In Harmony

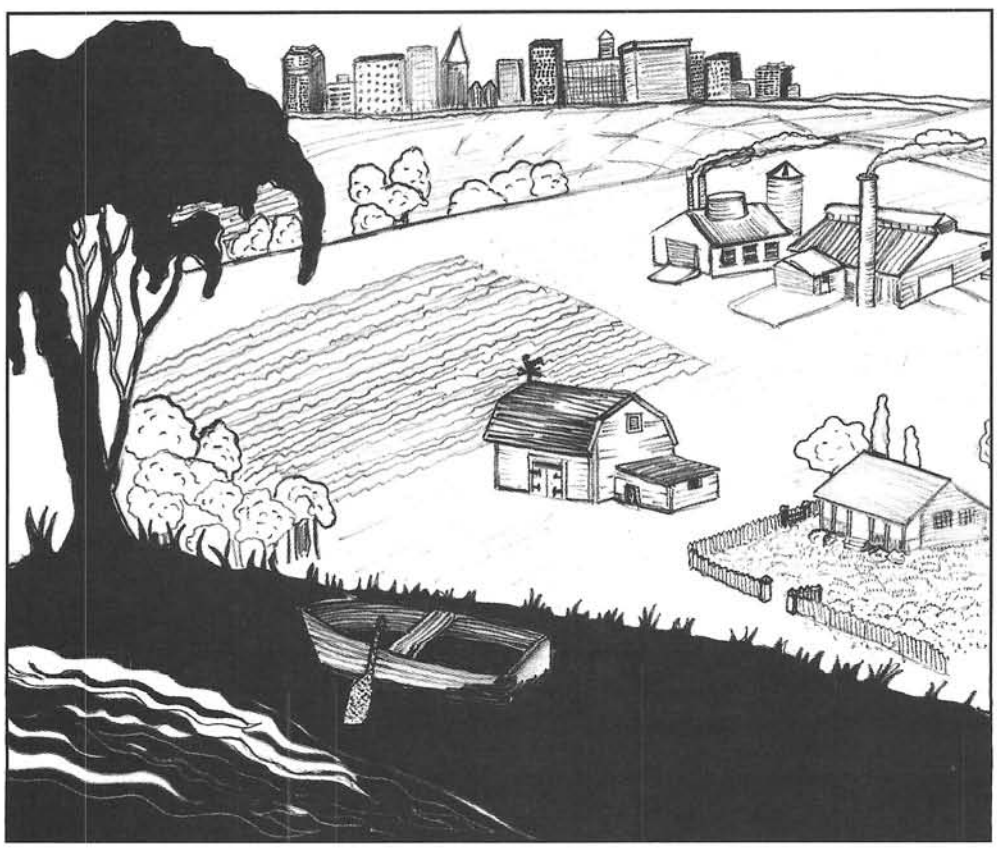
LEVEL: Grades 4-6
SUBJECTS: Social Studies (Geography), Science
SKILLS: Analyzing, applying, comparing similarities and differences, critical thinking, evaluating, interpreting, map reading, observing, reading data, solving problems, understanding cause and effect

MATERIALS
Transparency of your county's soil survey map or the attached ***Land Use Map***, overhead projector and screen, copies of the attached ***Soil Type Descriptions***, ***Land Use Map***, ***Map Key***, and county soil survey.

VOCABULARY
adequate, drainage, frost heave, land capability, land classification, land use, soil survey, vibration, water table

RELATED LESSONS
Amazing Grazing
Cows or Condos?
Perc Through the Pores
Till We or Won't We?
Soil Is Not Trivial

SUPPORTING INFORMATION
Land is used for many different purposes. It is used for growing fruit, grazing cattle, developing a shopping mall, a park, or a garden, building a reservoir, or mining for minerals. Determining the highest and best use of land is important. Human decisions to build homes and businesses on the floodplain of a river or on a steep hillside susceptible to mudslides may not be based on careful consideration or understanding of soil characteristics



BRIEF DESCRIPTION
Students develop mapmaking, map reading, and graph reading skills as they learn the capabilities and limitations of our land resources by using a soil survey. In the process students begin to develop the knowledge needed to build a foundation for understanding the complex issues involved in making land use decisions in harmony with the land's capability.

