**INTRODUCTION**

**OVERVIEW**
This module begins by rooting students to their community through a sense of place. Through hands-on mapping, climate and community-based investigations students begin to examine and interpret the landscape and environment of their community and how the relationship between geography and climate affects their region’s agricultural production.

**ESSENTIAL QUESTION**
What geographic features and climatic elements led New York’s farmers to settle in particular regions?

**NEW YORK STATE STANDARDS**

**Social Studies Standards**

**Standard 3-Geography: Elementary: #1**
Geography can be divided into six essential elements which can be used to analyze important historic, geographic, economic, and environmental questions and issues. These six elements include: the world in spatial terms, places and regions, physical settings (including natural resources), human systems, environment and society, and the use of geography.

**Math, Science, Technology Standards**

**Standard 1 – Analysis, Inquiry and Design: Elementary: Scientific Inquiry: #1**
The central purpose of scientific inquiry is to develop explanations of natural phenomena in a continuing, creative process.

**Standard 1 – Analysis, Inquiry and Design: Elementary: Scientific Inquiry: #2**
Beyond the use of reasoning and consensus, scientific inquiry involves the testing of proposed explanations involving the use of conventional techniques and procedures and usually requiring considerable ingenuity.

**Standard 1 – Analysis, Inquiry and Design: Elementary: Scientific Inquiry: #3**
The observations made while testing proposed explanations, when analyzed using conventional and invented methods, provide new insights into phenomena.

**Standard 2 – Information Systems: Elementary: Information Systems: #1**
Information technology is used to retrieve, process, and communicate information and as a tool to enhance learning.
Students use measurement in both metric and English measure to provide a major link between the abstractions of mathematics and the real world in order to describe and compare objects and data.

Standard 4: Science: Elementary: The Living Environment: #1
Living things are both similar to and different from each other and nonliving things.

Standard 4: Science: Elementary: The Living Environment: #4
The continuity of life is sustained through reproduction and development.

Standard 4: Science: Elementary: The Living Environment: #6
Plants and animals depend on each other and their physical environment.

**Desired Outcomes/Indicators of Success**

Students will:
- develop an understanding of geography by learning how to read and interpret maps
- develop an increased awareness of their surroundings
- gather appropriate information from a variety of resources and demonstrate the ability to convey information on a map.
- deepen their understanding of place by investigating the climate of their region and its impact on agriculture
- use garden activities to learn and understand how farmers analyze their land and determine what crops to produce.

**Student Inquiries**

Students will:
- begin by exploring maps
- discover how maps reveal information about people, places and history
- interpret a USDA Hardiness Zone Map
- test the soil in their region
- identify the geographic features of their community and relate those to what has historically been grown in their region.
- complete a site analysis.
- compare plant growing requirements and local environmental conditions to develop a list of possible crops to grow on their site.

**Resources**

Books:


Websites:
Cornell Cooperative Extension – includes guides for growing vegetables & fruits and links to 57 regional extension websites
http://www.cce.cornell.edu

Cornell Soil Nutrient Analysis Lab—how to submit a soil sample
http://www.css.cornell.edu/soiltest/newindex.asp

Cornell University Garden-Based Learning—Resources for educators working with youth gardening programs
http://www.hort.cornell.edu/gbl/groundwork/index.html

Cornell University Home Gardening Website—links to a wide range of basic gardening information
http://www.explore.cornell.edu/scene.cfm?scene=Home%20Gardening

Kidsgardening.com—A vast collection of youth garden web resources from the National Gardening Association
http://www.kidsgardening.com

Kidsgardening.com: Branch Out with Weather and Climate
http://www.kidsgardening.com/Dig/DigDetail.taf?ID=890&Type=Art

Kidsgardening.com: Making Weather.Tracking Tools
http://www.kidsgardening.com/Dig/DigDetail.taf?ID=1965&Type=Art

Kidsgardening.com: Mapping Out the Schoolyard—information on how to plan your school garden
http://www.kidsgardening.com/Dig/DigDetail.taf?ID=1877&Type=Art

Kidsgardening.com: Soil Sleuths
http://www.kidsgardening.com/Dig/DigDetail.taf?ID=1042&Type=Art

Kidsgardening.com: Starting with a Design
http://www.kidsgardening.com/Dig/DigDetail.taf?ID=1042&Type=Art

NASA Soil Science Education Page—Soil background information for elementary school students
http://soil.gsfc.nasa.gov/index.html

