

CONCEPT MAP OF UNIT

Students will learn about solar thermal technology. Students will then examine a solar thermal unit to determine how it works and describe the process verbally.

TOPIC:

STEM 3: Solar-Thermal

TEACHER

Debbie Grothaus

GRADE

9th grade Physics

KEY LEARNING(S)

The basics of solar thermal technology and how a pre-built solar thermal unit can be used to heat a water tank.

UNIT ESSENTIAL QUESTIONS

What is solar thermal technology? What are some of its possible uses? How can a solar thermal unit be used to heat a water tank? How would you explain it to someone that doesn't know anything about the technology?

OPTIONAL INSTRUCTIONAL TOOLS

Solar thermal unit (already built)
"Solar Hot Water Fundamentals" by Peter Skinner et al

CONCEPT

Basic Solar Thermal technology and its possible uses.

CONCEPT

Looking at a solar thermal unit, determine how it might be used to heat a tank of water.

CONCEPT

Express verbally the concepts used in the solar thermal unit and how they would work to heat a hot water tank.

LESSON ESSENTIAL QUESTIONS

What is solar thermal energy? What are the benefits and disadvantages of using solar thermal? What are some of its possible uses?

LESSON ESSENTIAL QUESTIONS

What are the separate components of the solar thermal unit and how could it be used in your home to heat your hot water tank?

LESSON ESSENTIAL QUESTIONS

How would you explain how the solar thermal unit works to heat water to someone that knows nothing about the technology involved?

VOCABULARY

Solar – thermal

Active solar thermal system (vs. passive)

VOCABULARY

Drain back

Closed loop

Harp

Serpentine

VOCABULARY

ADDITIONAL INFORMATION

Being able to clearly verbalize the configuration, the technology and the process used with the solar thermal unit will enable students to practice being able to clearly explain a concept to someone that would have no prior knowledge of solar thermal. Students must use evidence, be able to correctly use the visual aid, and use the correct verbage to accomplish the task.

Extensions might include: drawing a schematic diagram of the system; building their own unit,; installing and using a unit; researching other uses for the technology; contrasting and comparing solar thermal systems with photovoltaic systems; etc.

CONCEPT MAP OF UNIT

Students will design and build a solar water heater and see how large a temperature change they can achieve in their subsequent redesign and testing. Students will redesign their solar water heater design.

TOPIC

Solar Power/Solar Water Heater

TEACHER

Jessica Esquibel

GRADE

8th**KEY LEARNING(S)**

Design and construct solar power water heater to gain experience using the design cycle.

Design controlled experiments and collect and analyze data

Integrate their own (and shared) data to drive design decisions and improvements to a solar water heater

UNIT ESSENTIAL QUESTIONS

What design will give you warmer water faster?

How can you create a controlled experiment?

OPTIONAL INSTRUCTIONAL TOOLS

- NASA solar heater design challenge sheet
- Solar Cookers International: Pasteurization
- Practical Action: Comprehensive fact brief on solar water heating
- eHow: Information on Solar Energy and Solar Water heating in 3rd World Countries
- eHow: How to Use Solar Power in 3rd World Countries
- Solar Energy Background Info and Readings for Students
- The Futures Channel: Educational Videos and Activities -- 2-5 minute videos focus on STEM issues and examples

CONCEPT

Compare and evaluate the effectiveness of the solar water heaters.

CONCEPT

Collect and analyze data. Compare data with the class.

CONCEPT

Show that the solar energy can be easily collected and converted to heat energy.

LESSON ESSENTIAL QUESTIONS

Does your design affect the temperature?

LESSON ESSENTIAL QUESTIONS

Does your data correlate with the solar water heater design?

LESSON ESSENTIAL QUESTIONS

How can you check collected water to see if it is converted to heat energy?

VOCABULARY

Solar energy
Radiant heat
Convection, Conduction

VOCABULARY

[Words]

VOCABULARY

Law of thermodynamics
Energy
Heat

ADDITIONAL INFORMATION

Assessment will consist of vocabulary and completed solar water heaters.

- Thoroughness of the students' designs
- Involvement in discussions
- Cooperative teamwork
- Safety behavior
- Quality of experimental data
- Graphs
- Re-design improvements
- Written responses to questions

CONCEPT MAP OF UNIT

Solar water heaters otherwise known as solar domestic hot water systems is a cheap way to heat the water we use at home. Why cheap, the source of energy is free- the SUN. Solar water heating systems include storage tanks and solar collectors. The system utilizes a series of copper tubes installed within the panel with one side transparent to allow the sun to penetrate but at the same time traps the heat within. The other side of the box is wood covered with a layer of Styrofoam to help with the insulation. HTF or heat transfer fluid can be water or glycol. Each of these substances have pros and cons, water freezing at extremely cold temperatures while glycol does not but glycol degrades with temperature and time and corrodes copper pipes.