OBJECTIVES
The students will:
- explain that land resources differ due to soil type, geology, topography, the climate, or history;
- identify how human decisions about land use are influenced by both the natural resource base and economics; and
- make their own land-use decisions.

ESTIMATED TEACHING TIME
Four sessions: 45 minutes each.

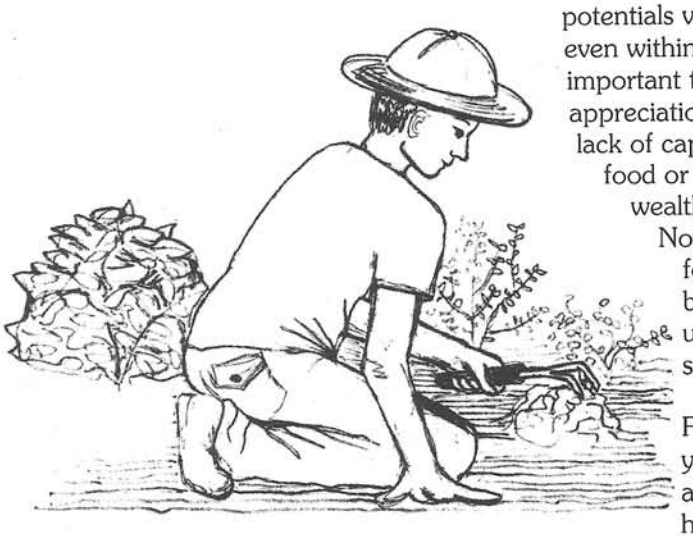
and its limitations, topography, climate, and history. A soil's capability needs to be carefully considered when making land-use decisions. That capability is identified by a soil capability and classification system found in soil surveys.

For most counties across the United States, soil survey maps have been developed by the United States Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS). These maps are a series of aerial photographs, superimposed with outlines of soil groupings and topographical characteristics. These maps have resulted from more than a hundred years of research. Each book of maps is keyed to a series of charts describing the class of soil (classifications) and its capability to be used for a variety of purposes. Soil classes include agricultural use (including landscaping), engineering purposes (all forms of building and construction), and (town, local government and county) planning.

This information can provide insight as to the soil's suitability for growing crops, building roads and highways, constructing homesites, etc. Work on these soil surveys began in the early 1960s and continues today with new digitized computer processes. Soil surveys can be found at the local office of the Natural Resources Conservation Service (listed under "United States Government - Agriculture, Dept. of" in the phone book) and in some public libraries. (There are several areas in the country that have not been mapped. Urban areas that were built before the soil surveys were conducted for a given state were not photographed and are not included in the survey. Soils in these urban areas have been greatly disturbed by construction or are covered by pavement and buildings. A few states do not have all of the counties surveyed because they have large public land holdings, which are federally managed. In those areas, a resource inventory is used in place of the soil survey.)

Along with soil types and capabilities (land classification), there are other factors that need to be considered when making land-use decisions. These are topography (particularly the slope and the flood prone terrain), climate, weather patterns, growing seasons, and rainfall. Whether planning a garden, landscaping a home or business, building a golf course, or growing food crops, it is critical to make a careful assessment of the natural resources and environmental concerns. Equally important is heeding the land's limitations.

On a broader scale, students and adults need to understand the limitations of the land to meet the food needs of our rapidly growing population. Awareness of the importance of geography to food production is relatively low among U.S. consumers due to our country's excellent infrastructure, transportation, and marketing system. Yet, it is important in comprehending the global food situation to understand these land capabilities from a geographic perspective. Understanding that land-use potentials vary by region, and even within regions, is important to create an appreciation for capability or lack of capability to produce food or otherwise create the wealth to purchase food. Not all land is suitable for growing, grazing, building or some other uses it may currently support.



