



Module 3, Investigation 2: Briefing 1

What's hot at the mall?

Background

This investigation examines how shopping malls change natural environments.

NASA scientists have been studying how hot it gets around shopping malls. Wherever malls are built trees and wildlife habitat are lost. Malls use a lot of land, stand out on the landscape, and are visible on aerial photos and satellite images.

Vegetation shades areas, preventing a build up of heat. Trees absorb and use the Sun's energy for photosynthesis. The loss of vegetation in built-up and paved areas causes the formation of hot spots. Heat builds up during the day because the Sun's energy is retained by buildings and pavement. This causes surface temperatures and the surrounding air temperature to rise. Much of this stored-up heat is released at night.

On a hot summer day we may feel a blast of heat when we walk from an air-conditioned mall across an asphalt parking lot to our car. The heat rises from the pavement to meet us and warms us all the way across the lot. While we shopped, our car absorbed the Sun's rays and heated up. During the summer, temperatures in parking lots are as high as 49°C (120°F). When you add up all the heat from parking lots, buildings, cars, and roads, and remove the trees that might soak up the heat and keep things cool, it is no wonder that temperatures rise in built-up areas.

Objectives

In this investigation you will

- identify topics that NASA scientists study;
- explain why NASA scientists are interested in studying malls;
- correctly identify a mall on the Huntsville, Alabama, thermal image;
- distinguish between hot and cool areas on thermal images; and
- explain some of the environmental consequences of constructing a shopping mall.

Procedures for the Investigation

You will consider environmental changes caused by shopping malls by examining thermal images gathered by NASA showing an area in Huntsville, Alabama. A thermal image shows differences in temperature on Earth's surface. You may be working alone or in groups to complete Logs distributed by your teacher.

References

Geography for Life: National Geography Standards 1994

http://science.msfc.nasa.gov/newhome/headlines/essd08may97_1.htm

Background on Huntsville and features of the Madison Square Mall vicinity was provided by Blaine Adams, geography graduate student at Virginia Tech and native of Huntsville, Alabama



Module 3, Investigation 2: Log 1

What's hot at the mall?

The construction of a mall affects the surrounding environment. Malls sometimes replace ecosystems such as forests, wetlands, or open grasslands. These ecosystems provide habitats for wildlife and play an important role in pollution control.

Identify what happens to the following environmental features when a mall is built. An example is provided for #1.

1. Land and soils

A mall will cover a lot of soil with buildings and pavement. Rainwater cannot soak into the pavement and may run off to nearby land, causing erosion.

2. Forest and vegetation

3. Wildlife habitats

4. Streams and drainage patterns

5. Temperature of air and ground



Module 3, Investigation 2: Figure 1

What's hot at the mall?



