

Western Engineering Outreach

Homes for Different Climates

Grade 6-8

Meet Today's ENG HERO!



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Ayman El Ansary is an Assistant Professor in Civil and Environmental Engineering at Western University. Dr. El Ansary's research interests lie in the area of Structural Engineering and Engineering Optimization. His main fields of expertise include response of structures to seismic and wind loading, analysis and stability of liquid-storage tanks under hydrostatics and hydrodynamic loading, and structural shape optimization. To learn more about Dr. El Ansary, please visit:

https://www.eng.uwo.ca/civil/faculty/el_ansary_a/index.html

Learning Goals:

- Explain why engineers design different types of homes in different locations (to meet the needs of various climates).
- Give several examples of different home designs engineers might use for different climates (such as thick walls for desert climates, peaked roofs for snowy areas, elevated foundations for tropical climates).
- Explain the wide range of building materials used to construct homes in different climates (to take advantage of local materials and labor).
- 6 to 8- Understanding Earth and Space Systems, Heat in the Environment 1.1 assess the social and environmental benefits of technologies that reduce heat loss or transfer (e.g., insulated clothing, building insulation, green roofs, energy-efficient buildings)

Materials:

- Laptops for research
- Cardboard
- Popsicle sticks
- Hay or grass
- Pebbles
- Sugar cubes
- Tape
- Scissors
- Glue
- Clay
- Construction paper

For testing

- Bin and cup to pour water on the house
- Hair dryer for wind and heat
- Pebbles for earthquake



Engineering and Science Connections:

Background:

Climate is defined as weather over a long period of time, and a climate zone is a region with the same climate. The Köppen climate classification system defines in great detail the world's climates, including five major climate types: moist tropical, dry, humid middle latitude, continental, and cold. China contains all these basic types.

Moist tropical climates are known for high temperatures year round and for a large amount of year round rain.

Dry climates are characterized by little rain and a huge daily temperature range. Two subgroups, are semi arid or steppe, and arid or desert. In humid middle latitude climates land/water differences play a large part. These climates have warm, dry summers and cool, wet winters. Continental climates can be found in the interior regions of large land masses. Total precipitation is low and seasonal temperatures vary widely. Cold climates are areas where permanent ice and tundra are always present. Only about four months of the year have above freezing temperatures.

These categories are further subdivided based on temperature and precipitation in different seasons, and then a third level of subdivisions for more climate variations. Names for different types of climates include tropical, rainforest, savanna, temperate, subtropical, desert, steppe (or grassland or prairie), chaparral (or forest or woodland or scrub), grassland, deciduous forest, taiga (or subarctic or Boreal), tundra and alpine (or mountain or high plateau).

In all climates, unique design strategies are employed to create houses that work best for the local environmental conditions. For example, making thick walls for insulation in severely hot climates; peaked roofs to shed heavy snow loads; raised foundations for perpetually wet or often flooding climates (and to catch cooling breezes under the house); partially underground sod-roofed homes for warmth in severe cold; temporary tent homes made of poles, hides, cloth and carpets for people that move seasonally; basements and root cellars for seasonal food storage and protection from tornados.

Not every climate has trees from which to build housing, but every climate has some local resources that can be used, everything from stones to bamboo to clay to sod to animal hides to snow to wool to dried grasses! Part of understanding and building in a certain climate is investigating its resources for housing materials.

To do a good job designing homes that work well in different climates, engineers must investigate and ask: What are the expected weather conditions for the region, year round? What design strategies might protect people from those weather conditions? What are available construction materials and labor?

Activity:

Intro:

People in different parts of the world have different materials that they can use to build their homes and other structures. When building a home, they think about how to best use these materials to build a house that works well for where and how they live. In the southwestern part of the US, where people have a lot of clay and little wood, they build houses from adobe, a mixture of clay, straw and water.



An example adobe house.

Adobe houses have very thick walls that keep them cool in the hot dry desert weather. Adobe houses would not be good in places where it rains a lot because too much water makes adobe crumble. The weather in certain tropical islands in the Pacific ocean is hot, but wet. People there make their homes from materials that are easy to find, such as palm leaves, woven grasses and bamboo. Sometimes they build the houses on stilts to keep them off the wet ground and let the breezes move under the house, helping to keep it cool.



An example igloo.

Homes for Different Climates

In ages past, the Inuit in Alaska and Canada built their houses out of sod or snow. These dome-shaped houses are called igloos. The dome shape of the igloo makes it very strong and able to withstand powerful winter storms. Some Indigenous peoples built dome-shaped houses made of poles, leaves and tree bark. These houses were called wigwams. Indigenous people tribes that moved a lot often built cone-shaped tepees using buffalo skins or bark. Tepees could be easily built and taken apart quickly. Some Indigenous peoples lived in more permanent structures called lodges made from logs and sod.



A stone house with a sod-covered roof, and a house structure made of wood.

When early American settlers came to New England, they found the ground covered with large stones. They used these stones to build houses and walls that you still see in New England today. The northwest part of the US and Canada has plenty of forests, so most houses in these areas are made of wood. In areas of China with few forests, it is rare to have a wooden house. Instead, the Chinese people use tile, concrete and stone to build beautiful pagodas and other structures.



An example pagoda.

Homes for Different Climates

In parts of Africa, where tall grasses grow, people weave the stems of dried grass together to make thatch huts. In Tibet, some people even make their houses out of wool! They shear the wool from ox-like animals called yaks. The wool walls keep the houses warm through the cold winter months. Most houses in the US today are built of wood, brick, stone, concrete, aluminum or even glass!



An example teepee.

Engineering Design Challenge:

Plan:

1. Think about why people need houses, what materials are needed to build a house, and what the various parts of a house include.
2. Choose an environment where you want to build your house. Try to figure out what type of climate your house must be able to handle in that environment.
3. Design and sketch a house to withstand that climate.

Build:

1. Build your designs with the available materials. Construct your house on an 8.5 x 11 platform

Test:

1. Test the house against the elements that would be appropriate for the climate you built your house to withstand.
2. Adjust your house to add things that will help protect it in that environment once you see the results of the testing

What Did You Learn?



- All about the different types ways that climate effects the designs of the houses in those areas
- Which materials are used in different climates to protect against different things in their environments

Future Learning



- What are some other structures whose designs are impacted by the environments they are built in?
- Investigate these further by learning about tornado shelters, bunkers, and other structures that are built to protect people from the environment

Share your creations!

We would love to see what you made. Email as at discover@uwo.ca or tag us on social media.

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Thanks for discovering with us!