For example, in recent years, authors and animal-rights activists have suggested that land used to graze domesticated animals (cattle, sheep, goats, and horses) would be used "more productively" to grow grains, fruits, and vegetables for direct human consumption. This concept is not feasible due to numerous factors. Many lands currently used to graze livestock are not suitable to raise crops for many reasons: little rainfall; a rocky terrain; a shallow layer of topsoil; a growing season too short for any crop to mature; a steep slope; erodible soils; too wet in certain seasons; etc. Rangelands constitute nearly half the world's land surface and provide more than three-fourths of the feed for its livestock. If livestock do not graze these lands, a significant amount of protein would not be available to meet human needs.

Students need an understanding of the land available and suitable for agriculture. They also need to understand that these issues are complex and need careful consideration rather than broad "one-size-fits-all" solutions. In short, we need to make land-use decisions of people's desires "in harmony" with the land's capability.

GETTING STARTED

While not essential, it is recommended that this lesson should be taught following the lessons "Perc Through the Pores," "Till We or Won't We?," and "Soil Is Not Trivial," to provide a context for making land-use decisions. Make copies of the attached ***Soil Type Descriptions, Land Use Map, Map Key,*** and make a transparency of the ***Land Use Map***. Obtain a copy of your county's soils survey from the local office of the Natural Resources Conservation Service (NRCS) office listed under United States Government in the phone book. Invite a speaker from the local historical society to speak about the changes in land use in your community for Session Two.

PROCEDURE

SESSION ONE

1. Ask the students:

   A. Where are oranges grown commercially in the United States? *(Florida, Southern California, Arizona, Texas)* Identify these states on a map.

      - What do these states have in common? *(All of these areas are relatively warm in the winter. All seldom experience hard freezes. All can be considered either warm temperate or subtropical.)*

      - Why is this important to grow oranges? *(The citrus tree and fruit cannot withstand prolonged freezing temperatures. The fruit freezes in 30 minutes with temperatures at 26 F to 28 F. Leaves and stems are killed by a few minutes at 20 F to 28 F.)*

      - Can we grow oranges in our state? Why or why not? If so, where?

   B. Where are apples primarily grown? *(Michigan, New York, Washington, Pennsylvania, Ohio, and all of the New England states)* Identify these states on a map.

      - What do these states have in common? *(All are Northern states. All have plenty of water. All experience cold winters. All experience hard freezes in the winter.)*

      - Why is this important to growing apples? *(The apple tree needs freezing temperatures to blossom and initiate fruit set.)*

      - Can we grow apples in our state? Why or why not? If so, where? *(Some Southern areas can grow apples, if the elevation is high enough and the area experiences freezing temperatures for significant durations. Mexico, for example, grows apples in cooler mountain areas, but there are great challenges involved in producing this crop in Southern climates and the major producers are all Northern states.)*

   C. Why are some foods commercially grown only in the North and others only grown in the South? *(Climate plays a large role.)*

   D. Begin to create a list of where foods and fibers are grown and the students' educated guesses about why this is the case. *(cotton, lemons, limes, grapefruit - South and cranberries, maple syrup, blueberries, cherries - North)*

2. Ask the students to volunteer whatever information they have about where crops are grown, what they raise in their garden; what flowers or trees grow where they live; and what problems they or their parents have had trying to grow plants. Did plants die because of over watering or during prolonged rainy period? Did a houseplant freeze? Did someone forget to water it?

3. Address the knowledge students may have about climate and relate it to a broad-based understanding of climate. Brainstorm factors that may promote or hinder growing crops in certain regions. *(Climate, elevation, topography, and so on.)*

   - If students cannot get beyond the climate, ask them to think of the impact of elevation on the micro-climates of a tall mountain. *(The climate at the top of a mountain is far different than the climate at the bottom of a mountain; this affects vegetation and soils and is reflected in the plants that can be found at different elevations.)*

   - What else do they know about mountains, their land and topography? *(Rocky, unpredictable weather, steep slopes, etc.)* These all affect crops.

