

## **Grade 8 Science Unit: Environmental Issues: Land Use Change Instructional Sequence**

### **Day 1**

Pretest

**Materials Needed:**

Land Use Change Unit Assessment [LUC\_Unit\_Assessment.pdf]

## Day 2

***Students will examine the significance of the location of shopping malls. Huntsville, Alabama, is used as an example to illustrate that different human activities have different location requirements.***

Refer to Mission Geography Module 3, Investigation 1 for content background information and more details.

1. Have students develop a list of different topics that they think NASA scientists are studying. Share the list with the class. Discuss the topics presented and have students identify which topics are local issues and which may be global issues.
2. Using this discussion as a starting point, explain to students that NASA scientists study many different topics and use photos and data gathered by airplanes as well as images and data gathered by satellites. Sometimes the topics that NASA scientists study are very important in local communities. In all locations, it is important for us to know how human activities affect the use of land.
3. Open the discussion of the impact of shopping malls on the landscape by asking students to write some reasons why it is important to have convenient places to shop. List the reasons on the board or overhead transparency.
4. Ask students to identify some advantages and disadvantages of walking versus driving to shopping places. Discuss the differences between walking to shopping places and driving to shopping places.
5. Ask students to read the **Briefing** on malls and distribute **Log 1**. Small groups may discuss the questions and complete the rankings of land uses most important for malls to be near. Display group responses.
6. Distribute **Log 2**. Ask students to complete the activity ranking the features that are most important and least important to the location of community facilities (sports stadium, airport, high school, fire station, and hospital). Discuss the results.

### **Materials Needed:**

Mission Geography Module 3, Investigation 1: Briefing Handout (one copy of each per student)

[MG\_logs\_activity1a.pdf]

Mission Geography Module 3, Investigation 1: Log 1 Handout (one copy of each per student)

[MG\_logs\_activity1b.pdf]

Mission Geography Module 3, Investigation 1: Log 2 Handout (one copy of each per student)

[MG\_logs\_activity1c.pdf]

### **Assessment information:**

Mission Geography Module 3, Investigation 1: Logs 1 and 2 Assessment [MG\_logs\_assessment1.pdf]

### **Teacher Resources:**

Mission Geography Module 3, Investigation 1 [MG\_mod3-1.pdf]

## Day 3

**Students will examine the land use around a mall area. They will investigate human-built and natural features in the area surrounding the Madison Square Mall in Huntsville, Alabama.**

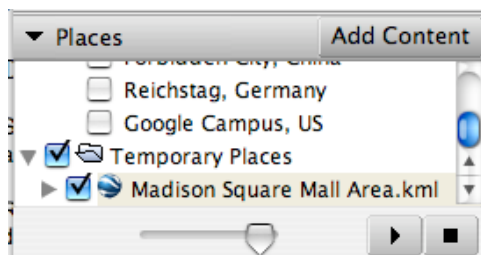
### Helpful implementation idea:

Prior to class, be sure that the Google Earth application is ready to use on students' computers. It is important to test out the KML file on each computer to ensure that students will be able to view the coverage area. Often, classroom computers may use Google Earth for other investigations that involve layers that cover other "checked" layers. These "covering" layers should be deleted or unchecked prior using the Land Use Change files to minimize potential issues that may occur with students viewing the Land Use Change curricular files.

1. Distribute the handout: **Let's Go to the Mall!** to each student.
2. Instruct students to open the **Madison Square Mall Area.kml** in Google Earth. Display the image in front of the classroom. Ask students to identify the feature that is most likely a mall. Tell students to look for human-built features and natural features in the Madison Square Mall area. Have them record their observations on the handout.

### Helpful implementation idea:

Show students that when they download a KML file from the Internet, it is placed on to their computer's desktop and the Google Earth application will launch automatically. Google Earth will add the file name as a layer in the "**Temporary Places**" folder in the **Places** window. See image below. Show students that if they zoom-in or pan around the viewer window and get lost, they can double click on the file name in the **Places** window to return to the original location.



3. Have students use Google Earth to identify the 14 features noted on the handout. Tell students they might need to zoom-in closely to identify each feature.
4. After students have completed their feature identifications, review the identity of each feature with Google Earth at the front of the classroom. Have students articulate visual evidence to support their identification claims. When possible, prompt students to identify differences with respect to tone, size, texture, pattern, shadow, site, and association in the image.

### Helpful implementation idea:

Note that lower-level learners or classes with large numbers of students with disabilities might need additional modeling and scaffolding with hints and prompts to identify features. Going through each feature identification one at a time with these students, using prompts to highlight specific image features with a projected computer image is an effective instructional strategy.

### Materials Needed:

Handout: Let's Go to the Mall! – (Mall Activity 1) (one copy of each per student) [Mall\_activity1.pdf]  
 Google Earth file: Madison Square Mall Area.kml

**Assessment information:**

Let's Go to the Mall! – (Mall Activity 1) Assessment [Mall\_activity1\_assess.pdf]

## Day 4

***Students will examine the land use around a mall area. They will investigate human-built and natural features in the area surrounding the Madison Square Mall in Huntsville, Alabama. They will use basic elements of aerial photo interpretation (including tone, size, texture, pattern, shadow, site, and association) to aid in identifying objects in aerial photographs.***

1. Display the **Madison Square Mall Area.kml** file in Google Earth. Ask students to recall specific features they identified in the previous day's lesson. Have students articulate visual evidence to support their identification claims. When possible, prompt students to identify differences with respect to tone, size, texture, pattern, shadow, site, and association in the image.
2. Instruct students to answer the **analysis** question. Ask students to think about what the land around the mall may have looked like before the mall was built. Prompt students to think about what the land may have looked like in their neighborhood before houses and streets were built. Discuss student responses to this question. Note to students that most land in this area was either previously woodlands or cropland. Note the forested just south of the mall to students as possible evidence.
3. Have students complete the remainder of the **Let's Go to the Mall!** handout.
4. Review answers with students.
5. Handout **Basic Elements of Aerial Photo Interpretation**. Have students read the handout.
6. Display the image of the image of the Madison Square Mall area (**Madison Square Mall Area.kml**) in Google Earth. Have students identify and discuss an example of tone, size, texture, pattern, shadow, site, and association from the image.  
For shadows, it is recommended to talk about the shadows produced by trees in the mall parking lot.

