

TEACHER QUEST TAMPA BAY PROGRAM

ACTION PLAN

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Lesson Title: Geothermal Energy

Grade Level: 8th

Subject Area(s): Math

Date: 7/22/2010

Summer Work Experience

Coastal Caisson Company (CCC) has four geothermal applications located just offsite at their *Basement* facility. USF was contracted to evaluate the thermal diffusion capabilities of these systems in February 2009. I was tasked with interpreting the USF data and making recommendations for system improvement.

System A consists of 4-10" and 4-16" diameter vertical wells in series which came online in July 2009 operating at 1 gallon per minute (gpm). Only 2 of 8 wells were operational due to pump limitations. At some point between December 2009 and January 2010 the system was taken offline. However, during its operational phase, USF collected the following data: inflow at 95° = average 2.5° temperature drop and inflow at 105° = average 3.5° temperature drop.

Systems B and C are both horizontal slinky geothermal applications with system B installed at 3 feet below ground level and system C installed 8 ft below ground level within the groundwater. Both systems are 60ft in length with temperature probes at various depths at 15ft, 30ft, and 45ft from inflow. Neither of these systems has been operational due to pumping capacity limitations.

System D consists of 9 W shaped geothermal sinks installed within a CSM basement wall. Each CSM sink contains approximately 65 linear feet (LF). This system has operated intermittently since October 2009 at 2 gpm for 8 of the 9 CSM sinks. It is currently the only system online at this time. USF collected the following data: inflow unknown (due to cut sensor line) = 13° temperature drop.

USF concluded that system A is 4.5 times more efficient than system D by averaging the 13° temperature differential for system D over 8 sinks for 1.6° per sink and comparing with the maximum temperature drop reported for system A of 7.2°.

Because the current pumping capacity is insufficient to operate all four geothermal systems (or any one system to full efficiency), I have developed a scope of work (SOW) to upgrade that pump which is currently in review and hopefully will be out for bid here shortly. In the meantime, I have also proposed an autonomous solar pumping system to operate the basement portion only (system D). That proposal is currently being considered and hopefully will be approved as well.

This project has definitely made me rethink our access to renewable energy in the state of Florida, specifically with geothermal applications.

Lesson Plan

Objective

Students will create and compare two conceptual air-conditioning designs; one using regular technology and one using groundwater temperature to heat/cool our home.

Sunshine State Standards

MA.8.A.1.1, MA.8.A.1.3, MA.8.A.4.1, MA.8.G.5.1, SC.8.N.3.1, SC.8.N.4.1, SC.8.N.4.4

Materials

Internet, computers, power point, pencils, paper

Instructional Procedures

1. Working in groups, students will select location within the USA for their home and size of their home – including room layout, windows, doors, number of stories, orientation.
2. They will research the average reported ground/groundwater temperatures [www.noritz.com/u/US_ground_temperature%5B1%5D.pdf], outdoor temperatures in the winter and summer [<http://countrystudies.us/united-states/weather/>], and energy costs [[http://michaelbluejay.com/electricity/ cost.html](http://michaelbluejay.com/electricity/cost.html)] for their chosen location.

3. Using this research data, they will create two conceptual air-conditioning designs:
 - a. Regular heat pump that uses the outdoor air to provide heating/cooling - calculate the total heating/cooling load using outdoor temperatures.
 - b. Geothermal heat pump that use the earth to provide heating/cooling - calculate the total heating/cooling load using groundwater temperatures.

[\[http://www.heatload.com/unico/heatloadpreform.htm\]](http://www.heatload.com/unico/heatloadpreform.htm)

preform.pl

All measurements on this form should be in feet. For inches 1 through 9 just add that number as a decimal value of the measurement. For inches 10 and 11 round up to the next foot. For example, 8 feet and 6 inches would be typed 8.6, or 13 feet and 11 inches would just be typed as 14 feet.

Select Room Type:	<input type="text" value="Other"/>	HELP
Enter room dimensions:	L: 50 ft W: 50 ft H: 10 ft	HELP
Enter area of exposed walls:	2000 ft ²	HELP
Is the floor a concrete slab on grade?	<input type="radio"/> Yes <input checked="" type="radio"/> No	HELP
Enter area of glass doors and windows facing north and south:	100 ft ²	HELP
Enter area of glass doors and windows facing east and west:	100 ft ²	HELP
Are the windows shaded?	<input type="radio"/> Yes <input checked="" type="radio"/> No	HELP
Enter area of non-glass doors:	25 ft ²	HELP
Enter area of exposed floors over vented crawlspaces, garages, or exterior of house:	2500 ft ²	HELP
Is there ductwork exposed above the room?	<input type="radio"/> Yes <input checked="" type="radio"/> No	HELP
Is there ductwork exposed below the room?	<input type="radio"/> Yes <input checked="" type="radio"/> No	HELP
Is this the last room in the calculation?	<input type="radio"/> Yes <input checked="" type="radio"/> No	HELP

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Wall Type	R19
Ceiling Type	R19
Window Type	Single Pane
Functional Low Temperature	55°
Functional High Temperature	95°
Grains of Water	88
Minimal Overnight Temperature Drops	Yes

Room Name	Heat Loss	Heat Gain
Bathroom 2	15022 btu	32671 btu
TOTAL HOUSE REQUIREMENTS	15022 btu	32671 btu
ACTUAL HOUSE DISTRIBUTION		37000 btu

Recommended Equipment
M1260 with a 3.5 ton condensor. Click [here](#) to order.

4. Students will use the heating/cooling load size (Btu) to calculate energy usage (kW) and operational cost (\$) for their two conceptual designs.
5. Students will compare and reflect on their designs and the benefits of using geothermal technology.
6. Incorporate field trip to basement.

Integration of Summer Work Experience/Follow-up Activities

Field trip to the Coastal Caisson Facility

Invite Coastal Caisson employees to my school for the Great American Teach-in

Assessment Instrument

Rubric based with self-evaluation and class evaluation components.