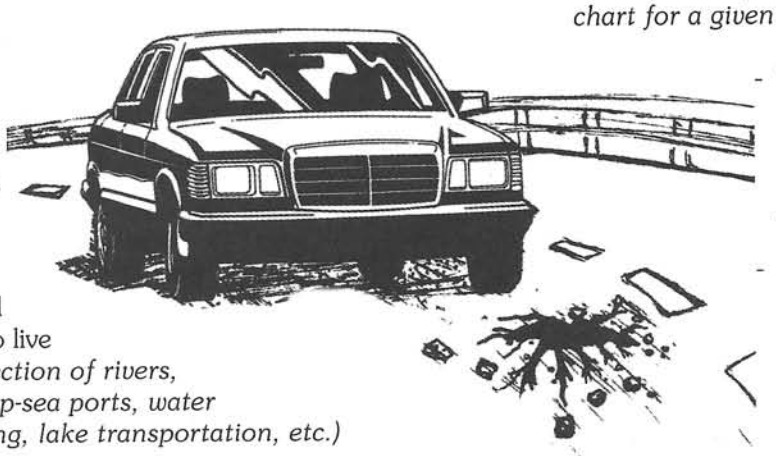
   - Lead into a discussion of land. *(Some land has steep slopes or rocky soil. Some land is marshy or low lying and floods at certain times of the year. Some land has shallow soils, other land has deep soils. Land may be in the form of*

rolling hills or deep valleys. Land may border a river or the ocean. Some land is mined for valuable minerals or precious metals. Some land is a desert.)

- What do students observe about land in their area? (Repeat this question at the end of this lesson.)

SESSION TWO

1. Ask the students:



- When cities were first built, why were the cities built where they were? Why did people want to live there? *(Intersection of rivers, good soil, deep-sea ports, water sources, mining, lake transportation, etc.)*

- Why did people settle in our community? *(Local answers will vary.)*

Indicate that this is a lesson on land and land use. Without realizing it, they may already know many factors that affect how land is used today, and why decisions were made in the past.

2. Show students a copy or copies of the soil survey of your county. Show how much information is available in this book: the maps, charts, text, etc.

3. Brainstorm with the class and make a classroom list of the ways local land is used. *(Apartment buildings, factories, fruit production, forestry, rangelands, farms, parks, gardens, roads, schools, etc.)*

   Have a speaker from a local historical society present ways the use of land has changed over time. Ask:

   - What influenced how this land was originally used and how it is used today? *(Answers will vary.)*

SESSION THREE

1. Distribute copies of the current ***Land Use Map***, ***Map Key***, *and* ***Soil Types Descriptions*** chart enclosed. Project the transparency copy of the map.

   A. Select one section of the map, ask students to use the map key and identify the soil type that is in that area.

   B. Using the ***Soil Type Descriptions*** chart, ask the students to read the soil characteristics.

      - What does the soil type chart indicate about the soil's ability to support farming? *(See chart for a given soil type.)*

      - What does the soil type chart indicate about the soil's ability to support growing grasses? *(See chart for a given soil type.)*

      - What does the soil type chart indicate about the soil's ability to support forestry? *(See chart for a given soil type.)*

      - What does the soil type chart indicate about the soil's ability to support building a pond on this site? *(See chart for a given soil type.)*

      - What does the soil type chart indicate about the soil's ability to support building a highway on this site? *(See chart for a given soil type.)*

      - What does the soil type chart indicate about the soil's ability to support a home site? *(See chart for a given soil type.)*

      - Will the soil need to be drained to make it suitable for those uses? *(See chart for a given soil type.)*

2. Share with the students that this ***Land Use Map***, ***Map Key***, *and* ***Soil Types Descriptions*** chart represent a small amount of the information in the soil survey book for your county. They may use this resource to buy land, build a house, plan a school, site a garden, etc.

