5E Essential Lesson-SC.6.E.7.5

Student:	**Subject/Grade level:** 6
Earth's Weather and Climate – Heat Transfer	**Unit Engaging Question:** What changes might the Earth experience if the amount of the Sun's energy reaching Earth changed?

Summative Assessment:

Write to explain:

How do multiple variables cause uneven heating of the earth?

Criteria	3	2	1
Multiple Variables	Student includes at least three variables	Student includes two variables	Student only includes one variable
Explanation	Student clearly explains how each of the three variables impacts the uneven heating of the earth with examples	Student clearly explains how two of the variables impacts the uneven heating of the earth with examples	Student only explains how one variable impacts the uneven heating of the earth with examples

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EVALUATE - Day 5

How will students demonstrate that they have achieved the lesson objective?

Summative Assessment:

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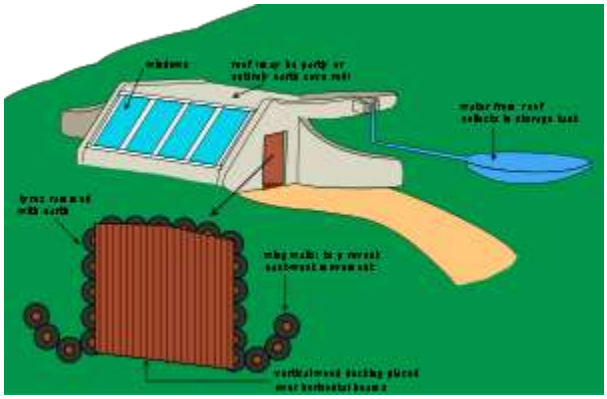
Scroll down for Article and Cornell Notes

What is Earthship?

Earthship



The design used with most earthships. A large series of windows characterise the earthsheltered building and the use of tires

A somewhat customized earthship built at Rio Arriba County, New Mexico, USA and shot from the side

1

An **Earthship** is a type of passive solar homemade of natural and recycled materials. In **passive solar building design**, windows, walls, and floors are made to collect, store, and distribute solar energy in the form of heat in the winter and reject solar heat in the summer. This is called passive solar design because, unlike active solar heating systems, it does not involve the use of mechanical and electrical devices. Designed and marketed by **Earthship Biotecture** of Taos, New Mexico, the homes are primarily constructed to work autonomously and are generally made of earth-filled tires, using thermal mass construction to naturally regulate indoor temperature. In building design, **thermal mass** is a property of the mass of a building which enables it to store heat, providing "inertia" against temperature fluctuations. They also usually have their own special natural ventilation system. Earthships are generally Off-the-grid homes, minimizing their reliance on public utilities and fossil fuels. The term **off-the-grid** (**OTG**) can refer to living in a self-sufficient manner without reliance on one or more public utilities.

2

The original Earthships' designs were at first very experimental, but with practice and evolution the houses began looking attractive.

3

Earthships are built to utilize the available local resources, especially energy from the Sun. For example, windows on sun-facing walls admit lighting and heating, and the buildings are often horseshoe-shaped to maximize natural light and solar-gain during winter months. The thick, dense inner walls provide thermal mass that naturally regulates the interior temperature during both cold and hot outside temperatures.

4

Internal, non-load-bearing walls are often made of a honeycomb of recycled cans joined by concrete and are referred to as tin can walls. These walls are usually thickly plastered with stucco.The roof of an Earthship is heavily insulated – often with earth or adobe – for added energy efficiency.

Systems

5 The Earthship was designed as a structure that would exist in harmony with its environment and be freed from the constraints of modern shelters which rely on centralized utilities. It is important that the Earthship create its own utilities as well as use readily available and sustainable materials. In order to be entirely self-sufficient the Earthship needs to be able to handle the three systems of water, electricity, and climate. While these systems are not exclusive to Earthships, a properly designed Earthship must have these systems.

Climate

6 The interior climate of an Earthship is stabilized and made comfortable by taking advantage of many phenomena. Mainly, the Earthship tries to take advantage of the properties of thermal mass and passive solar heating and cooling. Examples are large front windows with integrated shades, trombe walls and other technologies such as skylights. A trombe wall is a passive solar building technique where a wall is built on the winter sun side of a building with a glass external layer and a high heat capacity internal layer separated by a layer of air. Trombe walls are commonly used to absorb heat during sunlit hours of winter then slowly release the heat over night.

7 The load-bearing walls of an Earthship, which are made from steel-belted tires rammed with earth, serve two purposes. First, they hold up the roof, and second, they provide a dense thermal mass that will soak up heat during the day and radiate heat during the night, keeping the interior climate relatively comfortable all day.

8 In addition to high thermal mass, some Earthships may be earth-sheltered. **Earth sheltering** is the architectural practice of using earth against building walls for external thermal mass, to reduce heat loss, and to easily maintain a steady indoor air temperature. The benefits of earth-sheltering are twofold because it adds to the thermal mass and, if the Earthship is buried deep enough, allows the structure to take advantage of the Earth's stable temperature. The Earthship is designed in such a way that the sun provides heating, ventilation, and lighting. To take advantage of the sun, an Earthship is positioned so that its principal wall, which is nonstructural and made mostly of glass sheets, faces directly towards the equator. This positioning allows for optimum solar exposure.

9 To allow the sun to heat the mass of the Earthship, the solar-orientated wall is angled so that it is perpendicular to light from the winter sun. This allows for maximum exposure in the winter, when heat is wanted, and lesser exposure in the summer, when heat is to be avoided. Some Earthships, especially those built in colder climates, use insulated shading on the solar-orientated wall to reduce heat loss during the night (Reynolds 2000).

Adapted from “What is an Earthship”; Environment and Ecology; http://environment-ecology.com/environment-and-architecture/375-what-is-earthship.html, Aug 11, 2015

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	Topic/Objective:	Name:
	To apply knowledge of transfer of solar radiation in the construction of a Earthship	Class/Period:
		Date:

Essential Question: How does what we know about solar radiation help us to design the most energy efficient Earthship?

Questions:	Notes:
	P 1 – What is the purpose of passive solar design ?
	P1 – How does the property of thermal mass impact a building?
	P 3 – Why is the position of the windows in an Earthship important?
	P 6 – How do trombe walls take advantage of our knowledge of solar radiation?
	P 7 - How does the data gained in the activities support the claims about the second purpose of load bearing walls?
	P 8 – How does the data gained in the activities support the fact that the principal wall faces directly towards the equator.

Summary:

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