New York Agricultural Statistics Services – contains current and historical data on agriculture in New York State
www.nass.usda.gov/ny

New York State County Clerk’s Office – contact list
http://www.dos.state.ny.us/lists/coclerks.html

NOAA National Weather Service Kids website
http://www.weather.gov/om/reachout/kidspage.shtml

NRCS Soil Page—Extensive information on soil from the Natural Resources Conservation Service
http://soils.usda.gov/

Old Farmer’s Almanac gardening tips website –contains information for planning and planting your garden
http://www.almanac.com/garden/
School Garden Wizard—How to start a school garden resources from Chicago Botanic Garden
http://www.schoolgardenwizard.org/

Young Yorkers Leaflet: Unlocking the Mysteries of the Past — Using Maps to Learn About a Community’s History
http://www.yorkers.org/leaflets/unlocking.htm

The Weather Channel: Gardening website – enter your zip code for information on planting essentials in your area
http://www.weather.com/garden
PROCEDURE

**ACTIVITY #1: INTRODUCTION TO MAPPING**

Maps are most often used to help us locate places. However, maps do much more than show us how to get from one place to another. They are also rich resources for learning about a place’s history. You can discover a great deal of information about a community just from studying an old map. For instance, the types of businesses and cultural institutions that were part of a community, where individuals of that community lived, and even their ethnic backgrounds can often be determined just by studying an old map. You can also trace the growth and development of a community by comparing maps from different periods in a community’s history.

- Begin with a discussion about the various kinds of maps and how different maps reveal diverse information about an area
  - **Sample questions:**
    - What do we use maps for?
    - Why are there so many different kinds of maps?
    - What information can a map illustrate?
    - Could one map effectively display all of that information?

- Using the **Maps Graphic Organizer** worksheet, indicate all of the different kinds of maps you encounter - look around your classroom, in your social studies text book, around your community, etc.
  - **Use the chart to answer the following questions:**
    - What is the title of your map?
    - What does the map show?
    - What type of map is this?
    - In your opinion, how could the information on this map be helpful to a farmer?

- Using a modern map of your town and an historical map from the primary sources section, list the similarities and differences between the maps. Use the **Maps Venn Diagram** worksheet to indicate what has changed and remained the same. Note: natural boundaries, county boundaries, and town names.

**ACTIVITY #2: NATURAL GEOGRAPHY & CLIMATE**

To effectively understand how a region’s geography defines agricultural production, students will explore the relationship between natural boundaries such as mountains, rivers, lakes, and valleys that define the regions of New York and the corresponding climatic regions.

**Question for discussion:** based on the list of maps you created in activity #1, how could farmers use maps to help them plan their crops?

Individually or in small groups explore the following maps and answer the corresponding scaffolding questions. You may wish to prepare one color copy (hard copy or overhead transparency) of each map and have the children color a black and white version to further promote comprehension of the material depicted.

- **Landforms – Facts on File State Maps on File: New York**
- **USDA Hardiness Zone Map – New York**
- **Precipitation Map – Average Annual Precipitation (in inches) – New York**
- **Soil Regions Map – New York**
- **Climatic Regions Map – New York**
Activity #3: New York Agricultural Production and Population Maps

In addition to illustrating New York’s geographic and climatic features, maps can be used to display economic and demographic information. Students will explore the following maps and answer the corresponding scaffolding questions.

- Use the New York Agricultural Production maps to begin investigating the top producing counties.
- Looking at the Agricultural Production maps and your Landforms map explore the relationships between agricultural production and the natural regions. Consider how geography and climate affect the agricultural products in the region.
- Using the Population Map consider the placement of the greatest and smallest population densities and compare that to their corresponding agricultural production, climate and natural boundaries.

Garden Activities

To complement the history lessons, your students are going to become farmers through the creation of a school garden (outdoor or indoor) designed to simulate a working farm. The activities revolve around the creation of a ‘farm’ distinguished from a garden by including a focus on producing a marketable crop. The crop you choose can vary, but the exercises look at the garden as a business so students can have a true sense of what it would be like to be a farmer.

Some examples of possible ‘school farm’ garden projects include (but certainly are not limited to):

- Grow salad vegetables like lettuce, carrots and radishes (indoor or outdoor) and then sell fresh produce or host a fundraiser salad party.
- Grow herbs (indoor and outdoor) and turn them into craft projects like potpourri or sachets to sell.
- Produce potted house plants from cuttings (indoor) and sell them for a holiday such as Mother’s Day or Valentine’s Day.
- Grow annual flowers from seed (indoor) and sell the small plants when it is time to transplant them outside.

