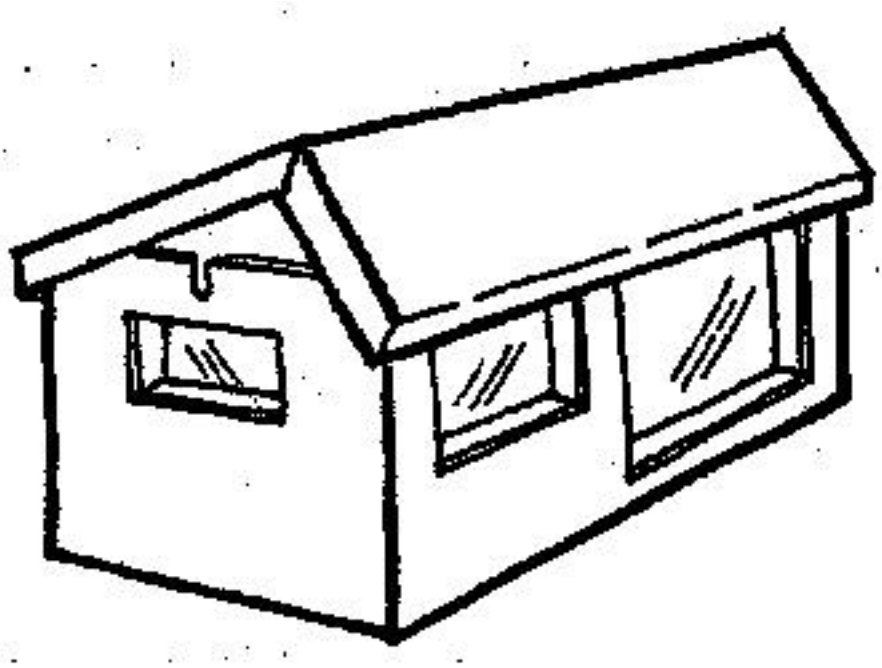
Complete plans to make the Energy House can be found at Design Coalition's website at
www.designcoalition.org

the Energy House Experiments

by: Lou Host-Jablonski, AIA



These are the experiments for the Energy House.

Discover the right design for a solar-heated house that really works.

You build the Energy House in stages. Each time you do an experiment you change it a little.
That way you can see how each change makes the house work a little differently.

design coalition

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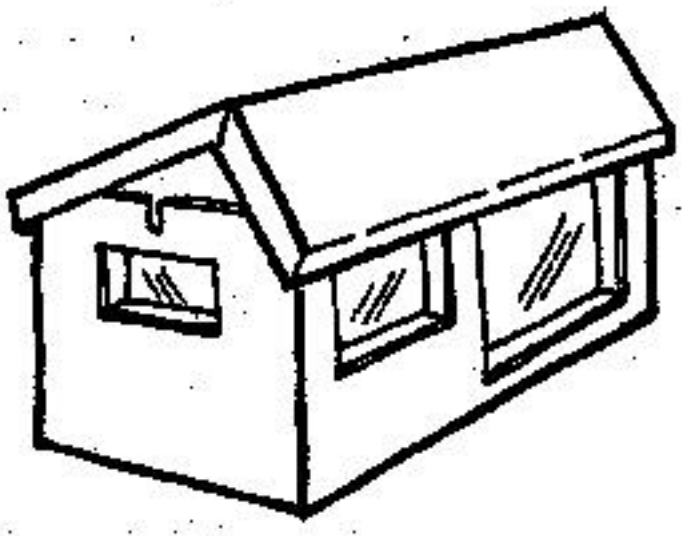


First, experiments about HEAT LOSS...

EXPERIMENT 1

In **Experiment 1**, you are measuring the BASE CASE. That means that you will find out the basic way your Energy House works that you can compare all the future experiments to.

the Steps...

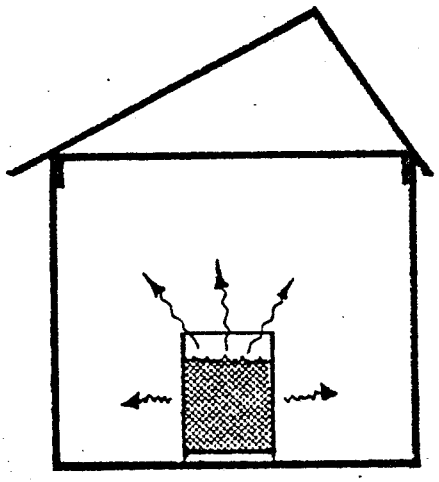
1. Make the house model. For this experiment, don't cut out any windows.