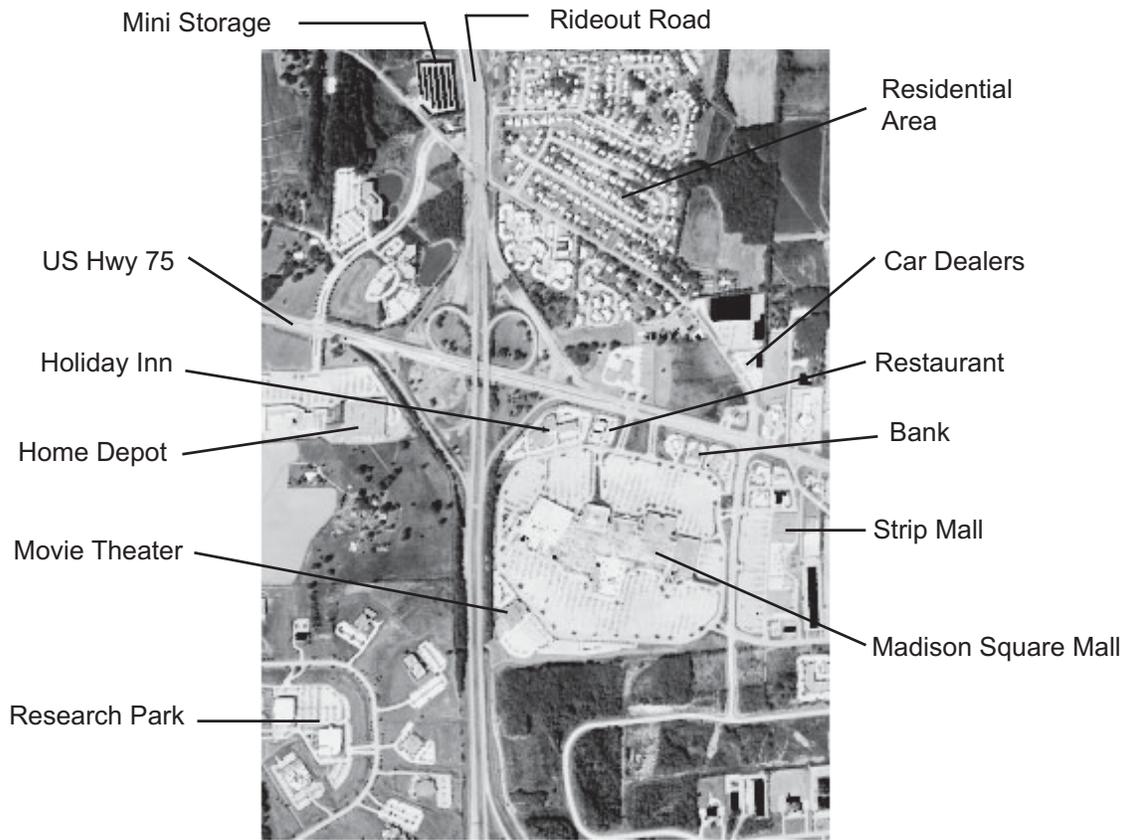
Source: http://science.msfc.nasa.gov/newhome/headlines/atlanta/hsv_IR.gif



Module 3, Investigation 2: Figure 2

What's hot at the mall?

Huntsville, Alabama, by day





Module 3, Investigation 2: Log 2

What's hot at the mall?

Now that you have considered some of the environmental effects of malls, examine the daytime thermal image of Huntsville. In the thermal image, warmer temperatures are represented by lighter shades of gray and white, and cooler temperatures by darker shades. Use Figures 1 and 2 to answer the following questions.

1. What is the largest warm feature on the image?

2. What is the largest cool feature on the image?

3. Why are some areas warmer than other areas? For example, why is the shopping mall parking lot warmer than the trees and grassy areas in the highway cloverleaf?

4. Can you find any cool spots in the mall parking area? What causes those cool spots?

5. Do you have any suggestions for making the parking areas cooler during the day?



Module 3, Investigation 2: Briefing 2

What's hot at the mall?

It is important to understand that just as much sunlight falls on cities as on woodlands of the same size. The difference is in how urban materials react to solar energy. Asphalt in parking lots and on rooftops, in particular, soaks up heat and reradiates it as thermal infrared radiation.

On the other hand, water absorbs a large amount of heat before its temperature rises, and it takes a long time to release it. That means that trees, which have a large water content and release water into the atmosphere to keep cool, absorb a lot of the incoming heat and release it over a longer period of time.

The temperature differences shown in the image are related to how materials absorb and release heat. Asphalt absorbs heat from the Sun and quickly releases it as heat radiation. Temperatures in the parking lot during summer are as high as 48.9°C (120°F) during the day, while tree islands in the lot are only 31.7°C (89°F)—a difference of 17.2°C (31°F)! At the same time nearby wooded areas are as low as 29.4°C (85°F). High daytime temperatures result in the parking lot cooling to only 23.9°C (75°F) at night. The tree islands and the woods are much cooler at 17.2°C (63°F). Even grassy areas near the woods are hotter than the woods because the meadow has less vegetation and shade.

Edited excerpt from *Research at NASA's Global Hydrology and Climate Center*
http://science.msfc.nasa.gov/newhome/headlines/essd08may97_1.htm



Module 3, Investigation 2: Log 3

What's hot at the mall?