Extension activity: Have students click the "**Places of Interest**" layer on Google Earth and identify specific locations on the Google Earth image.

### **Materials Needed:**

Handout: Let's Go to the Mall! – (Mall Activity 1) (one copy of each per student) [Mall\_activity1.pdf]  
 Handout: Basic Elements of Aerial Photo Interpretation [Air\_Photo\_Interpretation.pdf]  
 Google Earth file: Madison Square Mall Area.kml

### **Assessment information:**

Let's Go to the Mall! – (Mall Activity 1) Assessment [Mall\_activity1\_assess.pdf]

## Day 5

***Students will investigate how shopping malls change natural environments. Students will study a mall and its immediate surroundings to understand concepts involved in the formation of urban heat islands.***

Refer to Mission Geography Module 3, Investigation 2 for content background information and more details.

1. Distribute Module 3, Investigation 2: **Briefing 1** and have students read the Background, Objectives, and Procedures.
2. Distribute **Log 1** and ask students to consider how the construction of a mall affects the surrounding environment. For example, 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. Have students identify what will happen to the environmental features listed in the Log when a mall is built.
3. Instruct students to open the **Madison Square Mall Area.kml** file in Google Earth. Display the image in front of the classroom. Explain to students that this is the aerial imagery of the area around the Madison Square Mall area in Huntsville, Alabama. Next, handout **What's Hot at the Mall?** Explain to students that the image on the handout is a **thermal image**. In **the thermal image, warmer** temperatures are represented by **lighter shades of gray and white**. **Cooler temperatures** are represented by **darker shades**. Instruct students to complete the handout.
4. After students have completed the handout, display the thermal image at the front of classroom and review student responses. Discuss how heat is absorbed and reradiated more on certain surface materials such as pavement and asphalt when compared to natural wooded areas of trees that release heat over a much longer period of time. Explain this why it feels very hot when you get out of your car on a hot sunny day at the mall and much cooler by a tree.

### **Materials Needed:**

Mission Geography Module 3, Investigation 1: Briefing Handout (one copy of each per student)  
[MG\_logs\_activity2a.pdf]  
Mission Geography Module 3, Investigation 1: Log 1 Handout (one copy of each per student)  
[MG\_logs\_activity2b.pdf]  
Handout: What's Hot at the Mall? [Mall\_activity2.pdf]  
Google Earth file: Madison Square Mall.kml

### **Assessment information:**

Mission Geography Module 3, Investigation 1: Log 1 Assessment [MG\_logs\_assessment1.pdf]  
Handout: What's Hot at the Mall? [Mall\_activity2\_assess.pdf]

### **Teacher Resources:**

Mission Geography Module 3, Investigation 2 [MG\_mod3-2.pdf]

## Day 6

***Students will be introduced to the main reasons an urban heat island occurs. Students will explain how communities can use certain heat island reduction strategies to reduce the impact of an urban heat island effect.***

### **Prior to class:**

Prepare an overhead transparency of the **Temperatures with Infrared Thermometer Data Chart** located in Teachers Resources.

### **At the beginning of class:**

Select two students to go outside with the infrared thermometer to obtain temperatures with an infrared thermometer of asphalt in sun, asphalt in shade, concrete sidewalk, grass in the sun, and grass in a shaded area under a tree. Have students record the data on the overhead transparency of the **Temperatures with Infrared Thermometer Data Chart**.

### **Important information:**

Data taken on a cloudy day without the sun present may produce mixed results in the data taken with the infrared thermometer.

1. Begin class by asking students why it feels hot when they get out of a car on a hot sunny day at the mall. Next, ask them why it feels much cooler by a tree.
2. Introduce the concept of urban heat islands by showing the EPA video clip, **Urban Heat Island Effect - Mitigation**. Prior to showing the video clip, ask students to focus on the following questions:
  - What is an urban heat island effect?
  - What causes an urban heat island effect?
  - How can cities reduce an urban heat island effect?

Show the video clip. After showing the video clip, discuss the above questions.

3. Handout **Urban Heat Islands** to students. Explain the graph of the **urban heat-island profile**. Emphasize to students that trees absorb the same amount of heat as to other surfaces found in cities, but release it over a longer period of time through the process of **evapotranspiration**.
4. Handout the **Understanding Urban Heat Islands** worksheet. Instruct students to read the **Urban Heat Islands** handout in order to complete the **Understanding Urban Heat Islands** worksheet.
5. As a class, review responses to the **Understanding Urban Heat Islands** worksheet. Be sure to discuss the last question. Emphasize that using a combination of heat island reduction strategies will most effectively reduce a city's temperature.
6. Show students the infrared thermometer. Explain how it uses a laser to measure the amount of infrared energy emitted by an object to determine its temperature.
7. Display the completed **Temperatures with Infrared Thermometer Data Chart**. Review the temperatures of the different outdoor materials.