2. Fill the can with hot water, place it in the house and put on the ceiling. The can of hot water is the **furnace** of the Energy House. It heats up the inside of the house, and you measure how long it takes for the Energy House to get cold again.

3. REMEMBER, always use the same temperature water at the start of each experiment, and fill the can with exactly the same amount of water each time.

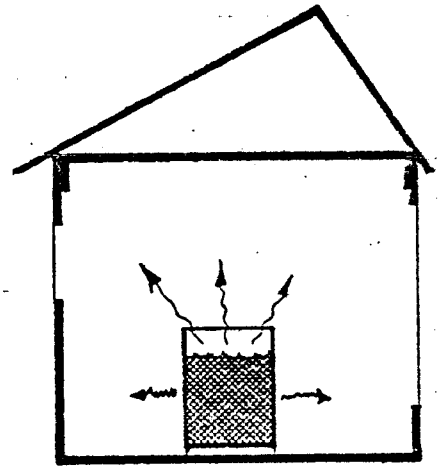
4. Then, decide if you're going to check the temperature every 15 minutes or 20 minutes. It doesn't matter which, but once you choose then you need to always do it the same way for all the experiments. Otherwise when you graph your results, it won't make much sense

5. Graph the temperatures. To learn about making a graph, see the separate section on ***Graphing***.



EXPERIMENT 2

Experiment 2 makes the Energy House more realistic, because no house is without windows! But windows do lose heat. Compare to Experiment 1.



the Steps..

1. Cut window and door openings. Remember to leave a hinge for the door; don't cut all the way around. Cut one set of plastic windows and tape them in place.
2. Place the hot water 'furnace' and measure the temperature drop. Keep the door closed.
3. Put the thermometer in. place the "bulb" part of the thermometer inside the Energy House, and keep the part with the numbers out where you easily can read them.
4. Graph the temperatures, and compare them to Experiment 1.

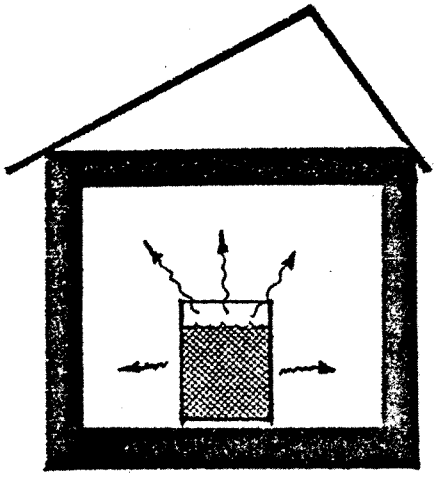
Things to notice....
Did the windows fog up? If they did, why do you think they did?

a WORD that architects use...

CONDENSATION is what the fog on the windows is called.
It is water droplets that come from moist air.

EXPERIMENT 3

Another unrealistic situation -- a house with no windows! But to make a point, which is that insulation saves heat.



the Steps...

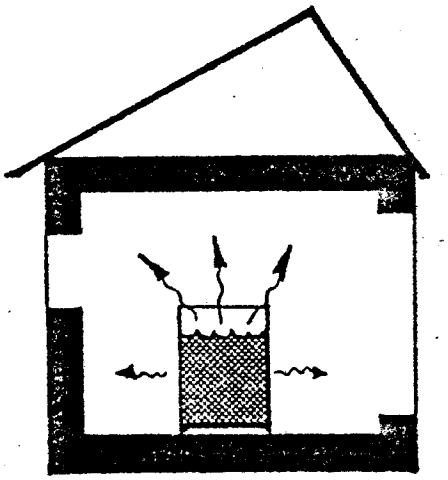
1. Cut insulation panels for the walls and ceiling, but don't cut out the windows yet.
2. Place the hot water 'furnace' and measure the temperature drop.
3. Graph the temperatures, and compare them to Experiment 1.

Things to notice....

Did the Energy House stay warmer longer? Do you think insulation stops heat from getting out of the house, or just slows it down?

