

LEARNING GUIDE

Programs Science, Plumbing and Heating

Module RENEWABLE ENERGY

Learning Unit Identify the Components of a Solar
Domestic Hot Water System

Introduction

The requirements for the components required for a solar thermal domestic hot water system are based on specific scientific principles. This lesson is appropriate for the science lab, plumbing, and heating ventilation and air conditioning curriculums.

This learning guide will teach you the components necessary for the operation of a solar thermal, ethyl glycol, domestic hot water system. As importantly, it will teach the scientific principles that necessitate the use of these components.

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**UPPER CAPE COD REGIONAL
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**Components of a Solar, Glycol,
Domestic Hot Water System**

Performance Objective: The student will list the components of a solar domestic hot water system and give the purpose of each component.

Given: An instruction sheet, instructor lecture and demonstration, and the text *Solar Hot Water Systems*

The Student Will: Have the ability to list solar water heating components and understand their purpose.

How Well: You must successfully answer the open-ended question in the Knowledge Test.

NAME: _____

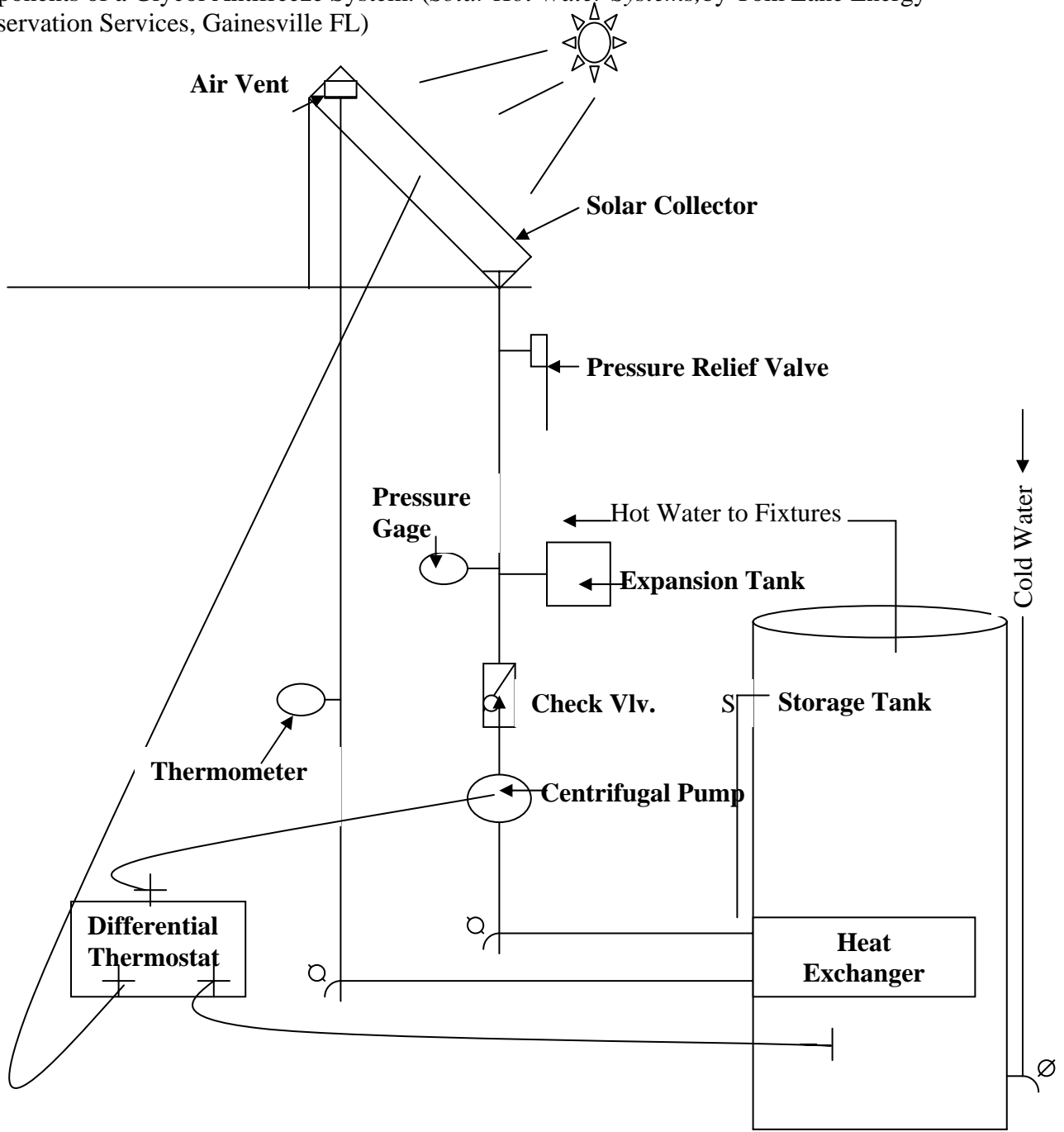
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GRADE: _____