For more ideas visit: http://www.kidsgardening.com/themes/business1.asp

Although the opportunity to sell the harvest to other friends, family, teachers and volunteers is a valuable experience and money raised can be used to fund the garden program in future years, if school policy prohibits selling your harvest for money you can also:

- Trade harvest for other goods and services. For instance, students can trade their harvest for a special movie afternoon. The traded harvest could then be given to teachers or other staff in the school. Trading of the harvest can be a good history lesson as many early farmers would trade for materials in addition to selling harvest for money.
- Estimate the value of the crop and then donate to a local senior center or food pantry and receive a receipt for the donation.
- Sell to each other with pretend money. Price your products and then give each student a set amount of ‘money’ they can use to purchase products to take home.

By creating a purpose for the harvest, you introduce your students to the responsibility and pressure real life farmers experience. With a successful crop, they will learn about the excitement and rewards of being a farmer and if your crop fails, they will discover a very valuable lesson - farming is a hard way of life and some times environmental factors are beyond human control. To make sure you experience success, you may choose to ‘diversify’ your farm and choose more than one marketable crop to produce (diversification is another valuable farm life lesson, discuss the saying: "Don't put all your eggs in one basket").
**Getting Started:** So where do you begin? Begin your school farm project by first receiving approval from all necessary administrators. Discuss your vision with principals or other supervisors and make sure they are on board with your new venture.

Once you receive the stamp of approval, focus on creating a support team. Garden programs are usually more work than 1 person can sustain, so to ensure success, enlist other teachers, parents and community volunteers to serve on a planning and advisory committee. Members of this team may take an active role in helping you find supplies, teach lessons and maintain garden areas, or they may serve as a resource for ideas and help with promoting your project to other parents and in the community. Both types of members are vital to garden operations.

Another person to approach early on about your program is the school custodian or janitor. Many teachers note a good relationship with the custodian can be valuable in accessing resources (like storage closets and water sources) and by having an extra set of eyes to help keep on eye on gardens. On the flip side, if a custodian is not involved, you run the risk he/she will feel your garden is creating additional work for them and they may find ways to make your program more difficult (for instance not allowing you access to storage space or by complaining to administrators about the garden mess).

Make sure to contact and involve any one who may have a stake in your program. Another group of potential key supporters are the people who live in the neighborhood around the school. They may be especially helpful for maintenance during vacations and other breaks.

The first task of your new committee is to create a clear set of goals and link the school farm to the curriculum. Once you have a clear set of goals, you need to decide what kind of growing space will best fit your resources. Gardens can either be indoor or outdoor. Your indoor garden options include windowsill gardens, prefabricated Grow Labs or do-it-yourself light tables. Your outdoor options include in ground beds, raised beds and container gardens.

**Indoor Gardens:** Creating indoor gardens is a good option for schools in locations experiencing long winters and short growing seasons during the school year. The simplest form of indoor gardening is to place plants in front of windows that receive a decent amount of light. Windows that face south and west are best and they usually receive enough light to grow leaf and root vegetables (beets, carrots, lettuce, onions and radishes) and herbs. East and north facing windows do not receive as much light, so they will limit your planting options to mostly houseplants, however, houseplants can be an exciting and rewarding crop. You will need to spend a few days monitoring your window space to determine how much light is available for an indoor garden.

Grow lights (fluorescent tube lights designed to hang low over growing areas) are a more effective way to produce indoor crops. You can purchase prefabricated GrowLabs (the National Gardening Association’s Kids Gardening Store sells a number of different models for schools available at: [http://store.yahoo.com/nationalgardening/growlab.html](http://store.yahoo.com/nationalgardening/growlab.html)) or you can make your own. With grow lights, you can control the amount of light your plants receive and can expand your crop options to fruit crops like tomatoes and strawberries.