EXPERIMENT 4

Now the Energy House is getting more realistic. This experiment is good to compare to the next one.



the Steps...

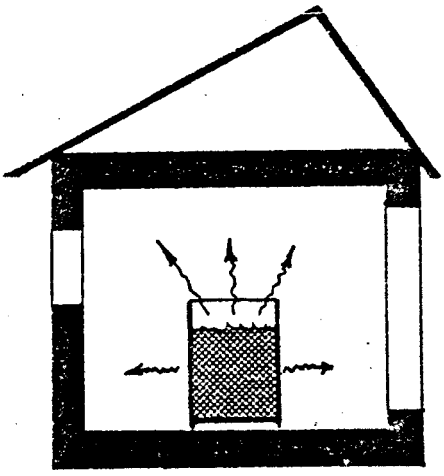
1. Cut window and door openings into the insulation. Then put insulation back in.
2. Place the hot water 'furnace' and measure the temperature drop. Keep the door closed.
3. Graph the temperatures.

Things to notice....

Did the windows fog up this time? Did the heat stay in longer?

EXPERIMENT 5

This experiment shows an important thing -- air insulates!



the Steps...

1. Cut out a second set of plastic windows and tape them to the inside of the insulation.
2. Place the hot water 'furnace' and measure the temperature drop. Keep the door closed.
3. Graph the temperatures.

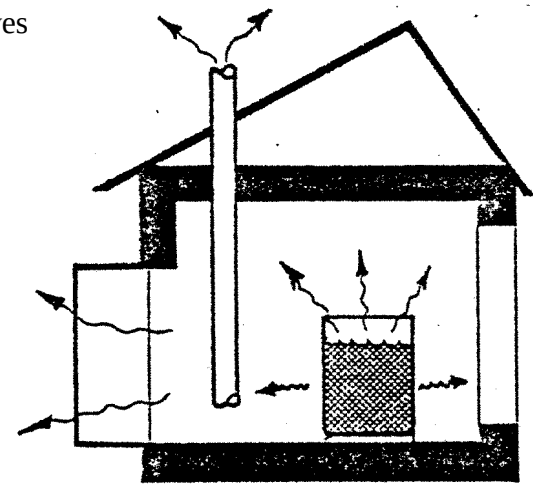
Things to notice....

Compare your graph of this experiment to Experiment 3 and Experiment 4. Which keeps heat in longer? Did the windows fog up this time? How much? Why do you think there's a difference?

If you made sure the window plastic is taped in place, the air inside the double-pane windows is still, not moving or blowing through. Do you think these windows would insulate as well if air WAS blowing through?

EXPERIMENT 6

What happens to all the heat in your house when somebody leaves the door open?



the Steps...

1. Cut a hole in the roof and ceiling insulation for the chimney. You can make the chimney by rolling up a piece of paper, or using the tube from a roll of paper towels, or something similar. Make it a snug fit, (and save the plug of insulation to replace when the experiment is over!)

2. Place the hot water 'furnace' and measure the temperature drop. This time leave the door open a little.

3. Graph the temperatures.

Things to notice....

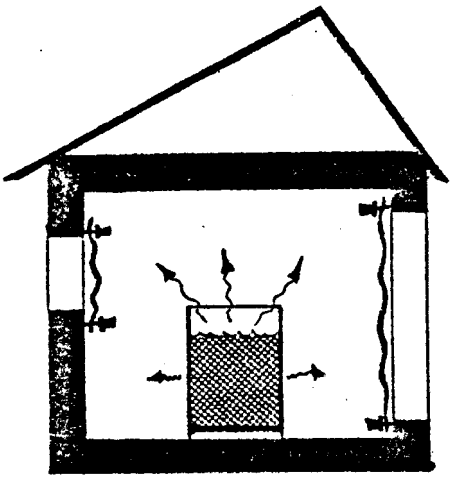
Did the windows fog up this time? What effect does having some air moving through have on the Energy House?

a WORD that architects use...

INFILTRATION means air leakage in a house that lets cold air in and warm air out -- because air from the outdoors "filters in" to a house.

EXPERIMENT 7

Heavy curtains add another insulating air space. They must seal tightly however to create a still pocket of air.



the Steps...

1. Cut out the cloth curtains, big enough to completely cover the windows and overlap onto the wall. Use the push-pins to fasten them tightly against the windows.

