



WEATHERIZATION

TOPIC OF STUDY

Energy Efficiency



90 MINUTES

KEY TERMS

spillage
backdrafting
corrosion
combustion air
(Vocabulary presented in
schematics of hot water
heater parts in the lesson)

LESSON

Domestic Hot Water

BIG IDEA(S)

Choosing a hot water heat requires understanding many variables including the need for replacement, efficiency, upfront cost, fuel cost, venting needs, amount of water demand, and life expectancy.

OBJECTIVES

Students will:

- Describe how hot water heaters (HWHs) works
- Identify and compare the parts and processes of several kinds of water heaters
- Describe how to assess the need for HWH replacement
- Describe how choosing a hot water heat requires understanding many variables including need for replacement, efficiency, upfront cost, fuel cost, venting needs, amount of water demand, life expectancy and more
- Describe the hazards associated with hot water heaters

TASK LIST SUBCATEGORY

- 102 Describe how energy is fundamental to our everyday lives
- 305 Recognize and mitigate hazards
- 803 Identify and evaluate mechanical, electrical, plumbing and roofing systems
- 810 Use industry vocabulary

OVERVIEW

Domestic hot water heaters (DHWs). This lesson covers how different hot water heaters work, their pros and cons, hazards associated with this combustion appliance, and additional ways to save hot water, one of the highest costs for a homeowner, about 18% of energy costs per year.

STANDARDS

PA/SDP

3.4.10.B2. Demonstrate how humans devise technologies to reduce the negative consequences of other technologies.

3.4.12.E3. Compare and contrast energy and power **systems** as they relate to pollution, renewable and non-renewable resources, and conservation

4.2.10.B. Evaluate factors affecting availability of natural resources. Analyze technologies that affect the use of our natural resources.

Career Cluster 15: STEM. Demonstrate technical skills needed in a chosen STEM field.





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INSTRUCTIONAL

TEXT/REFERENCES

Energy Conservation Handbook, pp. 123-131

MATERIALS NEEDED

Content: Hot water heater set up in lab, if available. Cut away of a hot water heater that shows interior work, if available.

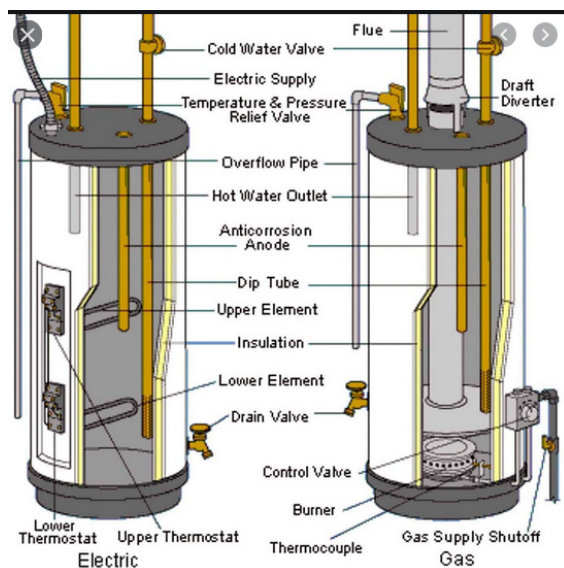
IMPLEMENTATION (LESSON PLAN)

1. Ask: *Remember our energy use pie chart for house energy use? What percent is used for Hot Water?* List all the ways we use hot water at home (showers, washing machine, dishwasher, bathroom sink, housecleaning with hot water, etc.). It is about 18%.
2. DHW heaters use and waste of energy
 - a. Tank heating
 - b. Flow through pipes
 - c. During standby when the tank is waiting for use
3. Assessing Condition (*Energy Conservation Handbook*, p.125 chart and p. 126)
 - a. Hazards that require repair
 - b. Hazards that require replacement
4. Energy saving measures
 - a. Hot water temperature. For every 10 degrees you turn it down, you'll save 3% to 5% on your bill. Most water heaters come preset at 140 degrees, which has the added risk of scalding. The Energy Department recommends most households lower it to 120 degrees.
 - b. Tank Insulation. If you have an older tank, and especially if it's located in an unheated space, wrapping it with an insulating blanket is a cheap and easy way to reduce costs.
 - i. Manufacturers have figured this out, so most newer models already are insulated. It's easy to find out which one you have. Look on its label to see if it has an R-value of at least 24. If not, you should insulate your tank.
 - ii. With these older models, an insulating blanket can cut heat loss by 25% to 45% and save 4% to 9% on the average water-heating bill.
 - c. Pipe Insulation. By insulating your hot water pipes, water will arrive at the faucet 2 to 4 degrees warmer, which means you won't have to wait as long for it to heat up, thus saving energy, water, and money. While this isn't an expensive DIY job — 6-ft.-long, self-sealing sleeves (\$2.50) easily slip over pipes — it could take effort, depending on where your hot water pipes are located. (See Lesson *Basic Plumbing Applications* for pipe insulation installation.)
5. Other Energy saving measures
 - a. **Drain the Sediment.** Tanks naturally build up sediment, which reduces efficiency and makes saving energy a challenge. Draining the tank will keep it running efficiently. And it's really easy to do:
 - i. Turn off the water and power to the unit. On a gas unit, set the burner to "pilot."
 - ii. Connect a garden hose to the spigot at the base of the tank.