### **Materials Needed:**

Handout: Urban Heat Islands [Urban\_heat\_islands.pdf]

Handout: Understanding Urban Heat Islands [Heat\_islands.pdf]

Video Clip: Urban Heat Island Effect – Mitigation [heat\_island.mov] (2 minutes)

Infrared Thermometer

**Teacher Resources:**

Temperatures with Infrared Thermometer Data Chart [ir\_temps.pdf]

**Assessment information:**

Understanding Urban Heat Islands Assessment [Heat\_islands\_assess.pdf]

## Day 7

**Students will investigate the formation of urban heat islands. Atlanta, Georgia will be used as a case study. Students will use satellite images of downtown Atlanta and its suburbs to examine temperature patterns of these areas.**

Refer to Mission Geography Module 3, Investigation 3 for content background information and more details.

1. Display the **sketch of an urban heat-island profile** to the front of the class. Ask students what causes the formation of urban heat islands. Emphasize that materials used to develop roads and buildings such as asphalt absorb more heat compared to trees and grasses.
2. Instruct students to open the **Downtown Atlanta.kml** file in Google Earth. Display the image in front of the classroom. Tell students this is the downtown area of Atlanta, Georgia and is considered a densely populated urban city center. Ask students to describe the land cover features in the aerial image. Prompt students with the following questions:  
*Do you observe more building and roads or more forested or farmland area?* (Buildings and roads)  
*If you walked on the streets in the downtown area on a summer day, what would the temperature feel like?* (Hot).  
*Why?* (Heat is being absorbed from the sun and reradiated).  
*Where might you find "cool areas" in downtown Atlanta?* (Shadows of buildings, under trees).  
 Prompt students to identify and discuss examples of tone, size, texture, pattern, shadow, site, and association in the aerial image. Highlight specific examples as needed to illustrate each element.
3. Instruct students to open the **Suburban Atlanta.kml** file in Google Earth. Display the image in front of the classroom. Tell students this is aerial image includes part of Atlanta, Georgia and its suburbs. Ask students to describe the land cover features in the aerial image. Prompt students to identify and discuss examples of tone, size, texture, pattern, shadow, site, and association in the aerial image. Highlight specific examples as needed to illustrate each element.
4. Distribute the handout, **Atlanta Case Study** to each student. Instruct students to read top paragraphs. Display the "Downtown Atlanta Day Temperature" and "Atlanta Suburban Day Temperature" thermal images to the front of the classroom (from **Thermal Data Images: Atlanta Case Study**). Have students complete the questions #1-4. Discuss answers after students have had time to complete these questions.
5. Display the "Downtown Atlanta Day Temperature" and "Downtown Atlanta Night Temperature" thermal images to the front of the classroom (from **Thermal Data Images: Atlanta Case Study**). Have students complete questions #5-7. Discuss answers after students have had time to complete these questions.

### Materials Needed:

Sketch of an urban heat-island profile image

Handout: Atlanta Case Study [Atlanta\_Case\_Study.pdf]

Thermal Data Images: Atlanta Case Study Web site or handout [Thermal\_Data\_Images\_ACS.pdf]

Google Earth file: Downtown Atlanta.kml

Google Earth file: Suburban Atlanta.kml

### Assessment information:

Atlanta Case Study Assessment [Atlanta\_Case\_Study\_assess.pdf]

### Teacher Resources:

Mission Geography Module 3, Investigation 3 [MG\_mod3-3.pdf]

## Day 8

***Students will interpret land use maps of the greater Atlanta area to understand environmental issues that are typically associated with sprawl.***

Refer to Mission Geography Module 3, Investigation 3 for content background information and more details.

1. Distribute the handout, **Atlanta Case Study** to each student. Instruct students to read the opening paragraph of **Part 2: Using Land Use Maps to Examine Sprawl**. Have students complete questions #1-3. Discuss the answers when finished.
2. Display the **Atlanta Case Study: Land Use Classification Maps**. These maps show the land use for the metropolitan Atlanta area for the years 1973, 1983, 1992, and 1997. Review the key with the students. Forested areas are green, farmland areas are yellow and water is blue. Red and orange points indicate areas of population densities. Instruct students to complete questions #4-7.
3. Instruct students to open the **Atlanta Area.kml** file in Google Earth. Display the image in front of the classroom. Show students how to turn on the road layer. Explain to students that this is the greater metropolitan area of Atlanta. Show students how to use the **Ruler tool** to measure distances in a straight line and for a path for Interstate 285. Instruct students to identify the locations of the interstate highways in and around the city, explore the land uses around these interstates, and complete questions #8-9.
4. Review student answers in a whole class setting for **Part 2: Using Land Use Maps to Examine Sprawl**. Display the **Atlanta Case Study: Land Use Classification Maps** in the front of the class and point out observable data patterns to students to reinforce image data interpretation and land use change patterns over time.

### **Materials Needed:**


Atlanta Case Study: Land Use Classification Maps Web site or handout [Land\_Use\_Maps\_ACS.pdf]  
Google Earth file: Atlanta Area.kml

### **Assessment information:**

Atlanta Case Study Assessment [Atlanta\_Case\_Study\_assess.pdf]

## Day 9

***Students will interpret features in aerial photographs of the Lehigh Valley area. Students will examine the significance of the location of shopping malls in the Lehigh Valley area. Students will examine and compare the land use around five mall areas in the Lehigh Valley.***

1. Display the Lehigh Valley area image (**Lehigh Valley Area.kml**) in Google Earth to the front of the classroom. Show students how to use the **Ruler tool**  to measure the distance from North to South and East to West. Measure these distances to show students they are looking at an area approximately 34 miles north-to-south and 35 miles east-to-west. 1190 square miles.