2. Place the hot water 'furnace' and measure the temperature drop. Keep the door closed.

3. Graph the temperatures.

Things to notice....

Compare this experiment to Experiment 5. Do the curtains make a difference for holding in heat?

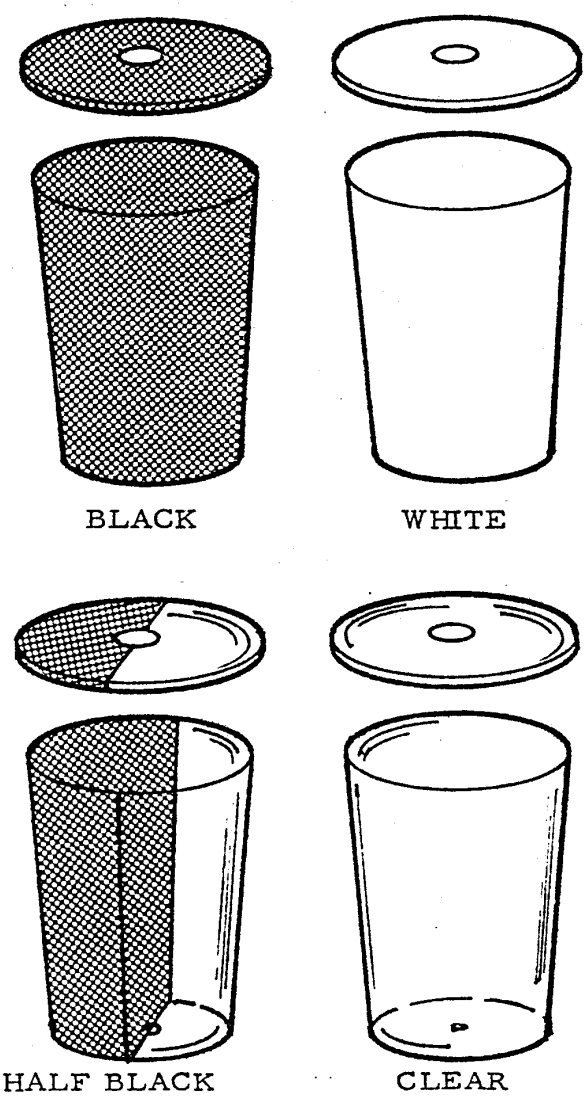
In the next experiments you will learn about HEAT GAIN!

When the sun's light shines on things, it heats them up. They GAIN HEAT.

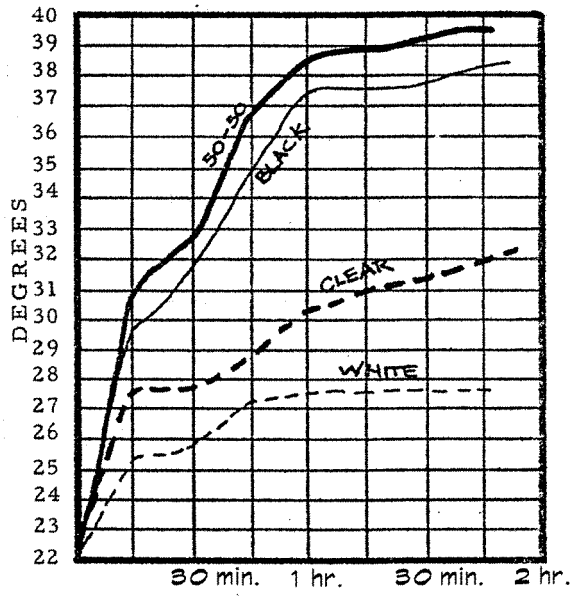
EXPERIMENT 8

For this experiment we use **4 plastic cups** instead of the Energy House. You will learn how solar collectors work!

the Steps...



1. Leave a jug of water stand overnight so it becomes room temperature.
2. Paint the outside of 4 clear plastic cups as shown in the pictures. Paint the lids too.
3. Make sure the lids have a hole big enough to fit the thermometer in, so you don't have to take off the lid to take readings.
4. Set the cups where they will receive equal, direct sunlight. Face the half-and-half cup with the clear side towards the sun.
5. Fill each cup with the same amount of room-temperature water. Cover.
6. Measure the temperature rise every 15 minutes.
7. Graph the temperatures. Your graph might look something like this one:



Things to notice....