IMPLEMENTATION (LESSON PLAN) - CONTINUED

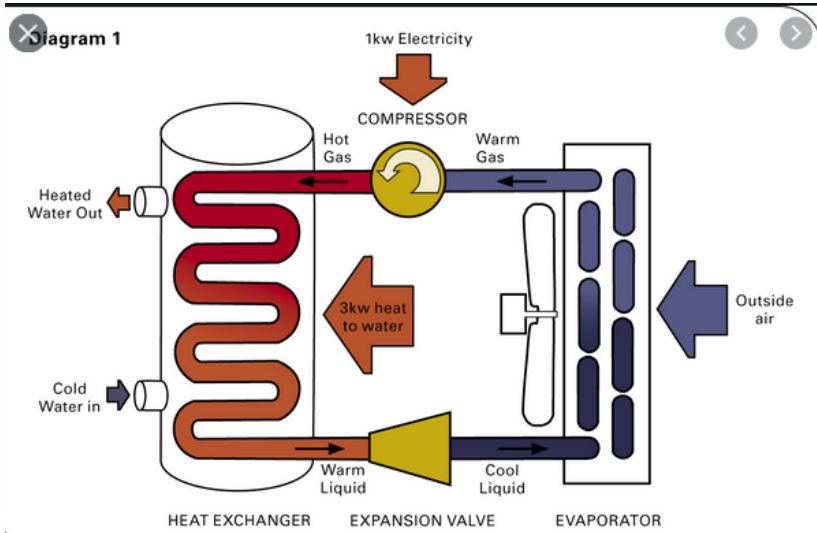
- iii. With the other end of the hose pointed at your floor drain, carefully lift the tank's pressure-relief valve and turn on the tank's spigot; water should begin to flow.
 - iv. **Tip:** While most manufacturers recommend draining the tank once or twice a year, you don't have to drain it completely; in fact, the Department of Energy recommends draining less water more often — just a quart every three months.
- b. **Use Less Hot Water.** One sure way to cut hot water costs is to use less of it. Homeowners need to be educated about ways to save.
- i. A family of four showering five minutes a day uses 700 gallons of water each week — a three-year supply of drinking water for one person!
 - ii. Simply by installing low-flow showerheads and faucet aerators (\$10 to \$20 each), you'll cut your hot water consumption by 25% to 60%. Plus, you'll save on your water bill. That family of four using low-flow fixtures can save 14,000 gallons of water a year.
 - iii. Also, make sure you use the "economy" setting on your dishwasher, and break the pre-washing habit. Modern dishwashers can handle a dirty dish. Scrape what's left of dinner into the trash or compost bin and then load. Energy Star appliances save the most energy when replacing older models. Run dishwashers when they are totally full.
6. Kinds of water heating units (Use the graphic below to explain how each type works, advantages and costs. This video is quick but gives a great overview: <https://www.youtube.com/watch?v=APHxDbCk4mc>)
- a. Storage water heaters
 - i. Super-efficient, gas fired condensing HWHs save more energy but are much more expensive. The internal flue spirals around and inside the tank so that the combustion gases spend more time releasing the heat until the water vapor in the gas - a natural by-product of the combustion process - condenses, releasing even more energy. The spot where the flue exits the tank is barely warm to the touch.
 - ii. View this video of how a gas hot water heater works (4:01 minutes): <https://www.youtube.com/watch?v=gQlatogID5c>
 - Electric
 - Closed or Sealed Combustion