Check out these web links for more information on growing indoor gardens:
- NGA’s Indoor Seed Starting FAQ: [http://www.kidsgardening.com/Dig/DigDetail.taf?ID=180&Type=faq](http://www.kidsgardening.com/Dig/DigDetail.taf?ID=180&Type=faq)
- University of Missouri Lighting Indoor Houseplants: [http://muextension.missouri.edu/explore/agguides/hort/g06515.htm](http://muextension.missouri.edu/explore/agguides/hort/g06515.htm)
Low-Cost Grow-Light Frame Plans from Cornell University:
http://www.gardening.cornell.edu/factsheets/growlite/index.html

Indoor Gardening Publications from Cornell University:
http://www.gardening.cornell.edu/houseplants/index.html

or check your local library for the books GrowLab®: A Complete Guide to Gardening in the Classroom and GrowLab®: Activities for Growing Minds.

Outdoor Gardens: The traditional outdoor garden is planted in the ground of a school yard. Unless the area has been cultivated before, you will need a tiller to break the compacted soil before you begin planting.

Another option commonly used by schools is to create gardens in raised beds. Raised beds are built by creating 4-sided, framed structures usually 1 to 2 feet high using materials such as rot resistant wood (like cedar), concrete blocks and recycled plastic ‘wood’ and then filling them with soil. Raised beds can be built over soil or on top of concrete or asphalt surfaces. Although raised beds are more expensive than planting directly in the ground, they do offer a number of benefits. You can choose your own soil making them easier to cultivate and eliminating worries about possible toxins such as lead. Raised beds usually have fewer weed and drainage problems. Additionally, they can be designed to be handicap accessible. Also, plants in raised beds are usually more protected from running feet. For more information about raised beds visit:  http://www.hort.vt.edu/human/pub426020d.html

Another outdoor option is to plant in containers. Examples of common containers include clay and plastic pots, and large wooden barrels, however, you can use anything that holds soil and has drainage holes. You can even use even an old bathtub. If you experience warm days, but cold nights, you can create an indoor/outdoor garden by growing plants in buckets with handles or pots with wheels and transport plants outdoors during the day and indoors at night. For ideas on planting container gardens visit:  http://www.kidsgardening.com/growingideas/projects/feb03/pg1.html

School Garden Tips:

- **Start SMALL!** Plan for a big garden in choosing your space but start very small. Don’t exhaust the enthusiasm of your students and volunteers by preparing soil and removing weeds on a large area. Let them get excited about the joy of a bountiful, FUN, small garden. Then expand as your confidence and experience increases.

- **Involve Your Students.** Involve your students in as many of the planning steps as possible. Teachers across the country have discovered that when students are involved in all stages of the process, they are more invested in the project's success and inspired to care for and respect their schoolyard gardens. The more they can participate in the planning, the more they will feel like ‘farmers.’

**GARDEN ACTIVITY #1: SOIL INVESTIGATIONS**

Although there are many factors contributing to successful farming operations, any farmer or gardener will tell you one of the most important elements is the soil. The soil is the base for all plant life. In addition to being the anchor matter for the plant roots, it also provides water and nutrients for the plant. Plants grown in good soil will perform better and experience fewer problems with insects and disease.

Soil by definition is made up of sand, silt and clay particles derived from rock broken down over thousands of years by climatic and environmental conditions (rain, glaciers, wind, rivers, animals, etc). Sand particles are defined as particles between 2.00 - 0.05 mm in diameter (USDA) and they feel gritty in your fingers. Silt particles are particles that are between 0.05 - 0.002 mm (USDA) and feel similar to flour.
Clay particles are particles smaller than 0.002 mm (USDA) and feel sticky in your fingers when wet and clump to the point that you can not see an individual particle without a microscope. These particles are derived from a number of different types of rock so defining something as sand, silt or clay is about sizing the particles, not determining their original source. The amount of each of these components characterizes your soil. For instance, if you have a lot of sand, your soil will drain quickly and in contrast if you have a lot of clay particles, your soil will often be compact and retain water.

In addition to the sand, silt and clay, you will also find nutrients, organic matter (decaying plant and animal material), and pore space (open space that holds air and water) in soil. These characteristics also impact the growing conditions for your plant. Just like people need vitamins, plants need certain nutrients for proper growth and development. The available nutrients affect plant growth below and above the ground and especially impact fruit production. Organic matter influences nutrient and pore space content. As plants and animals decay they release additional nutrients and create new pore space. The pore space is important to soil structure (the arrangement of the particles in relationship to each other). In an optimal situation about 50 % of the volume of the soil is pore space with half of that filled with water and half filled with air (the other 50% is the sand, silt, clay and organic matter). Roots need air as much as they need water and the plant can actually suffocate or drown if completely emerged in water for extended periods of time.