Which cup is the best collector of solar heat? Which is the worst? Why do you think there's such a difference?

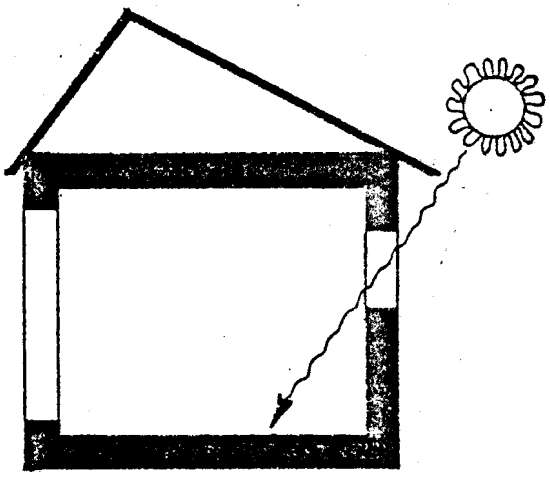
How would this experiment help you to design a good solar collector?

Can you describe how the cups in the sun are acting like miniature Energy Houses?

EXPERIMENT 9

The sun can't heat up your house if it can't get in. The direction that a house faces is the important thing here. On the north side windows are needed only for view and some light, but not heat.

the Steps...



1. Place the house in the sun, facing the door and the small window toward the sun.
2. Measure the temperature rise every half hour and graph the results.

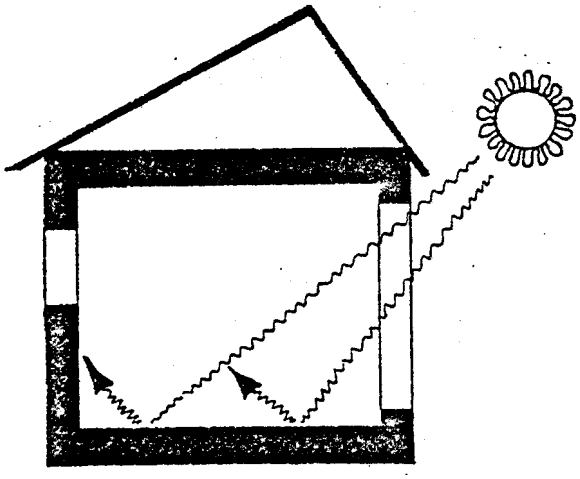
Things to notice....

Compare this experiment to Experiment 10. This experiment goes hand in hand with a study of the sun's motions through the sky.

EXPERIMENT 10

Here's the Greenhouse Effect demonstrated. Heat from the sun comes mostly in 'shorter' waves. Once these rays bounce off something they become 'longer' waves. Glass lets the 'shorter' waves through, but traps the 'longer' waves.

the Steps...



1. Place the house with the large windows facing the sun.
2. Measure the temperature rise.
3. Graph the temperatures.

Things to notice....

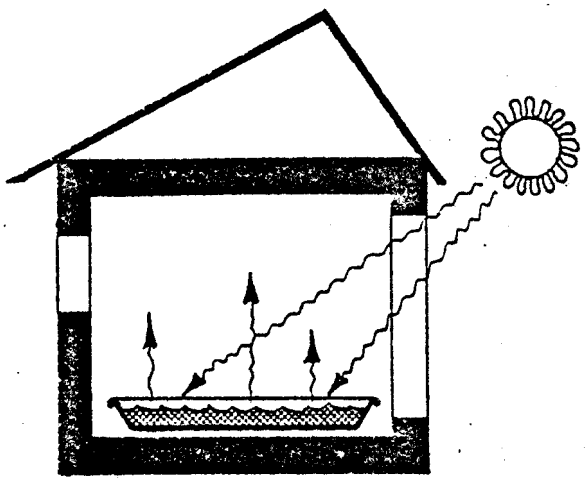
Did the windows fog up this time? Compare this experiment to the next one...

EXPERIMENT 11

Finally, this is the passively heated solar house in its basic form: well insulated; with large windows toward the sun and small windows elsewhere, and with heat storage material placed to absorb heat.

the Steps...