INSTRUCTION SHEET

Pressurized Glycol Systems circulate heated ethyl glycol (antifreeze) from solar collectors through a coil of tubing (a heat exchanger) that's submerged in an insulated storage tank. Many components are required for the proper operation of a Solar Domestic Hot Water System.

Reading Assignment: Read *Solar Hot Water Systems* pages 35-42 to understand the major components of a Glycol Antifreeze System. (*Solar Hot Water Systems*, by Tom Lane Energy Conservation Services, Gainesville FL)



COMPONENTS

Air Vent: The air vent uses a float to allow air to exit while keeping the ethyl glycol within the closed system. An air slug within the system could stop the circulation of antifreeze. *MA Science Frameworks 4.3 Differentiate between open and closed systems*

Check Valve: The check valve prevents any backward flow of antifreeze by gravity.

Differential Thermostat: The differential thermostat senses the temperature at the collector and at the storage tank. When the temperature is higher at the collector than at the storage tank, the control creates a circuit so that the circulating pump moves the antifreeze through the system. *MA Science Frameworks 4.5 Identify tools, and controls in a thermal system*

Expansion Tank: The expansion tank is partially filled with liquid (incompressible) and partially filled with air (compressible). A diaphragm separates the two. When a liquid is heated, it expands. The air compressing inside the expansion tank relieves the thermal expansion of the antifreeze. In this manner, excessive pressure cannot build up within the system. *MA Science Frameworks incompressibility of liquids*

Heat Exchanger: The heat exchanger is a series of loops of copper tubing. The tubing usually has fins. The fins give the tubing a larger surface area. Heated antifreeze is pumped through the inside of the tubing. The tubing is heated and the heat is transferred through **conduction**. The domestic hot water outside of the coil of tubing is heated through this exchange. *MA Science Frameworks 4.1 conduction, and convection*

Solar Collector: The solar collector consists of a network of tubes through which liquid is heated from the **radiation** of the sun. Behind the tubes is insulation. Above the tubing is glass, usually low iron, and tempered, designed to hold in the sun's energy within the collector and to transfer this heat energy through the tubes and absorber plates by **conduction**. *Science Frameworks 4.1 conduction, convection, radiation, re-radiation*

Pressure Relief Valve: The pressure relief valve is held closed by a spring. When dangerously excessive pressures are created, the valve is opened to relieve that excessive pressure.

Storage Tank: The storage tank holds the heated water. It should be sized large enough so that heat energy is maintained through days of low sunlight. With a heat differential of 7 degrees Fahrenheit inside the tank, **convection** will take place. Some alternate heat source should also be included in the design of the system. *MA Science Frameworks 4.1 convection*

Water Pump (circulation pump): The circulating pump is a centrifugal pump. When a circuit is created through the differential thermostat, the circulating pump circulates liquid from the solar collector to the heat exchanger. *MA Science Frameworks centrifugal force*

KNOWLEDGE TEST

Directions

Evaluate your knowledge by achieving “Proficient” on the following question.

Explain how the sun's heat energy (radiation) heats the water that ultimately comes from your tap. Include its passage through all the components of the system.

Grading Rubric

Mastery

Completely accurate account including radiation, conduction, and convection examples

Proficient

Basically accurate account, student lacks a complete understanding of component operation

Needs Improvement

Incomplete data, does not understand the operation of the system