Now that you have considered how to interpret a thermal image, read the NASA research handout Briefing 2 provided by your teacher.

After reading it, look at Figure 3, the day and night thermal images of the individual tree in a parking lot. Notice that the tree produces a shaded, cool area. In the night image, notice that the tree's leaves become so cool that they become nearly invisible.

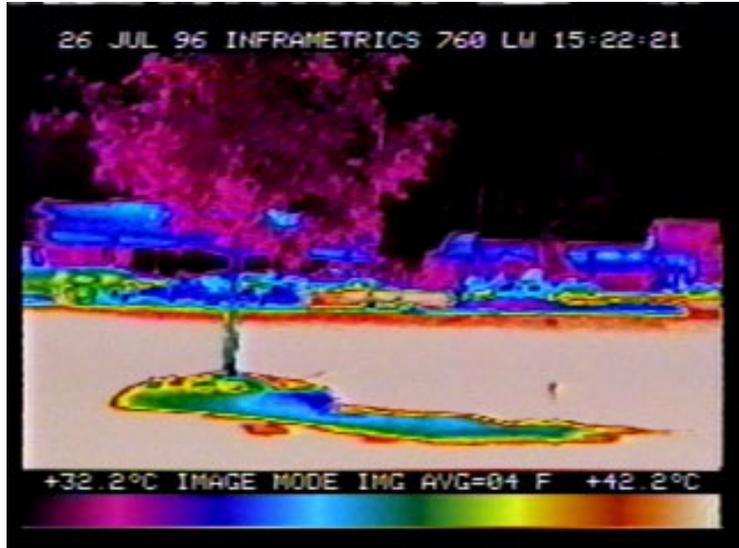
Now that you know about the effects that trees have on surface temperatures, consider how the temperatures of areas around a mall might be reduced if more trees were planted.

Using the Huntsville Madison Square Mall as a model, develop a sketch map of the ideal placement of trees in the parking areas. Use a large piece of paper so that you have plenty of space to draw your map. Keep in mind some of the disadvantages of having a large number of trees and vegetation around a shopping mall. For example, trees may reduce visibility, attract birds and other animals, and contribute to the loss of valuable parking spaces. When you share your map with others, be ready to explain why you located trees in certain sites and not in others.

Discussion Question

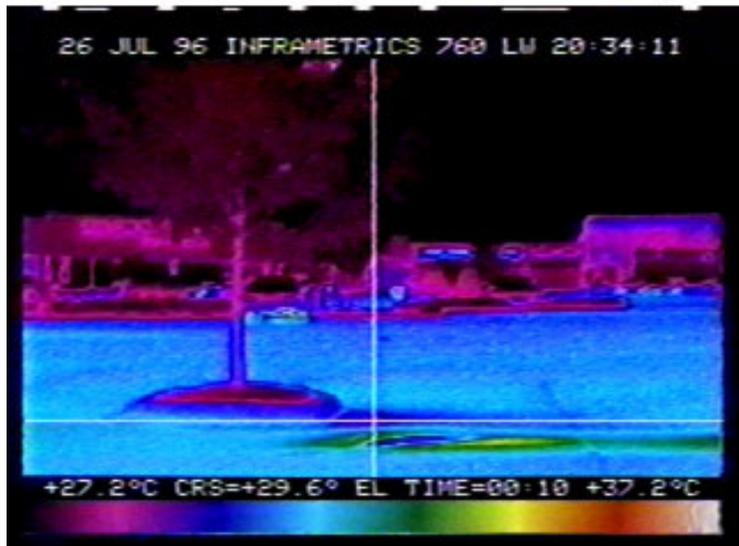
How would a new mall built across the street from your house affect your local environment? Write a brief answer on this sheet.

Figure 3: A tree in a parking lot



Day

Night



The color images are found at this NASA site:

http://science.msfc.nasa.gov/newhome/headlines/essd08may97_1.htm