   A. Ask the students:

      - When you want to build a house, what would happen if you bought land in the middle of summer and found out next spring that your land was under water? Would you be happy? *(This soil survey can predict that flooding may occur.)*

- Tell the students that the soil survey can tell them a great deal more than simply whether the area is seasonally wet.

B. Ask the students:

- How many of you have seen areas that have experienced disasters? What kind of disasters were they? *(Answers will vary.)*

- Could any of these events have been predicted? *(Yes, building on a 50-year floodplain means that over time records of flooding can predict that every 50 years a flood of a certain magnitude will occur. The exact date is not known. In areas where those records are not available, experts predict the likelihood of 50 year floods. If students are interested in understanding the natural resource base where they live, there are many avenues to learn about it. Some sites are more exposed to storms, e.g. seashores or hills prone to mudslides. The soil survey can provide significant information.)*

3. Ask the students if they notice the way the soil types are located all over the map. (Some students may notice that the road crosses several different soil types.)

   If the students do not notice that the road is built on several soil types, point it out, and begin to look at the Halsey soil in the middle of the page in the ***Soil Type Descriptions*** chart. Mention that the road between the housing development and pond needs to be repaired every spring. It gets large potholes and cracks. Ask:

   - Why does this happen? *(Answers will vary.)*

   - What does the chart say about this soil? *(See chart.)*

   - Besides the soil type, what does the map show about this area? *(Wet spots.)*

   - Is this a good place for a pond? *(Yes - a high water table.)*

   - What is a water table? *(The water table is the underground water level. The pond could be natural or manmade.)*

   - Is this a good place for a road? *(No - high water table, and subject to flooding.)*

   - Why is the road there? *(Probably history, it is a good example of inappropriate land use.)*

   - How could this flooding be solved? *(The road could be raised by bringing in fill or developing sub-surface drainage.)*

   - Does this really happen? *(Yes, that is exactly how we deal with some of these problems.)*

4. For homework, as they go home and return to school the next day, ask students to look for places in the road susceptible to potholes, cracking, sinking, etc. Ask:

   - Where is the road raised above the surrounding land?

   - Where are there bridges? Or culverts?

   - Where are there potholes or cracks in the road?

SESSION FOUR

1. Ask the students if they noticed the areas you asked them to look for on their trip from and to school? What did they observe?

2. Continue discussion from Session Three using the ***Land Use Map***, ***Map Key***, and ***Soil Type Descriptions*** chart. Ask:

   - Are there any other problem areas you observe on the map?

   A. Notice the first house from the highway in the housing development. (The house foundation could crack from both the vibrations of the Palmyra soils, if heavy trucks or equipment use the road and cause vibrations or from the swelling and shrinking of the clay content in the Halsey soils.)

B. The end of the highway near the river is subject to flooding.

2. Where would you like to build a house on this landscape? By the river? On the hill? Near other homes? Near the park? Have each student write his or her selection and the answers to these questions:

   - What problems will need to be solved?

   - How could they be solved?

   Discuss these options for home-site selection, challenges and possible solutions as a class. *(Answers will vary. Some will have no resolution except to build in another location or to accept the outcome.)*

3. Alert the student that there is a blackout section on the map where there is no soil information. Where is this? *(The factory area.)*

   Why is this area blacked out? *(The factory was built before the county survey was made or before the aerial photographs were taken.)*

   Have you noticed that many old factories were built near water? Why? *(Source of water, power for early mills, water transportation, etc.)*

