

Solar Hot Water Lab- Part 1 of 3

Using an *extremely* ☺ Passive Hot Water Heating System you will measure how much the sun can heat water.

3rd Hour:

1. Your name and group #: _____

2. Date: _____

3. Location (city): _____

4. Sky Conditions: _____ Clear _____ Partly Cloudy _____ Cloudy

Other Comments on the weather? _____

5. Amount of water being filled in the Solar Heated Portable Shower Bag: _____

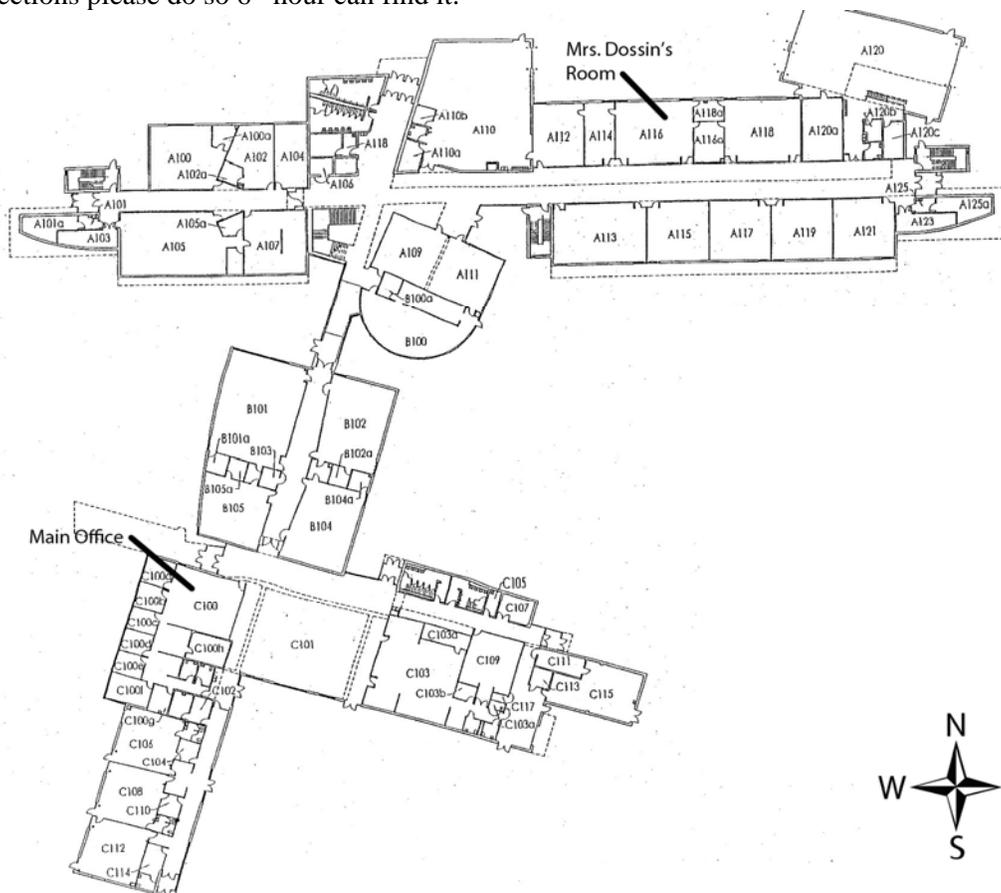
6. Temperature of cold water filling the bag in Fahrenheit : _____ (Measure the temperature of the water by first filling the bag up, then pouring a cup full of water from the bag into a Styrofoam cup. This should give you a close mean (average) temperature of the water.

7. Record the outside temperature in Fahrenheit: _____

8. Time you hang the water bag outside (specify am or pm): _____

Hang the bag in a location mutually agreed by your classmates. We want to space the bags around the outside of the RETC evenly so all bags are exposed to different directions. (North, East, South, West, North-East, South-East, South-West, North-West). When locating the bags it is important to suspend the bag in the air so the temperature is not effected by any touching material, and so we have gravity to help dispense the water.

9. On the map below, mark where you hung your group's Solar Heated Portable Shower Bag. If you need to write some specific directions please do so 6th hour can find it.



10. How many degrees do you think the water will increase by the time the 6th hour retrieves it? _____

Solar Hot Water Lab- Part 2 of 3

Using an *extremely* 😊 Passive Hot Water Heating System you will measure how much the sun can heat water.

6th Hour:

1. Your name and group #: _____

2. Date: _____

3. Location (city): _____

4. Sky Conditions: _____ Clear _____ Partly Cloudy _____ Cloudy

Other Comments on the weather? _____

5. On what side of the building is your group's water bag located? . (North, East, South, West, North-East, South-East, South-West, North-West). _____

6. Outside air temperature: _____

7. Time you retrieve the water bag from outside (specify am or pm): _____

8. Temperature of water inside of the bag in Fahrenheit: _____ (Measure the temperature of the water by pouring a cup full of water from the bag into a Styrofoam cup. This should give you a close mean (average) temperature of the water.

9. How many degrees did the water increase from this morning? (Please show your work) _____

10. How many hours was the solar hot water bag hanging? (Please show your work) _____

Empty one gallon from the hot water bag. Go back and hang the bags in the same spot you retrieved it.

11. Record the time you hang the water bag outside (specify am or pm): _____

Solar Hot Water Lab- Part 3 of 3

Remember when looking at the elementary schools water usage we said that another consideration to look at is the cost of different forms or **fuel sources** of energy at your school. Sometimes significant savings can be generated by switching to a less expensive fuel. For some applications it may be possible to use the sun or take advantage of heat being exhausted from the buildings or kitchen to heat or pre-heat the water.

Using the information recorded from the lab answer the following.

Calculate the amount of energy used to heat water at your school.

You will need to convert the temperatures you recorded in Fahrenheit into Centigrade using the formula below.

$$(\text{_____}^{\circ}\text{F} - 32) \times (5/9) = \text{_____}^{\circ}\text{C (Celsius)}$$

Temperature of cold water = _____^{°C}

Temperature of hot water = _____^{°C}

Difference cold vs. hot = _____^{°C}

www.convertunits.com

It takes 1 calorie to raise 1 gram of water 1^{°C} and,
1,000 grams of water = 1 liter so,

It takes 1,000 calories (*or 1kcal*) to heat 1 liter of water up 1^{°C}

If there is 2.78 liter per gallon, how many calories does it take to raise 1 gallon of water, 1^{°C}?

2.78 liters per gallon x 1,000 calories, per liter = 2,780 calories to heat up 1 gallon of water 1^{°C}.

So to find out how many calories it took to raise the one gallon of water from the cold water temperature to the hot water temperature.

_____ (Difference cold vs. hot in ^{°C}) X 2,780 calories = _____ calories to raise 1 gallon of cold water to the hot water temperature.

How many gallons of water was heated? _____ Gallons

How many total calories were required to heat all the HOT water used in the building for the year?

_____ Gallon of water heated X _____ Calories to raise 1 gallon of cold water to the hot water temperature = _____ Total Calories Used For Heating the Water

Convert the Calories used to heat the Hot Water into BTU's, Therms' and Kwh.

1 BTU= 252.5 calories

1 Therm= 25,210,420.6 calories

1kWh = 860,420.6 calories

_____ Total Calories Used For Heating Water / 252.5 = _____ BTU's

_____ Total Calories Used For Heating Water / 25,210,420.6 = _____ Therms

(1 Therm= .9765625 CCF)

_____ Total Calories Used For Heating Water / 860,420.6 = _____ kWh