2. Have students load the **Lehigh Valley Area.kml** file in Google Earth on their computers. Tell students not to zoom in on any features.

3. Ask students to identify prominent features in the aerial image based on tone, size, texture, pattern, site, or association from the image. Have students come up to the projected image to note these. For each feature ask students to make an attempt to identify the feature. Ask them to support their claim with evidence.

If students are having a hard time, point to the following prominent items and ask students what they think they might be:

- The Lehigh River
- The Delaware River
- Tan colored geometric areas that are likely farmland
- Green areas (these may be grass lawns in neighborhoods or golf courses)
- Interstate I-78
- The Kittatinny Ridge

See **Prominent Features in the Lehigh Valley Area** for examples.


4. Open the **Lehigh Valley Area Malls.kml** file in Google Earth. Display the image in front of the classroom. This KML file contains placemarks for 5 shopping malls in the Lehigh Valley area (Lehigh Valley Mall, Westgate Mall, Palmer Park Mall, South Mall, and Promenade Shops Mall. The Promenade Shops Mall is a newly constructed mall.

(Please note: The aerial photo of the location of the Promenade Shops Mall in Google Earth may only show the site location, and not the actual mall).

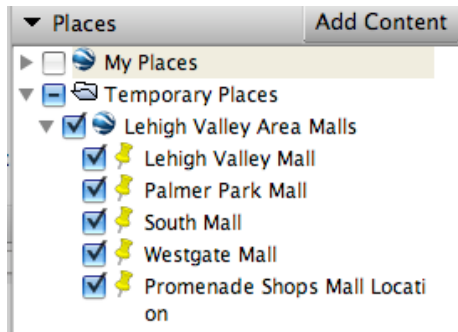
Use the **Ruler tool** to measure the distance from North to South and East to West. Measure these distances to show students they are looking at an area approximately 17 miles north-to-south and 17 miles east-to-west. 289 square miles.

More features will be prominent at this scale of the photograph. Students may notice the cities and towns along the Lehigh River. Emphasize to students the importance of using different scales for identifying features.

5. Tell students they will be investigating the land uses around the malls in the Lehigh Valley area.

Play the tour of the Lehigh Valley Area Malls for the students. (Click the **Play icon**  under **Places**).

6. Instruct students to open the **Lehigh Valley Area Malls.kml** file in Google Earth. Show students how to move from one mall to the next by extending the Lehigh Valley Area Malls drop-down list and clicking on a specific mall name.



7. Handout **Exploring the Mall Areas of the Lehigh Valley Area** to students. Review the table in the handout.

8. After students have completed the handout, review student responses in a whole class setting. For question #7, suggest to students that building a shopping mall on a brownfield site, an abandoned industrial site, would likely have the least impact on the environment.

**Materials Needed:**

Google Earth file: Lehigh Valley Area.kml

Google Earth file: Lehigh Valley Area Malls.kml

Handout: Exploring the Mall Areas of the Lehigh Valley Area [Exploring\_LV\_Malls.pdf]

Teacher Resource: Prominent Features in the Lehigh Valley Area [Features\_Lehigh\_Valley\_Area.pdf]

**Assessment information:**

Exploring the Mall Areas of the Lehigh Valley Area Assessment [Exploring\_LV\_Malls\_assess.pdf]


## Day 10

**Students will identify man-made and natural features in the Lehigh Valley. They will provide evidence (tone, size, shape, texture, pattern, shadow, site, and/or association) to support their identifications.**

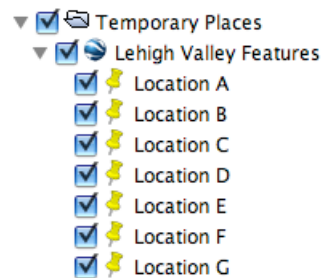
1. Tell students they will be using aerial images in Google Earth to identify land features in the Lehigh Valley area.

2. Ask students: *How can you identify objects in aerial photographs?* Review elements can be used to identify objects in aerial photographs: **tone, size, shape, texture, pattern, shadow, site, and association**. Have students refer to the handout: *Basic Elements of Aerial Photo Interpretation* for review if needed.

3. Display the **Lehigh Valley Features.kml** file in Google Earth to the front of the classroom. Tell students that this file contains the locations of 21 features in the Lehigh Valley area. For each location, they will have to determine if it is manmade or natural feature. They will try to determine what the feature might be by providing evidence to support their claim.

4. Play the tour of the Lehigh Valley Area Features for the students. (Click the **Play icon**  under **Places**).

5. Instruct students to open the **Lehigh Valley Features.kml** file in Google Earth. Show students how to move from one location to the next by extending the Lehigh Valley Features drop-down list and clicking on a specific location.



6. Handout **Identifying Land Features in the Lehigh Valley Area** to students. Read the directions. Have students open the **Lehigh Valley Features.kml** file in Google Earth. Have students view **Location A**. Discuss the completed example on the handout. Emphasize that students need to provide a justification for their identification. They should look at the tone, size, shape, texture, pattern, shadow, site, and association elements in the aerial photograph. Encourage students to refer to their handout, "Basic elements of aerial photographs" for reference materials.

7. Have students view **Location I**. Discuss the completed example on the handout.

8. Have students continue to work on the handout. Most students will be able to complete at least half of the locations in a class period.

### Helpful implementation idea:

An effective instructional strategy to use with classes containing a high proportion of lower-level learners, students with disabilities, and/or English language learners is to complete each location one item at a time. Display the location image to the front of the classroom. Ask students in a whole classroom setting to describe specific features they observe in the image. Have a student point these out with a meter stick and discuss each one. Prompt students with questions as needed to observe specific features.

