ACTIVITY NOTES

SUSTAINABLE ARCHITECTURE - TERRA ENERGY

14 to 16 years old

15 - 20 minutes

Includes:
Teacher Notes
Student Worksheet

EXPO CITY DUBAI

EXPO SCHOOL PROGRAMME

TEACHER NOTES

LESSON SUMMARY

This lesson activity complements Energy and Efficiency topics in high school science curricula. Students analyse energy generation and usage data from Terra, the Sustainability Pavilion at Expo City Dubai to understand how energy is used and ways in which the pavilion uses energy efficiently.

EXPO CITY DUBAI CONNECTION

The Sustainability Pavilion, named Terra (meaning Planet Earth,) brings Expo City Dubai's commitment to sustainability to life, acting as a catalyst for change in the UAE, the region and globally.

Terra fuses sustainability with technology, exemplifying the solution-creating capabilities of a smart, sustainability-driven city that is informed by science and demonstrating how we can live in harmony with nature and with each other.

Energy is generated through photovoltaic panels, 4,912 of which are arranged on a 130-metre-wide roof canopy and a series of 18 'Energy Trees' that rotate to face the sun, like sunflowers.

Other design features include:

- The solar roof acts as a giant shade to reduce the sun's heating effect
- The funnel shape of the pavilion canopy creates air flows that naturally ventilate the pavilion courtyard, and let in ambient light, further reducing energy requirements
- Energy is also saved by burying much of the occupied spaces below the ground and providing thick, insulated walls with minimal glazing

LEARNING OBJECTIVES

- Understand how innovative architecture can lead to the development of net-zero carbon buildings which generate their own power
- Analyse energy usage data to understand how energy is consumed by a building

MATERIALS/ RESOURCES REQUIRED

- Worksheet

ACTIVITY OVERVIEW

The main diagram shows where energy is created (left side of the diagram) and how energy is consumed (right side of diagram). It is important to note that, because of the environmental impact of battery production, Terra does not have battery storage for power at night.

The building, therefore, relies on the national grid for surplus energy requirements during the day and for night time use . To achieve net-zero energy, Terra must produce as much renewable energy as it takes from the grid.

Answers to the Questions:

1 ▪ a ▪ (5,000 + 2,000 =) 7,000 units of energy

b ▪ (2,500 + 1,600 + 1,200 + 1,200 + 600 + 1000 units needed during the day =) 7,100 units

c ▪ No – Terra has used 100 more units of energy from the national grid than it generated from the solar cells

2 ▪ From the diagram, most of the energy is used for cooling and ventilation. The daily power demand on cooling and ventilation is much higher in the Summer months than in the Winter, however, less energy is generated in the Winter months.

3 ▪ The amount of energy generated relies on peak sunlight hours. Daily fluctuations occur due to cloud cover and dust build up on the solar cells. Fluctuations also occur over the course of the year as the solar radiation is more intense in the Summer with longer hours of daylight.

4 ▪ Building the pavilion underground reduces the amount of heat conducting through the walls of the pavilion, making the inside of the building naturally cooler. Thick insulation on the walls provides further protection against heat entering the building from outside.

5 ▪ The double doors create an insulating layer of air between the inside and outside of the pavilion, this reduces the amount of cool air leaving the pavilion when the doors open, therefore, reducing the amount of energy used in cooling and ventilation.

DID YOU KNOW?

More information on the UAE's 2050 Net Zero target can be found by watching this video or following this link