4. Ask the class:

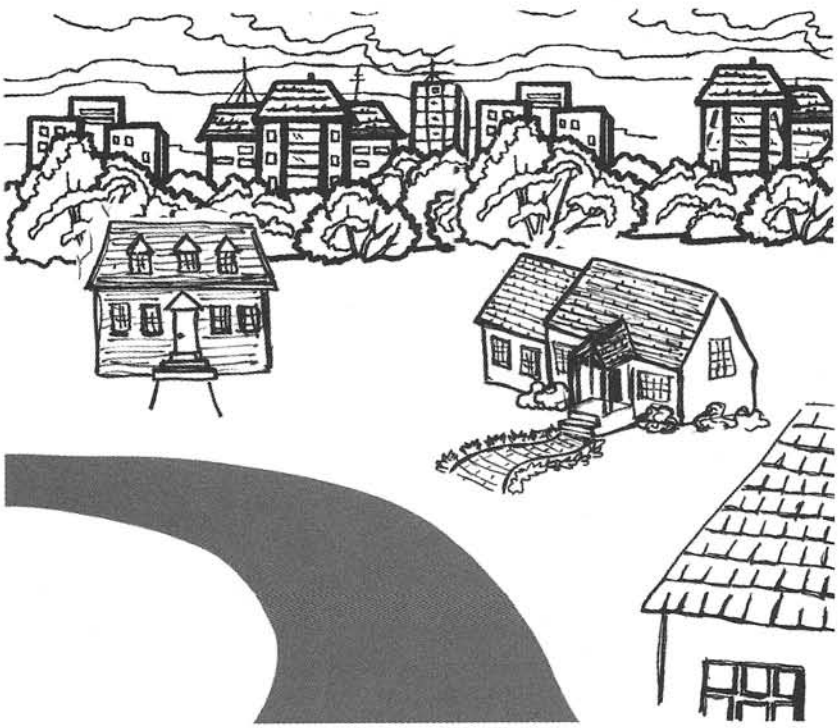
   - Why is the other land used as it is? *(The best land is being farmed; vegetables, Christmas trees and farm markets are in close proximity to home; the pond is in the best location, etc.)*

   - Is it appropriate to have cattle grazing in the pasture near the river, but fenced off from the river? *(Yes, the land near the river is seasonably wet and cannot be farmed. Neither houses nor businesses should be built on floodplains, etc.)*

   - Historically, who made these decisions? *(Answers vary but they were probably made by landowners based on economics.)*

   - Who makes these decisions today? *(Town zoning board, planning board, state or federal regulators, local or state conservation agencies, etc. Economics still plays a significant role.)*

5. Explain that when making land-use decisions, there is information available as well as experts to be called upon. Decisions should be made based on a land's capability. In years past, soil and related natural resource information may not have been available. This may have resulted in decisions being made that may not have reflected the land's capability.



EVALUATION OPTIONS

1. Assess students' map and chart reading skills in this and other activities.

2. Evaluate completeness of the students' decisions about land uses in Session Four.

3. Have each student create his or her own list of suitable land-use decisions and poor land-use decisions from the map or county survey, if available.

EXTENSIONS AND VARIATIONS

1. Obtain a copy of the soil survey map from the NRCS office of the county in which the school lies as described in the Getting Started section. Have the students:

   A. Locate the school district on the county's soil survey map. (Other options may include their neighborhood, farm, or where friends or family live.)

   B. Identify key indicators with which they are familiar such as roads, streams, buildings, lakes, parks, etc.

   C. Ask students what date the soil survey was published (on front cover as date issued), date the photos were taken, and data collected (series date). [These can vary from the early 1960s to the present.] Discuss changes that may have occurred since the publishing dates and/or the photo and data collection. (Highways, school locations, and suburban development will vary greatly over the 40-year period, depending upon when your county's survey was completed.)