What is the best kind of soil? Well there is no such thing as the perfect soil, but there is a perfect soil for a particular plant. Each plant likes different conditions. In general, common garden plants prefer a well-draining loam (a soil that is composed of approximately 40 percent sand, 40 percent silt, and 20 percent clay with plenty of organic matter and ample pore space) however there are plants that grow better in sandy conditions and others that grow well in compact, clay soils.

Farmers begin by analyzing their soil and then determine the best crops to grow. Although soil can be amended and improved (adding organic matter is common practice to improve drainage and nutrient content) on a large scale it is best to pick out a crop that will grow well in the soil available to you. With your school farm, you may have more control over the soil you use (especially if you are using container gardens, raised bed gardens or indoor gardens), but the following activities will help you to practice analyzing soils and discussing different soil properties including soil texture, drainage and nutrient content.

For more background information on soil visit:
   NRCS Soil Website: http://soils.usda.gov/

**Soil Texture:** Soil texture is the way soil feels and it is determined by the amount of sand, silt and clay particles present. Here are two activities to determine the particle make up of your soil. If you are starting an outdoor in-ground or raised-bed garden, try the activities using the soil from the prospective plot.

If you are going to create container gardens or indoor gardens, most likely you will be using a soilless potting mix (these mixes are usually made from peat moss, vermiculate or perlite and are called soilless mixes because they do not include sand, silt or clay), so ask students to bring in soil samples from home or use soil from your playground area.

**Ribbon Test:** Take a small clump of soil and add water until it makes a moist ball. Next rub the soil together between your fingers. If the soil makes a nice, long ribbon, then it has a lot of clay in it (thus sticks together well). If it crumbles in your hand, then it has a lot of sand. If it is somewhere in between, then you probably have a good mix (a soil with a good mix of all 3 components is called a loam). Although this test does not give you an exact percentage of each component, it provides a general description and it can be used in the field due to the ease of implementation (all you need is a little water).
Shake It Up: Invite students to further explore different soil components by creating "mudshakes" and watching components settle out. For each soil sample, have students fill a clear plastic container about two-thirds full of water, then add enough soil to nearly fill it to the top. Also add a pinch of laundry detergent to help the soil components separate well. Shake the container vigorously then observe it over the next couple of days as the particles settle into layers. Ask students to hypothesize about the composition of the different layers. The larger particles (sand) are heaviest and will settle at the bottom, followed by silt with the last full layer being clay. The clay may stay suspended and cloud the water for a long time. Organic matter will float on or just below the water surface.

Once the container has settled, compare the results to your ribbon test. How do they compare? Measure the height of each layer and then translate that into percentages for each component (height of each component divided by height of the sample). Use the Shake It Up worksheet to help with your evaluation.

Soil Drainage: Soil drainage is a critical factor when determining good crops for a particular site. Although having water available is certainly important, too much water causes the plants to suffocate and also promotes many fungal diseases. Although there are some plants that grow well in boggy soils, most production crops (vegetables, row crops, fruit trees) need good to excellent drainage. Below are two experiments to test the drainage of soil or potting mix for your prospective school farm.

For an Outdoor Garden: Dig a 12-18 inch deep hole in the proposed location for your school farm project (a post hole digger will work well). Fill the hole with water. If the water drains within a few hours, then the drainage is excellent, if it empties within 24 hours, then the drainage is acceptable and if it takes longer than that, then you have poor drainage.

For Indoor, Raised Bed or Container Gardens: Obtain a collection of different types of soils and potting mixes from local garden centers and landscape supply companies. When building raised beds, you usually order garden soil by the truck load from landscape supply companies. Many times the companies will have multiple blends of soil with varying amounts of compost and organic matter for you to choose from. Check to see if they will donate samples of the different types of soil for you to test. Indoor and container gardens usually use soilless potting mixes or garden soil amended with peat moss. A variety of types of potting soils are available at all garden centers.

Fill 6-inch, plastic pots (make sure they have drainage holes) with the different types of soil and potting mixes you were able to obtain. Additionally, fill one pot with sand to use for comparison. Add water to your pots until it emerges from the drainage holes. This is a sign that the soils are completely saturated. Wait 30 minutes to make sure all excess water has drained.

One at a time, hold each pot over a plastic tray or clear plastic bowl (the tray or bowl needs to be able to hold up to 1 cup of water). Measure out 1 cup of water and slowly pour it over each pot of soil. Record the amount of time it takes before water begins to emerge from the drainage holes. Continue to hold the pot over the tray or bowl until it stops dripping and then measure the amount of water in the tray or bowl (pour back into the 1 cup measuring cup).

