer. We shined the beam into a fish tank full of water. A few drops of milk in the water, and a dusting of flour in the air, made the beam visible along its path. Refraction at the interface illustrated light's property of following a path of least time, as we did ourselves in analogy by a combination run and baby-step race across the living room.

While shining the beam not quite straight into one end of the tank, we saw total internal reflection for glancing reflections from the tank-air (or water-air, on the top) interfaces. The beam, unable to escape even partially by glancing reflections, was trapped in the tank until reaching the far end. This is how a multimode fiber optic works. We used a lens to focus the beam from the laser pointer onto the end of a 100 micron core glass fiber and saw the light come out the far end of the fiber. By wrapping the fiber around a finger, we could see some of the light spill out where the bending of the fiber spoiled the total internal reflection of the beams within.



In our next meeting, we plan to devise a way to modulate either the laser beam intensity or its coupling into the fiber, to make our own fiber optic communicator.

Alexander Graham Bell

Rob Higley