4-H Virtual Forest User's Guide
Sprawl

Concept

This module will illustrate the influence of human activity on a forested ecosystem. Students will observe how a typical development pattern impacts forest cover, temperature, animal species, and erosion as a road, subdivision, shopping center, school complex, and park are constructed in a forested area known as "Shady Grove."

This module supports the following SOL's:

<u>Science</u>

Scientific Investigation, Reasoning, and Logic

3.1   a) predictions and observations are made
       j) inferences are made and conclusions are drawn

4.1   b) hypotheses are formulated based on cause-and-effect relationships

Living Systems

4.5   a) behavioral and structural adaptations
       f) influence of human activity on ecosystems

Resources

3.10   b) the effects of human activity on the quality of air, water, and habitat

4.8   d) forests, soil, and land

6.9   a) management of renewable resources (water, air, soil, plant life, animal life)
       c) the mitigation of land-use and environmental hazards through preventive measures

LS.12 The student will investigate and understand the relationships between ecosystem dynamics and human activity.

       b) change in habitat size, quality, or structure
       c) change in species composition
       d) population disturbances and factors that threaten or enhance species survival

Module Description

Frame 1. An introductory frame that contains the title "Sprawl" and credits.

Frame 2. The module begins with an overhead frame of Shady Grove forest bisected by a stream. We hear the sound of birds singing and water trickling. Text reads:

> "Shady Grove is a healthy forest ecosystem covered by trees that shade the environment, protect water quality, provide wildlife habitat, and prevent erosion."

A youth's voice provides narration throughout the module. She introduces the module in frame 2.

> "Providing for the needs of residents and businesses while conserving natural resources is a real challenge for most cities and towns. Watch what happens to Shady Grove as a nearby city grows larger."

Six buttons in the sidebar at the right allow students to track the effects of each development activity on tree cover, temperature, box turtles, water quality, erosion, and feral cats. (A feral cat is a domesticated cat that has turned wild). Shady Grove begins with 100% tree cover, 320 box turtles, a temperature of 70 degrees, zero feral cats, excellent water quality, and no erosion.

Students will use an arrow in the lower right corner to navigate through the module, adding different development features each time they advance. Students advance to the next frame by clicking the arrow to add a road. After clicking on the arrow, there is a brief pause before we leave this frame. We hear the sound of rain, see sheets of rain cross the screen, and the stream pulses slightly. We fade to Frame 3.

Frame 3. Frame 3 illustrates that 10% of the tree cover has been removed to make room for a new road. The narrator says:

> "A road has been constructed through Shady Grove to allow for future development. What effect do you think this had on tree cover, box turtles, temperature, feral cats, water quality, and erosion? Click on the arrows to see if you are right!"

The user can now indicate what trend he/she expects to see for each item listed. An incorrect answer results in a buzzer. Correct answers result in brief summary text. The answers are:

> Tree Cover (down). "Correct! Tree cover declined by 10%."
> Box Turtles (down). "Yes! The number of box turtles dropped to 283."
> Temperature (up). "Right! Temperature increased slightly to 70.5 degrees."

Feral Cats (up). "Correct! Two unwanted cats were dropped off by the roadside."
Water Quality (down). "Yes! Water quality went down slightly."
Erosion (up). "Right! Erosion increased due to disturbance of the stream banks."

At this point the user will advance to the next frame. After clicking on the arrow, there is a brief pause before we leave this frame. We hear the sound of rain, see sheets of rain cross the screen, and the stream pace quickens. We fade to frame 4.

Frame 4. A subdivision and shopping center have been constructed in Shady Grove to meet the demands of the growing population. What impact did this have on the Shady Grove ecosystem?

Tree Cover (down). "Correct! Tree cover declined by another 40%."
Box Turtles (down). "Yes! 150 box turtles are left."
Temperature (up). "Right! Temperature increased to 73 degrees."
Feral Cats (up). "Correct! The cats had kittens, which survive and multiply."
Water Quality (down). "Yes! Water quality went down again."
Erosion (up). "Right! Erosion increased once again."

In addition to these trends, users will notice an increase in traffic on Shady Grove Road and signs of erosion along the stream banks. The sounds of traffic have replaced the sounds of birds and water.

At this point the user will advance to the next frame. After clicking on the arrow, there is a brief pause before we leave this frame. We hear the sound of rain, see sheets of rain cross the screen, and the stream turns brown following the rain, reflecting the increase in runoff, erosion, and sedimentation. We fade to frame 5.

Frame 5. To serve the needs of the residents, the Shady Grove School complex, home of the Fighting Cardinals, is constructed. Forest is removed to make way for parking lots, school buildings, and playing fields. Due to pressure from the community, the last remaining tract of forestland comes up for sale, and the newly formed Shady Grove Parks Committee successfully lobbies the County Government to purchase the area and turn it into a park. Shady Memorial Park includes a large picnic pavilion for outdoor gatherings, a parking lot, and walking trails.

The same trends exhibited during the previous frames continue here. Forest gives way to development. The number of turtles continues to decline due to habitat loss. Feral cats, a species that can adapt and thrive in the presence of human population, increases as they breed at will and feed on food scraps left outside by well meaning homeowners. The cats also prey upon native birds and small mammals, and raid dumpsters. Runoff and erosion continue to increase due to loss of forest canopy cover. As a result, water quality decreases.