Use the Drainage Experiment Worksheet to collect the data and ask students to hypothesize what this means about drainage. The faster the water began to drain, the better drainage the soil or potting mix possesses. Also the closer the end water measurement is to the original 1 cup of water, the better the drainage of the soil or potting mix.

Generally you want your soil to hold moisture, but not stay too wet. Based on this information, what soil or mix do they think is best? For further exploration, give the students a chance to feel each pot of soil and record whether or not it feels wet or moist. An additional method to test moisture is available by using a moisture meter which uses sensors to detect water levels (many garden catalogs have these available or you may be able to borrow one from a local gardener).
Nutrient Content: Plants receive nutrients by absorbing them through their roots. The soil nutrients come from decaying plant and animal matter. As they decompose, the nutrients are released into useable form into the soil.

Plants have 6 macronutrients (nutrients they need in large quantities: nitrogen, phosphorus, potassium, sulphur, calcium and magnesium) and 8 micronutrients (nutrients they need in small quantities: iron, zinc, copper, molybdenum, boron, manganese, chlorine and nickel) essential to their growth and development.

Obtain a do-it-yourself soil test kit. These kits are available at local garden stores and from garden catalogs. Using your prospective soil, test the nutrient content of your soil (most kits only test for pH and the big 3 nutrients: nitrogen, phosphorus and potassium). Write the results of each test on the chalkboard.

If you are planting an indoor garden, you can use these tests on your chosen mix too, however some mixes contain slow release fertilizers which will not read properly. For soilless potting mixes, a better option is to check the bag for nutrient content and if you do not find information about it, contact the company for the details. Do not be surprised to find out your soilless mix does not contain any nutrients. Often times this is the case so the grower can have complete control over the amount and timing of nutrients supplied. So if you are using a potting mix, you may want to practice soil testing using a sample from your playground.

What do the results say about your soil’s nutrient content? Does your soil have the nutrients needed for healthy plant growth? Will you need to supplement your soil with additional nutrients through fertilizer or compost?

Do-it-yourself soil kits vary in their accuracy. For more accurate results, obtain a soil test kit from your local Cooperative Extension office or from http://www.css.cornell.edu/soiltest/newindex.asp and send a test sample to the Soil Nutrient Analysis Lab. Share the results with your class and compare to the results from the do-it-yourself kit. How do the results compare? How reliable were the do-it-yourself soil test kits?

For Further Study: The Natural Resources Conservation Service (NRCS) has developed soil surveys which include soil maps and other information for farmers and ranchers to help with land use and management. Originally these surveys were published in hard copy by the U.S. Department of Agriculture and could be obtained from your state or local NRCS office. To ease distribution, these surveys are being added to the NRCS Web site or distributed on CD. Check with your local NRCS office or http://soils.usda.gov/survey/printed_surveys/ to determine the availability of your local soil survey.

Garden Activity #2: Conducting a Site Analysis

A site analysis includes a thorough evaluation of existing structures, plant materials, climatic and environmental conditions. During a site analysis, you take accurate measurements of your site and notes about important factors that will impact your crops. The end result is a detailed map and report to be used when designing the layout of your farm operation or landscape.

As a class, complete a site analysis for your school farm.

Steps for completing a site analysis for an outdoor location:
- Contact school maintenance staff to locate all utility lines (water, sewer, electric, gas, phone etc.). Never dig before learning the location of utility lines.
- Obtain a large tape measure (a 100-foot measure works well).
- Provide students with paper, clipboards (or cardboard pieces with paper clips) and pencils.
- Take the students outside to evaluate the site. Begin by making a rough sketch of the space and all the major landmarks on a piece of paper (if you are short on time or concerned about the ability
level of your students, you may want to create a sketch outlining the border and major structures ahead of time and make copies for them). Next take exact measurements of the borders around the site and write it down on your sketch. Once you have measured the parameters, take measurements of the locations and sizes of major trees, sidewalks, the utility lines and other structures. Write all measurements on your sketch.