Water or glycol (HTF) is pumped to the copper pipe within the solar collector panel and when heated at the right temperature, it travels to the water tank, the holding tank for your hot water. Heat from HTF is then transferred to the water in the tank by conduction. Temperature gauges and valves are installed along certain points with the entire system. The gauges allow easy monitoring of the temperature and the valves 1) to release steam so that pressure won't build up within the pipe (pressure valve) and 2) to release excess air to ensure that HTF flow is continuous.

TOPIC: SOLAR THERMAL WATER HEATER	Science & Technology
TEACHER	Mignon Penalosa
GRADE	8 th grade

KEY LEARNING(S)

Water heaters can be expensive but building one for your home is not at all difficult. Harnessing the sun's energy to heat water at home is not only cheap but also eco-friendly. This renewable source of energy is abundant here in New Mexico and materials are easy to find.

UNIT ESSENTIAL QUESTIONS

How do you build a solar thermal water heater?

OPTIONAL INSTRUCTIONAL TOOLS

Solar Hot Water Fundamentals
by: Peter Skinner, Todd Paternoster, Will Skinner, Betsy Wyman, and Alan Paul

CONCEPT

Building a solar thermal water heater can be inexpensive and easy. Materials that are readily available will be utilized to build the solar collectors that will be used to capture the sun's energy for heating the HTF (water or glycol)

CONCEPT

The concept of heat transfer from HTF to the actual water that is consumed in the household is conduction. In all cases, heat is always transferred from one substance that is hot to the other that is cold simply because cold is the absence of heat. Conduction is a mode of heat transfer that requires a substance or object to be in contact with the other substance or object. In this case, HTF that is hot traveling within the copper pipes will transfer its heat to the water in the water tank that is used for consumption. Copper pipes excellent conductors of heat thus making a good material for the solar thermal heater.

LESSON ESSENTIAL QUESTIONS

What materials are needed to build a solar thermal water heater?

LESSON ESSENTIAL QUESTIONS

What are the various phases that HTF needs to go through to heat the water in the storage tank?

VOCABULARY

Solar, Copper tubing, Heat transfer Plexiglass, Soldering, Solder

VOCABULARY

Conduction, Thermal energy, Conductor

ADDITIONAL INFORMATION

www.solarsystems-usa.net/solarthermal

CONCEPT MAP OF UNIT

This unit will introduce basic solar thermal design for a drainback system then actual construction of a simple solar water heater panel using copper, pvc, wood and plexiglass. Hands-on experience on the construction process will be introduced like drilling, measuring, sawing, hammering, painting, screwing, soldering and copper tubing and bending.

TOPIC: SOLAR HOT WATER COLLECTORS STEM 1: Solar-Thermal Technology

TEACHER

Ronelle D. Asuncion

GRADE

9

KEY LEARNING(S)

Recognizing the basic components of a basic solar water heating system; understanding how it works and constructing a simple solar water heater panel.

UNIT ESSENTIAL QUESTIONS

How to construct a simple but efficient solar water heater panel?

OPTIONAL INSTRUCTIONAL TOOLS

Solar Hot Water Fundamental by: Skinner, et al

CONCEPT

A drainback solar loop system is simple. A pump takes heat transfer fluid from a tank and propels it up to the collectors above the tank and pump. That fluid falls back into the tank after passing through the collector array

CONCEPT

Constructing a drainback solar water collector needs a few satisfying hours of measuring, thinking, sawing, hammering, painting, drilling, wrench-turning, soldering, copper tubing and bending. It requires basic skills in using the appropriate hand tools in order to construct it properly.

LESSON ESSENTIAL QUESTIONS

What are the basic components of a drainback solar water heater?
How does a simple solar water heater work?

LESSON ESSENTIAL QUESTIONS

How to construct solar water heater panel using copper, pvc, wood, plexiglass and appropriate hand tools?

VOCABULARY

Drainback system
HTF-Heat Transfer Fluid
HX-Heat Exchanger

VOCABULARY

Drilling
Copper
PVC
Copper tubing
Bending
Soldering
plexiglass

ADDITIONAL INFORMATION