**Materials Needed:**

Handout: Identifying Land Features in the Lehigh Valley Area [ID\_Features\_LVarea.pdf]

Google Earth file: Lehigh Valley Features.kml

Handout: Basic Elements of Aerial Photo Interpretation (Recommended) [Air\_Photo\_Interpretation.pdf]

**Assessment information:**

Identifying Land Features in the Lehigh Valley Area [ID\_Features\_LVarea\_assess.pdf]

## Day 11

**Students will identify man-made and natural features in the Lehigh Valley. They will provide evidence (tone, size, shape, texture, pattern, shadow, site, and/or association) to support their identifications.**

1. Tell students they will continue to use aerial images in Google Earth to identify land features in the Lehigh Valley area.

2. Ask students: *How can you identify objects in aerial photographs?* Review elements can be used to identify objects in aerial photographs: **tone, size, shape, texture, pattern, shadow, site, and association**. Have students refer to the handout: *Basic Elements of Aerial Photo Interpretation* for review if needed.

3. Display the **Lehigh Valley Features.kml** file in Google Earth to the front of the classroom and instruct students to load this layer in Google Earth on their computers.

4. Instruct students to complete the handout **Identifying Land Features in the Lehigh Valley Area**. Emphasize that students need to provide a justification for their identification. They should look at the tone, size, shape, texture, pattern, shadow, site, and association elements in the aerial photograph for each location. Encourage students to refer to their handout, "Basic elements of aerial photographs" for reference materials.

5. After students have completed the handout, review student responses in a whole class setting. Display each location while they are being discussed.

### **Helpful implementation idea:**

An effective instructional strategy to use with classes containing a high proportion of lower-level learners, students with disabilities, and/or English language learners is to complete each location one item at a time. Display the location image to the front of the classroom. Ask students in a whole classroom setting to describe specific features they observe in the image. Have a student point these out with a meter stick and discuss each one. Prompt students with questions as needed to observe specific features.

### **Helpful implementation idea:**

Some students may not be familiar with appearances of quarries. Display Location O and P together. Prompt students to identify the differences in tone and size of the two different quarries.

### **Materials Needed:**

Handout: Identifying Land Features in the Lehigh Valley Area [ID\_Features\_LVarea.pdf]

Google Earth file: Lehigh Valley Features.kml

Handout: Basic Elements of Aerial Photo Interpretation (Recommended) [Air\_Photo\_Interpretation.pdf]

### **Assessment information:**

Identifying Land Features in the Lehigh Valley Area [ID\_Features\_LVarea\_assess.pdf]

## Day 12

***Students will understand how satellites use remote sensing to produce images. Students will recognize that the earth's surface has different basic land surfaces that reflect/emit different radiation. Students will identify and interpret features on Landsat images.***

1. Display the mystery image of the strawberry from the Lehigh Earth System Science Education Remote Sensing Web site - <http://www.ei.lehigh.edu/esse/rs/> to the front of the classroom. Use this Flash animation to introduce remote sensing as measuring or gathering information about an object or a phenomenon without having physical contact with the object. Continue to show the next Web page, <http://www.ei.lehigh.edu/esse/rs/?p=2> to highlight the use of a dental x-ray as another example of a remote sensing technique.
2. Continue to the next screen <http://www.ei.lehigh.edu/esse/rs/?p=3> to tell students that remote sensing instrumentation is housed on satellites in orbit around the Earth and are used by many different scientists to explore and understand the Earth.
3. Continue to <http://www.ei.lehigh.edu/esse/rs/?p=5>. Tell students that objects on Earth reflect, absorb, and emit electromagnetic radiation at unique wavelengths and frequencies. The electromagnetic radiation travels in waves across great distances. Different objects have different physical characteristics so they reflect or emit energy differently. Explain to students that the image on the right is a **true color** photo of Death Valley, California. The image on the left is a **false color satellite image** of that area. The colors appear different in the false color image due to the different energy being reflected from the ground features.
4. Show the animation at <http://www.ei.lehigh.edu/esse/rs/?p=6> to students. Review each step of the process of remote sensing with the students.
5. Show the images of Landsat 7, MODIS, and AVHRR at <http://www.ei.lehigh.edu/esse/rs/?p=10> to students. Explain that these satellite instruments monitor our earth's atmosphere and also record data on the Earth's surface that is used by scientists to monitor changes over time.
6. Show the complete animation sequence at <http://www.ei.lehigh.edu/esse/rs/?p=11> to students. Highlight the key features involved with image generation.
7. Show the clickable image sequence at <http://www.ei.lehigh.edu/esse/rs/?p=12> to show students that scientists used remotely sensed images to classify different land use types.
8. Display **Mystery Image 1** from the **Landsat Mystery Image Pairs** Website (or handout). Tell students they are looking at a pair of remotely sensed images taken from the Landsat 1 satellite. The Landsat image pairs are provided in two formats: a **natural-color composite image** taken with Thematic Mapper bands 3, 2 and 1 and a **false-color composite image** 4, 3 and 2. Tell students they will be learning how to use these types of remote sensing image pairs to analyze and interpret remotely sensed images taken from the Landsat satellite.
9. Distribute the **Mystery Landsat Images** handout to each student. Instruct students to look at each mystery image pair and predict what type of area they think each image represents. Have students record their predictions on the handout.
10. Have students read the description of **natural-color composite images** on Part 2. Instruct students to examine the **natural-color Landsat mystery images** and complete Part 2 of the handout. Review student responses as a class.
11. Have students read the description of **false-color composite images** on Part 3. Instruct students to examine the **false-color Landsat mystery images** and complete Part 3 of the handout. Review student responses as a class.