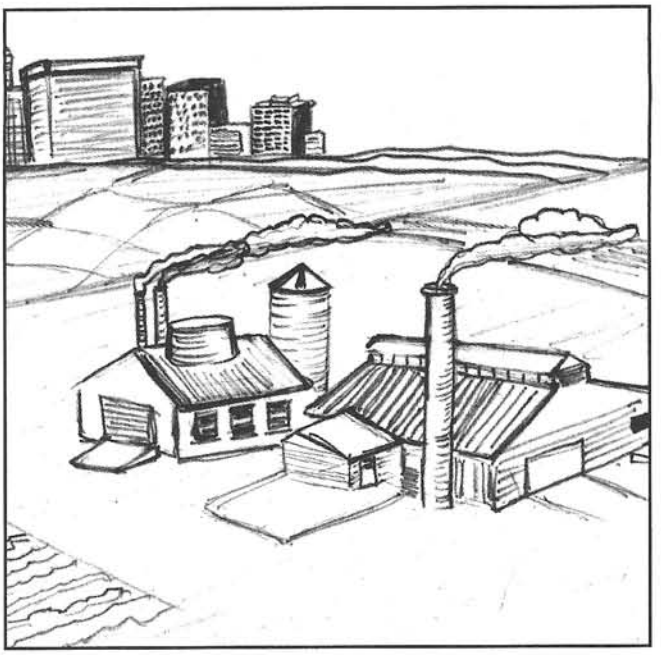
   D. If all or part of the entire district is urban, it may or may not have a soil survey. This depends upon how developed your city was when the aerial photos and soil samples were taken. Ask:

      - "Why does the soil survey end at the _____?" *(Land is paved, soils have been greatly altered by construction, fill may have been brought in from areas with differing soil types, etc.)*

2. Have the students draw their own maps of their neighborhood or some other limited land area or create a classroom-size map of the school district for a bulletin board.

   A. From these maps, identify the six major soil types from a select area. Use these six soil types and descriptions to answer the land use questions.

   B. Ask questions similar to those in Session Three and Session Four from information in the soil survey book. This will be a large task because each county book contains an amazing array of complex information.



3. In your community, identify possible problem sites where land classification or capability was not adequately considered. Discuss possible problems and solutions.

   - Have there been any problems? *(Highway repeatedly cracks or heaves in a certain area, potholes always develop in the same area of the road, mudslides, flooding, etc.)*