1. Place a black-painted pan in the Energy House
2. Fill with room temperature water.
3. Place the house in the sun, with the ***large*** windows facing the sun.
4. Measure the temperature rise and graph.
5. Block out the sun after 2 or 3 hours and keep taking readings as the temperature drops.
6. Graph the temperatures.



Things to notice....

Compare this experiment to Experiment 10. Does the house heat up faster or slower? Does it cool down faster or slower?

(*HINT*: Check here for hints about the slopes of lines in graphs)

In this experiment, the sun heats the water, the water absorbs heat and releases it slowly. If you had heat storage in a real house, you could store the sun's heat during the day and let it out at night when it is needed. Even better, you could pull all the curtains at night to keep more heat in. Unfortunately this is not possible to do with the model without opening up the Energy House and disturbing the experiment.

WORDS that architects use...

THERMAL MASS or THERMAL STORAGE:
Thermal mean heat. Thermal storage is a material that can store heat.

Water or pebbles make good thermal storage.

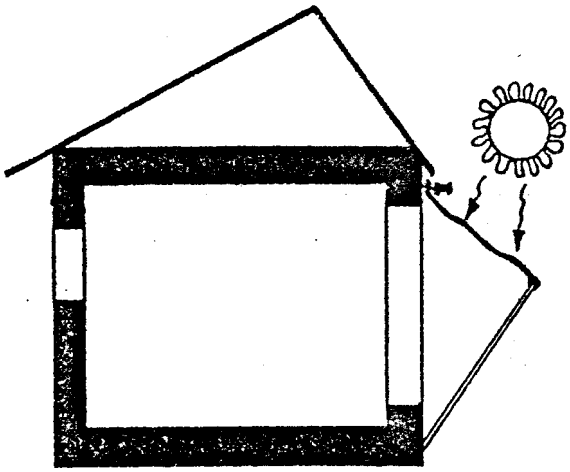
EXPERIMENT 12

This experiment is about keeping the house cool in summer.

"The sun can't heat up your house if it can't get in." That's true in summer as well as winter. Awnings, louvers or shutters stop the sun before it gets into the house.

Shades, curtains or blinds work to help a room stay cool too, by reflecting some of the heat back out. But not so well as something like and awning that keeps the sun from getting in the first place.

the Steps...



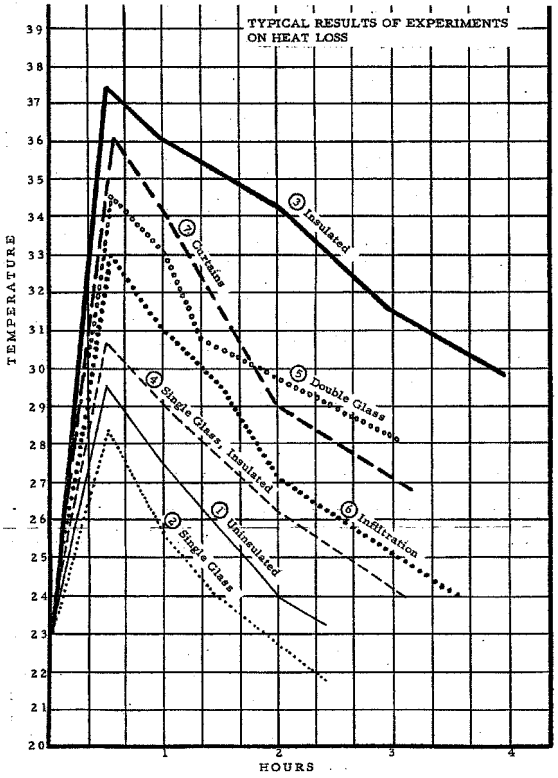
1. Make the awning and attach it to the house with push-pins.
2. Place house with the large windows facing the sun. Try to do this on a day when the Energy House will get the same amount of sun as in Experiment 10.
3. Measure and graph the heat rise.
4. Graph the temperatures.

Things to notice....

Compare your graph to Experiment 10 -- does the awning really work to keep the house cool?

People use electricity to run air conditioners to take away the heat after the sun has heated up their house. Do you think it would be better and cheaper to prevent the house from heating up in the first place?

If you've done all the experiments, now you have a complete set of graphs. What do they tell you about designing a real house?



Graph of HEAT LOSS experiments

Graph of HEAT GAIN experiments