12. Instruct students to complete the analysis questions in Part 4. Review student responses as a class.

**Materials Needed:**

Handout: Mystery Landsat Images [Mystery\_Landsat\_Images.pdf]

Landsat Mystery Image Pairs Website or handout [Landsat\_image\_pairs.pdf]

**Assessment information:**

Mystery Landsat Images Assessment [Mystery\_Landsat\_assess.pdf]

## Day 13

**Students will use remotely sensed images to recognize land use patterns of diverse areas in our world. They will also examine and interpret time-sequenced satellite data and aerial photographs of urban areas to interpret geographic growth patterns. In addition, they will examine landscape changes over time through analysis and interpretation of satellite data images and aerial photographs.**

1. Ask students how some feature in their neighborhood or city has changed over time. If students have difficulty, prompt them with the following examples: the development of a newly created park area, the building of a new shopping mall, a new school or sports arena. Ask students how that change might look on a satellite image before and after the feature was constructed.

2. Tell students they will be looking at a series of satellite image pairs to examine land use change over time. Have students view the **Land Use Change Images Web site** or handout. Tell students that each site highlights different landscape changes over time.

3. Distribute the handout, **Land Use Change** to each student. Have students complete Part 1: Making Predictions for each image pair.

4. Next, have students read the “**Background information review**” in Part 2 of the handout. Review with students some of the key color features used in false color satellite images for identifying features: *What might a red color indicate?* (Growth of vegetation, forests, grass, lawns and trees in established neighborhoods).

*What might a black color indicate?* (A water body such as a lake, ocean, or river).

*What might a green color indicate?* (Agricultural fields or bare soils).

5. Instruct students to complete the **Land Use Change** handout. Remind students to look at the tone, size, shape, texture, pattern, shadow, site, and association elements in the satellite image to help them with their interpretations.

6. Review student responses as a class. Use the satellite images on the **Land Use Change Images Web site** or handout to point out key land use change features. Refer to the **Land Use Change – Explanation Guide**.

7. Prior to discussing **question 18**, introduce the term “**sprawl**” to students. Sprawl is defined as the process in which the spread of development across the landscape far outpaces population growth. In discussing student responses to question 18, emphasize the importance of “smart growth” practices that takes advantage of wise resource use including: encouraging compact building development and discouraging dispersed, automobile dependent development at the urban fringe; taking advantage of existing structures such as reusing abandoned industrial sites (brownfield development; building along rail lines and public transportation routes; and creating highly connected roads, sidewalks and paths, allowing relatively direct travel by motorized and nonmotorized modes. Note to students that satellite images can be used to identify landscape provisions for smart growth practices in rapidly growing cities.

### **Materials Needed:**

Land Use Change Images Web site or handout [Landuse\_change\_images.pdf]

Handout: Land Use Change [Landuse\_change.pdf]

### **Assessment information:**

Land Use Change Assessment [Landuse\_change\_assess.pdf]

### **Teacher Resource:**

Land Use Change – Explanation Guide [Landuse\_change\_guide.pdf]

## Day 14

**Students will recommend a plan for locating a new Wal-Mart Supercenter in the greater metropolitan Lehigh Valley area to have minimal impact on the environment. Students will use Google Earth to analyze and evaluate features of different land areas for proposed development sites. They will apply “smart growth” principles to their planning decisions.**

1. Ask students what types of things developers must consider when they plan to build a new large department store in an area. If needed, prompt students to think about infrastructure issues such as the availability of roads and sidewalks for transportation to get people to the store, and access to water and electrical lines to supply basic needs for the store to function.

2. Tell students that they will be conducting a role-playing simulation activity in which they will be employees of the Lehigh Valley Planning Commission (LVPC). Tell students that the LVPC is an organization that helps to guide sensible growth in the Lehigh Valley area in Pennsylvania. They provide advice and recommendations to cities and towns that wish to further develop their existing lands. Tell students that they have been contacted by the Wal-Mart Corporation to help them decide where to build the next Wal-Mart Supercenter in the Lehigh Valley area. Wal-Mart has contacted them for their advice and recommendations where they should build their next store to have the least impact on the environment. They will use Google Earth to examine four proposed locations for the new store, make a recommendation, prepare a proposal statement, and develop and present a short, 5 minute PowerPoint presentation that describes reasons why their development plan is the best plan.

3. Distribute the handout, **Where Should We Build The New Wal-Mart Supercenter?** to each student. Instruct students to read through the **Background** section.

Ask students the following questions:

*What is the mission of the LVPC?*

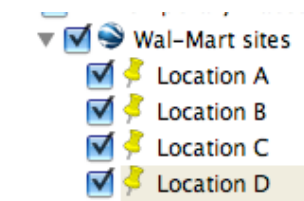
*What is sprawl?*

*What is Smart Growth?*

*How can we develop land for new businesses in responsible ways?*

Discuss responses to ensure students understand the main concepts.

4. Distribute the **Proposed Wal-Mart Supercenter Analysis Form** to each student. Display the **Wal-Mart sites.kml** file in Google Earth and show students how to move from one site location to the next by extending the Wal-Mart sites drop-down list and clicking on a specific location name.



5. Instruct students to examine the 4 proposed locations for developing a new Wal-Mart Supercenter in the Google Earth with the **Wal-Mart sites.kml** file.

6. Instruct students to complete the **Proposed Wal-Mart Supercenter Analysis Form**.

Highlight the **Helpful Hints** in the handout, **Where Should We Build The New Wal-Mart Supercenter?** Show students that they can turn on the **roads** layer in Google Earth to view the existing transportation infrastructure.