Tree Cover (down). "Correct! Tree cover declined by another 30%."
Box Turtles (down). "Yes! The number of box turtles dropped to 55."
Temperature (up). "Right! Temperature increased to 74 degrees."
Feral Cats (up). "Correct! Feral cats thrive around developed areas."
Water Quality (down). "Yes! Water quality went down again."
Erosion (up). "Right! Erosion is still going up."

After conducting the exercise, students will click the arrow to move forward to a summary screen.

Frame 6. This frame summarizes the trends illustrated in the Shady Grove scenario.

> "As urban development increases, forest cover is removed to make way for buildings and roads. Populations of the wild animals that are sensitive to habitat loss are reduced. However, the numbers of animals that thrive in the presence of humans, like feral cats, increase. In general, the reduction of tree cover causes an increase in temperature, runoff and soil erosion. This results in more flooding and poorer water quality. So, while development has its benefits, it also has costs. Let's go to the next frame to see how we can help create a sustainable urban forest."

Although not stated in the module, it may be helpful to point out that, since public funds are used to support road, water, and sewer construction and maintenance projects, the amount of tax dollars used to support the community increases as well.

Frame 7. The final frame is an interactive learning activity that encourages students to "improve the grove" and help make Shady Grove a sustainable urban forest environment. Users can click and drag three features to the appropriate location. Successful matches are characterized by the word "Yes!" and summary text that appears on the sidebar.

> Leaving trees along streams—called riparian buffers--helps cool the water, stop runoff from reaching the stream, and provides wildlife habitat. Drag the riparian buffer symbol and drop it on the stream.

> Large parking lots built with asphalt and concrete cause water to run off quickly when it rains. There are materials that we can use for parking lot construction, called 'permeable pavement', that allow water to soak into the ground rather than run off into a stream. Drag the permeable pavement symbol and drop it on the shopping center parking lot.

> Instead of building homes throughout an entire forest, we can group houses together in one area on smaller lots. This way, the rest of the land in the subdivision remains forested. This is called cluster development. Drag the cluster development symbol and drop it on Shady Acres.

We can make other improvements that are not presented in this activity. For example, school buildings, parking lots, and playing fields need lots of space. Planting trees on the school grounds can help provide shade, habitat for birds, and improve how the school complex looks. People might go to a park to relax, walk, or watch birds. Putting the parking lot by the main road will reduce vehicle traffic and noise inside the park.

And…

Frame 8. Having our pets spayed or neutered!

We tried to use realistic numbers throughout the Sprawl module. Here is how we arrived at the numbers we used.

Tree Cover. We reduced tree cover by visual estimation in proportion to the land area occupied by the various additions to "Shady Acres."

Temperature. A study by Akbari et al. (1992) showed a two degree temperature increase from rural to suburban land use, a two degree increase from suburban to commercial suburban land use, and a three degree increase from commercial to urban core land use (seven degrees total). Since this study looked at Phoenix, we went the conservative route and reduced the temperature increase by half for Virginia, with the exception of the change from suburban to commercial suburban land use.

Box Turtles. Data from the 1930's showed that approximately 9 to 17 terrestrial turtles per hectare occupied the habitat offered by pristine forests in Maryland. To arrive at the numbers for the module, we assumed that our forest represented an 80 acre area. We then assumed a conservative 10 turtles per hectare, or 4 turtles per acre. We reduced the total number of turtles in proportion to the habitat loss, and added in a factor for road mortality. For example, we begin with 80 x 4 = 320 turtles. Road construction reduces the forest canopy by 10%, so we reduced the number of turtles by 10% as well, and then subtracted an additional five turtles knowing that some individuals will become road kill. The number of turtles becomes 283. The subdivision and shopping center reduce habitat by an additional 40%. As a result, we multiply our original number (320) by 50%, the remaining habitat, and further reduced the number by 10 to reflect increased road kill resulting from the increased traffic. We continued this pattern throughout the module, until our final turtle count stands at 49.

Feral Cats. We began with the two cats dropped off at Frame 2. Although we did not use actual numbers thereafter, literature shows that feral cat populations increase exponentially. So, we can estimate the number of cats as well. Assume one cat dropped off by the roadside is a female that then has a litter of six kittens. The total number of feral cats then becomes eight. Next, assume that four of these cats are females, each of which has a litter containing six kittens. The population becomes 32: 24 kittens, plus eight adults. Sixteen females could possibly produce 96 kittens, and so on.

References

Akbari, H., S.D. Davis, J. Huang, and S. Winnett, eds. 1992. *Cooling our Communities*. LBL Report 31587, Berkeley, CA.

Booth, D. 2000. *Field Evaluation of Permeable Pavements for Stormwater Management.* United States Environmental Protection Agency. EPA-841-B-00-005B. 2 p.

Ernst, C.H., J.E. Lovich, and R.W. Barbour. 2000. *Turtles of the United States and Canada*. Smithsonian Institution Press. 571 pp.