IMPLEMENTATION (LESSON PLAN) - CONTINUED



Heat Pump Water Heaters



WEATHERIZATION

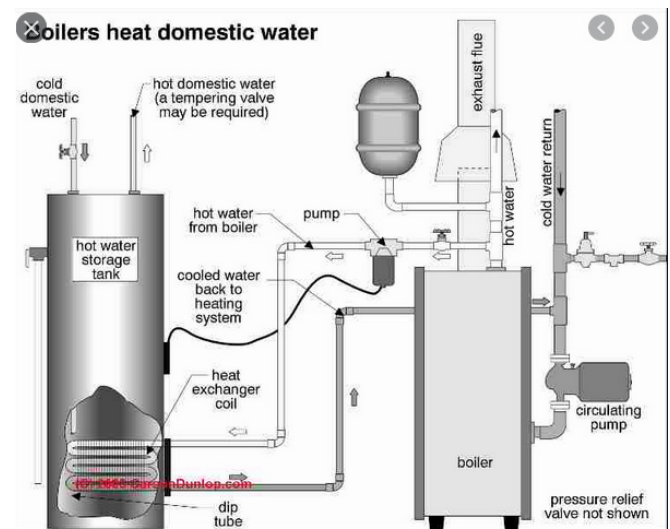
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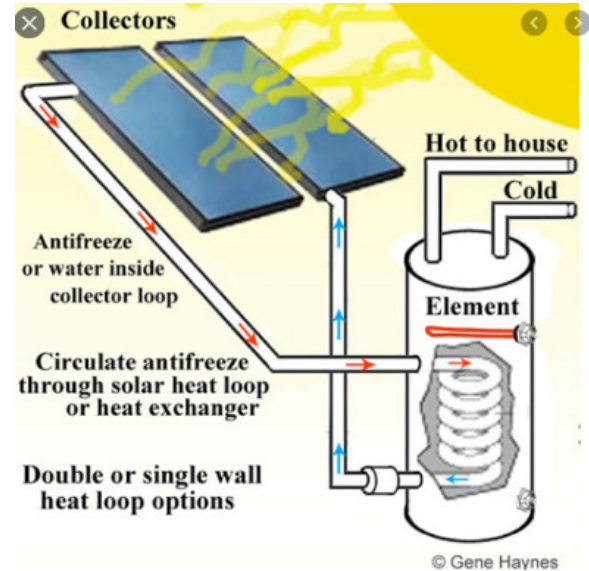
b. On-demand water heaters



c. Indirect water heaters



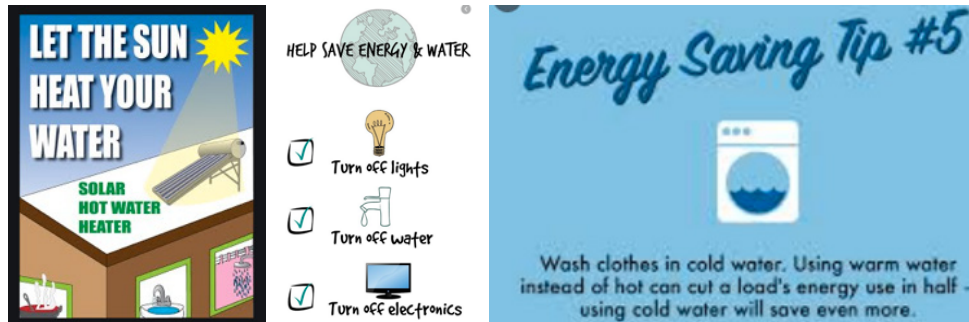
d. Solar water heaters



HOMEWORK

Design a Poster. Choose one of the ideas below and design a poster. You may use internet searches to help you locate additional information about your choice. Examples below.

1. Present a visual about one or more ways to save hot water use in homes.
2. Choose two kinds of hot water heaters and design a poster that compares the two and promotes your favorite.