Show students how to use the **Ruler Tool**  in Google Earth to measure the distances of residential areas to the proposed Wal-Mart locations.

**Materials Needed:**

Handout: Where Should We Build The New Wal-Mart Supercenter? [Walmart\_activity.pdf]

Handout: Proposed Wal-Mart Supercenter Analysis Form [Walmart\_analysis.pdf]

Google Earth file: Wal-Mart sites.kml

**Assessment information:**

Proposed Wal-Mart Supercenter Analysis Form Assessment [Walmart\_analysis\_assess.pdf]

Proposal Statement Rubric [proposal\_statement\_rubric.pdf]

Proposal Presentation Rubric [proposal\_present\_rubric.pdf]

## Day 15

**Students will recommend a plan for locating a new Wal-Mart Supercenter in the greater metropolitan Lehigh Valley area to have minimal impact on the environment. Students will use Google Earth to analyze and evaluate features of different land areas for proposed development sites. They will apply “smart growth” principles to their planning decisions.**

1. Begin class by asking students the following questions:

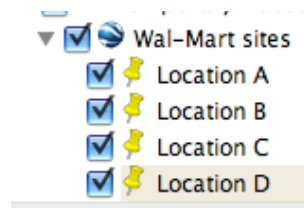
*What is the mission of the LVPC?*

*What is Smart Growth?*

*How do new businesses get water and electricity?*

*How can we develop land for new businesses in responsible ways?*

2. Distribute the **Proposed Wal-Mart Supercenter Analysis Form** to each student. Display the **Wal-Mart sites.kml** file in Google Earth and remind students how to move from one site location to the next by extending the Wal-Mart sites drop-down list and clicking on a specific location name.



3. Instruct students to examine the 4 proposed locations for developing a new Wal-Mart Supercenter in the Google Earth with the **Wal-Mart sites.kml** file.

4. Instruct students to complete the **Proposed Wal-Mart Supercenter Analysis Form** by responding to each item for all 4 proposed locations. Tell students to be very specific for each response they place in the chart.

Highlight the **Helpful Hints** in the handout.

Show students that they can turn on the **roads** layer in Google Earth to view the existing transportation infrastructure.

Show students how to use the **Ruler Tool**  in Google Earth to measure the distances of residential areas to the proposed Wal-Mart locations.

5. After students have completed the **Proposed Wal-Mart Supercenter Analysis Form**, have them analyze their findings and **make a recommendation** for the best location to develop a new Wal-Mart Supercenter. Prompt students to write their recommendation for the **best site** that will have the minimal impact on the environment on the **Proposed Wal-Mart Supercenter Analysis Form**.

### Materials Needed:

Handout: Where Should We Build The New Wal-Mart Supercenter? [Walmart\_activity.pdf]

Handout: Proposed Wal-Mart Supercenter Analysis Form [Walmart\_analysis.pdf]

Google Earth file: Wal-Mart sites.kml

### Assessment information:

Proposed Wal-Mart Supercenter Analysis Form Assessment [Walmart\_analysis\_assess.pdf]

Proposal Statement Rubric [proposal\_statement\_rubric.pdf]

Proposal Presentation Rubric [proposal\_present\_rubric.pdf]

## Day 16

**Students will recommend a plan for locating a new Wal-Mart Supercenter in the greater metropolitan Lehigh Valley area to have minimal impact on the environment. They will develop a proposal that applies “smart growth” principles to their planning decisions.**

1. Ask students: *What should the Wal-Mart Corporation consider when they plan to build a new store in an area?* If needed, prompt students to think about infrastructure issues such as the availability of roads and sidewalks for transportation to get people to the store, and access to water and electrical lines to supply basic needs for the store to function. Discuss responses.

2. Tell students they will write a **proposal statement** for selecting the best site for a new Wal-Mart Supercenter location that will have the least impact on the environment. Inform students that **each team member must write his or her own proposal statement**. Tell students that their proposal statement should clearly describe how the proposed site selection promotes “**smart growth**” to slow down effects from sprawl. Instruct students to read the guiding questions that their proposal statement should address - **#4 on the handout, Where Should We Build The New Wal-Mart Supercenter?**

3. Distribute the **Proposal Statement Rubric** to each student. Have students read the rubric. Tell the students that their proposal needs to address each rubric criteria.

### Helpful implementation idea:

For classes with low-level readers, read each criterion on the **Proposal Statement Rubric** to students and provide an example to clarify each criterion as needed.

4. Provide students with the remainder of the class period to develop their proposal statement and provide support as needed.

### Helpful implementation idea:

Tell students to use their **Proposed Wal-Mart Supercenter Analysis Form** to assist them with writing their proposal statement. Have students add content to their **Analysis Form** as they write their proposal statement. Allow students to use their **Analysis Form** during the next two days when they assemble their presentation.

5. Allow time at the end of the class period to have students self-assess their proposal statement with the **Proposal Statement Rubric**.

### Materials Needed:

Handout: Where Should We Build The New Wal-Mart Supercenter? [Walmart\_activity.pdf]

Handout: Proposed Wal-Mart Supercenter Analysis Form [Walmart\_analysis.pdf]

Google Earth file: Wal-Mart sites.kml

### Assessment information:

Proposed Wal-Mart Supercenter Analysis Form Assessment [Walmart\_analysis\_assess.pdf]

Proposal Statement Rubric [proposal\_statement\_rubric.pdf]

## Day 17

**Students will develop a presentation for locating a new Wal-Mart Supercenter in the greater metropolitan Lehigh Valley area to have minimal impact on the environment. Students will plan to communicate “smart growth” principles to their audience in a simulated planning commission meeting.**

1. Ask students: *What are some responsible development strategies the Wal-Mart Corporation may want to consider when they select a site for a new Wal-Mart Supercenter to have minimal impact on the environment?* Discuss responses.