   - What possible solutions may solve these problems? *(Answers will vary.)*

CREDIT

Soil Survey of Tompkins County, NY

ADDITIONAL RESOURCES

NRCS Office, Town Planning Board, Conservationists

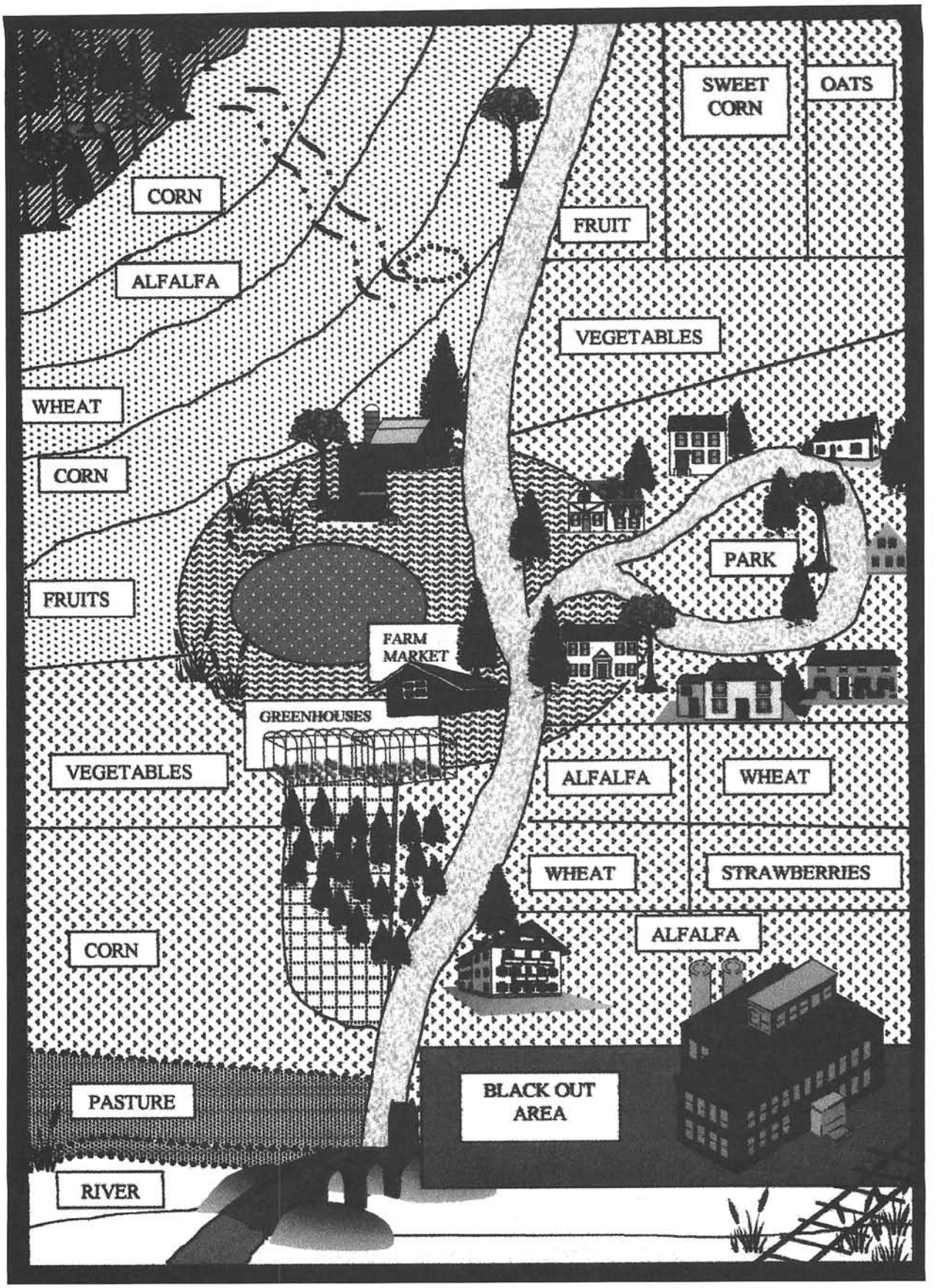
EDUCATOR'S NOTES

 Conceptual Framework Reference: I., I.A.1., I.A.2., I.C.3. I.F.1., II.A.3., II.B.3., III.B.1.

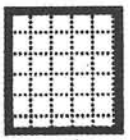
SOIL TYPE DESCRIPTIONS

Soil Type	Suitability for Agriculture			Suitability for Engineering		Town or County	
	Farm	Grasses	Forestry	Ponds	Highways	Homesites	Drainage
Genessee	Excellent	Excellent	Good, unless wet	Poor	Fair to Poor	Poor	Subject to flooding
Halsey	Poor	Good	Very Poor	Good, high water table is present	Poor, high water table, subject to flooding	Poor, expansion and contraction of the clay content of the soils could lead to cracking of the foundation	Maximum drainage needed
Palmyra	Fair	Good	Fair	Good	Poor, frost heave	Adequate, but will settle with heavy vibration	Not needed
Phelps	Excellent	Excellent	Excellent	Good	Poor, frost heave	Good	Needed seasonally
Wayland	Fair	Good	Very Poor	Poor	Poor, subject to flooding	Poor, subject to flooding	Maximum drainage needed, subject to flooding
Lordstown	Very Poor	Poor, but best kept in cover, high erosion	Poor, but best kept in cover, high erosion	Poor	Fair, soils are shallow, runoff is rapid	Very Poor, soils shallow, bedrock near surface, erosion hazard	Drainage needed in pockets

LAND USE MAP

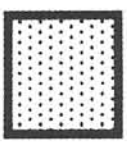


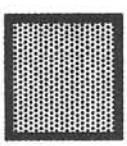
MAP KEY

Genessee 

Halsey 

Palmyra 

Phelps 

Wayland 

Lordstown 

Marsh 

Springs 

Wet Spots 

Perennial Pond or Lake 

Fencing