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TYPES OF WATER HEATERS

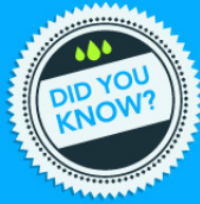
STORAGE	TANKLESS	HEAT PUMP	SOLAR	TANKLESS COIL & INDIRECT
COST \$	COST \$\$	COST \$\$	COST \$\$\$	COST \$\$
LIFE EXPECTANCY 10-15 years	LIFE EXPECTANCY 20+ years	LIFE EXPECTANCY 10-15 years	LIFE EXPECTANCY About 20 years	LIFE EXPECTANCY 10-11 years
PRO Lower purchase cost	PRO Provides a constant supply of hot water, and is 8-34 percent more energy efficient than a storage water heater. Depending on the amount of hot water your home uses daily, you could save at least \$100 a year.	PRO 2-3 times more energy efficient than a storage water heater and lower operating costs. Energy Star heat pump water heaters can save homeowners almost \$300 a year on their electric bills	PRO 50 percent more efficient than gas or electric water heaters	PRO Lower installation and maintenance costs
CON Standby heat loss -- energy can be wasted to keep the water in the tank heated to the set temperature.	CON Limited flow rate of hot water means simultaneous, multiple uses of hot water can stretch a tankless water heater to its limit, and some times the energy savings don't pay for the cost of purchase and installation.	CON Performance is dependent on the installation location, and heat pump water heaters exhaust cold air -- increasing the load on space conditioning appliances during heating months.	CON Solar water heaters may require a backup system for cloudy days and times of high demand.	CON Inefficient choice for many homes, especially for those in warmer climates.
SOLUTION Look for an insulated tank to reduce heat losses and lower operating costs.	SOLUTION Install two or more tankless water heaters connected in parallel or separate ones for appliances that use a lot of hot water.	SOLUTION Switching the heat pump water heater to regular resistance mode will stop cold air exhaust but also reduce the appliance's efficiency.	SOLUTION Make sure you buy a solar water heating system that includes a storage water heater as part of the system package.	



HOMEWORK (CONTINUED)



About 27 million households in the U.S. have a water heater that's more than **10 YEARS OLD.**



An average water heater lasts about 10-15 years, and when it fails, it can leave you in a mess.

DO YOUR RESEARCH EARLY to find one that best fits your needs.



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YOU SHOULD ALSO CONSIDER:

EFFICIENCY

To maximize energy and operating cost savings, look for an energy-efficient water heater. A water heater's efficiency is determined by a water heater's **ENERGY FACTOR (EF)**. Based on the amount of hot water produced per unit of fuel consumed, an energy factor includes:

RECOVERY EFFICIENCY

How efficiently the heat from the fuel is transferred to the water.

STANDBY LOSSES

The percentage of the heat loss per hour from the stored water compared to the water's heat.

CYCLING LOSSES

The loss of heat as water circulates through a tank or pipes.

COST

When buying a water heater, it is important to not only look at the purchase cost, but also the installation, operating and maintenance costs to determine if it is worth investing in a more efficient water heating system.

SIZE

To ensure you will have enough hot water when you want to use it, calculate your household's peak-hour hot water demand and use that to determine your water heater size.

TIPS FOR REDUCING YOUR WATER HEATING BILLS

USE LESS hot water.

Install **LOW-FLOW FAUCETS AND SHOWERHEADS.**

Low-flow fixtures cost about \$10-20 a piece and achieve water savings of **25-60 PERCENT.**



Buy a more efficient model or consider installing a **SOLAR WATER HEATER.**

Purchase **ENERGY STAR APPLIANCES,** such as dishwashers and clothes washers.

Turn down your water heater's **THERMOSTAT.**

Wash your clothes in **COLD WATER.**

Follow the manufacturer's recommendations for ways to **INSULATE YOUR WATER HEATER** tank and pipes.

FIX LEAKS:

A leak of one drip per second can cost **\$1 a month.**

Set water heater thermostat to **120 DEGREES F.**

SOURCES: Energy Saver (www.energy.gov/energysaver) and Energy Star (www.energystar.gov)

ENERGY.GOV





ASSESSMENT

Quiz 5 (*Energy Conservation Handbook*, p.175) - Domestic Hot Water

RESOURCES/LINKS

This Old House: Shows inside of an older tank

<https://www.youtube.com/watch?v=9kjabzlcLRA>

Department of Energy Infographic about water and related energy use:

<https://www.energy.gov/articles/new-infographic-and-projects-keep-your-energy-bills-out-hot-water>



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