2. Divide students into teams of two students that have selected the same site recommendation. Tell students that their team will develop a short, 5 minute PowerPoint presentation that clearly describes why their development plan is the best plan for the Wal-Mart Corporation to have minimal impact on the environment. Tell students they are trying to convince the Wal-Mart Corporation that their site selection is the best plan. Their presentation needs to be factual and persuasive as possible. Emphasize that they should make claims clearly and support them with facts and evidence.

3. Instruct students to read through the guidelines for the proposal presentation. See **#5 on the handout, Where Should We Build The New Wal-Mart Supercenter?** If needed, show students how to take a screenshot of Google Earth and how to insert the image into their presentation file.

4. Distribute the **Proposal Presentation Rubric** to each student. Have students read the rubric. Tell the students that their presentation needs to address each rubric criteria.

### Helpful implementation idea:

In classes with lower level readers, read each criterion on the **Proposal Presentation Rubric** to the students. Clarify any vocabulary terms they might have difficulty with and provide explanations as needed.

5. Tell students they will have one and a half class periods to develop their presentations.

### Helpful implementation idea:

Allow students to use their **Analysis Form** to help them organize and assemble their presentation.

6. Provide students with the remainder of the class period to develop their presentations and provide support as needed.

### Helpful implementation idea:

To promote individual accountability and deter social loafing within groups, provide each student with a group peer-assessment sheet to rate each group member's contribution to develop the presentation. Peer assessment allows team members to assess other members of the team as well as themselves. You may wish to consider using a peer assessment sheet to provide data that might be used in assigning an individual grade component for developing the presentation.

### Materials Needed:

Handout: Where Should We Build The New Wal-Mart Supercenter? [Walmart\_activity.pdf]

Handout: Proposed Wal-Mart Supercenter Analysis Form [Walmart\_analysis.pdf]

Google Earth file: Wal-Mart sites.kml

### Assessment information:

Proposal Presentation Rubric [proposal\_present\_rubric.pdf]

Proposed Wal-Mart Supercenter Analysis Form Assessment [Walmart\_analysis\_assess.pdf]

## Day 18

**Students will develop a presentation for locating a new Wal-Mart Supercenter in the greater metropolitan Lehigh Valley area to have minimal impact on the environment. They will communicate their planning decisions to their audience in a simulated planning commission meeting.**

1. Ask students: *What are some “smart growth” strategies the Wal-Mart Corporation may want to consider when they select a site for a new Wal-Mart Supercenter to ensure that their new store location does not contribute to sprawl?* Discuss responses.
2. Have students self-assess their presentation with the **Presentation Rubric**. Tell students they have one half of the class period to complete their presentation. If students have completed their presentation, encourage them to rehearse their presentation.
3. For the second half of class, provide each student team with 5 minutes each to present their proposals to the class. Remind students they are members of the Lehigh Valley Planning Commission and will be giving their presentation to the Wal-Mart Corporation to recommend a site location to develop a new Wal-Mart Supercenter in the Lehigh Valley area. Prompt students to make sure that their advice and recommendations are clear.

### **Helpful implementation idea:**

Remind students of good presentation skills, especially if the students have not had much experience giving oral presentations in the classroom. Tell students to have good body posture, be articulate and clear when they speak, and make eye contact with their audience. Tell students they should not read verbatim from their presentation slides.

### **Helpful implementation idea:**

To keep students focused on each group’s presentation, have students write down a question to ask the presenting group. At the conclusion of each presentation, randomly select two students to ask their questions to the presenting group. You may wish to consider using the students’ questions as a participation assessment to ensure individual accountability for paying attention during the group presentations.

### **Materials Needed:**

Handout: Where Should We Build The New Wal-Mart Supercenter? [Walmart\_activity.pdf]  
 Handout: Proposed Wal-Mart Supercenter Analysis Form [Walmart\_analysis.pdf]  
 Google Earth file: Wal-Mart sites.kml

### **Assessment information:**

Proposal Presentation Rubric [proposal\_present\_rubric.pdf]

## Day 19

***Students will communicate their planning decisions for locating a new Wal-Mart Supercenter in the greater metropolitan Lehigh Valley area to have minimal impact on the environment in a simulated planning commission meeting.***

1. Begin the class session by reminding students that they are members of the Lehigh Valley Planning Commission and will be giving their presentation to the Wal-Mart Corporation to recommend a site location to develop a new Wal-Mart Supercenter in the Lehigh Valley area. Prompt students to make sure that their advice and recommendations are clear.
2. Provide each student team with 5 minutes each to present their proposals to the class.

**Helpful implementation idea:**

Remind students of good presentation skills, especially if the students have not had much experience giving oral presentations in the classroom. Tell students to have good body posture, be articulate and clear when they speak, and make eye contact with their audience. Tell students they should not read verbatim from their presentation slides.

**Helpful implementation idea:**

To keep students focused on each group's presentation, have students write down a question to ask the presenting group. At the conclusion of each presentation, randomly select two students to ask their questions to the presenting group. You may wish to consider using the students' questions as a participation assessment to ensure individual accountability for paying attention during the group presentations.

**Note:**

Classes with large numbers of students may require additional time to complete their proposal presentations.

**Assessment information:**

Proposal Presentation Rubric [proposal\_present\_rubric.pdf]

## Day 20

Posttest

**Materials Needed:**

Land Use Change Unit Assessment [LUC\_Unit\_Assessment.pdf]