- Identify and label the existing plant material.
- Using the site analysis worksheet as your guide, make notes about important environmental factors on your site. Write answers on your sketch or on the site analysis worksheet.
- When you return to the classroom, instruct students to translate their sketches and measurements into maps drawn to scale by plotting them on a piece of graph paper. The easiest scale is for 1 block to equal 1 inch or 1 foot, but you can adjust based on the size of your location and graph paper.
- Once they have completed their design of the space, ask them to write in notes about the environmental factors impacting the space. Color code the notes using colored pencils or markers to provide contrast with the design. For instance, note areas with poor drainage with a brown marker, the direction of the sun with a yellow marker, and the location of a water source with a blue marker.

The steps to completing an indoor site analysis include:

- Obtain a large tape measure.
- Provide students with paper, clipboards (or cardboard pieces with paper clips) and pencils.
- Draw a rough sketch of your classroom then measure the dimensions. Note the potential location for your indoor garden and measure the dimensions of that space.
- Measure and sketch other major features of the room (desks, bookshelves, electric outlets, etc.).
- Use the indoor site analysis worksheet to answer questions about important factors that will impact your growing space. Write your answers on the sketch or worksheet.
- When you finish, instruct students to translate their sketches and measurements into maps drawn to scale by plotting them on a piece of graph paper. The easiest scale is for 1 block to equal 1 inch or 1 foot, but you can adjust based on the size of your location and graph paper.
- After completing their design of the space, ask them to write in notes about the other factors impacting the space. Color code the notes using colored pencils or markers to provide contrast with the design. For instance, note electric outlets using a red marker and water sources using a blue marker.

Although no space is perfect, if you decide after completing your site analysis, that the prospective location is not going to work well (for instance you notice it is too close to a busy street or there are no electric plugs where you wanted to place grow lights), look for additional available space for your farm project.

**Garden Activity #3: Understanding Plant Needs and Growing Requirements**

In order to understand why some plants grow better in your area than others, there are a number of important concepts your students must learn including:

**Plant Needs:** Plants have 5 basic needs. They need water, light, nutrients, air and a place to grow.

- **Water:** Plants need water for a number of important processes including photosynthesis (production of food) and transpiration (evaporation of water from the leaves into air that cools the plant and creates pressure to move water from roots to leaves). Water also aids in the absorption of some nutrients.
- **Light:** Energy from light is captured to use during photosynthesis. Photosynthesis is the process by which plants make their food.
- **Nutrients:** Just as people need vitamins, plants also need special nutrients to help them grow properly and for their biological processes to function.
- **Air**: Plants take in carbon dioxide and oxygen to use during photosynthesis.
- **A Place to Grow**: Plants need a place to call their own. Do they need soil? Actually, not all plants need soil. There are some plants called epiphytes that are adapted to living in trees and absorbing water and nutrients from the air. However, they do all need enough space to grow to maturity so they can produce seed to ensure their survival.

To test these plant needs, try to grow plants in the absence of one of these factors. For instance, try to grow a plant without water or try to grow a plant in a closet without light. Use at least 2 plants for each experiment including one control (for instance grow one plant in the window and one plant in the closet but provide them with the same amount of water, air, nutrients and space). Only test one variable at a time to isolate the results.

**Plants’ Needs Vary**: Plants grow all over the world in different climates and environments. They all need access to the elements listed above, but they need them in different quantities. Some need high light others need low light. Some need to take in a lot of extra nutrients, and some need very few. They are adapted to the basic conditions (water, light, nutrients, air and place) available to them in their native environment (the place they originally grew). That does not mean they can not grow in another environment, it just means they prefer those conditions, and grow best in places that provide similar conditions.

To demonstrate the fact that plants need different growing conditions you can perform experiments by growing different plant varieties, but providing constant growing conditions. For example, you can obtain a number of plants with different water requirements such as a cactus or a pothos ivy (low water needs), a begonia or cyclamen (medium water needs), a potted azalea or miniature rose (medium to high water needs). Place all of them in a classroom window and water them once a week with the exact same amount of water. Keep a journal monitoring their growth and development. (*Note if you do not see many differences, lower the amount of water the plants are receiving).

Another option is to grow the same plant in multiple conditions. For instance obtain 4 identical cactus plants and plant one in sand, one in garden soil, one in sand with a clear plastic bottle covering the pot (creates a humid environment) and one in garden soil with a clear plastic bottle covering the pot. Track the growth and development.

These are just a couple of examples. Write the 5 plant needs on the board and challenge students to come up with ways to test how different plants need different conditions. Have students write down one experimental idea and then detail the steps necessary to complete it. You can use the Plant Needs Experiment Worksheet to help guide the students. Then as group or individual projects, implement as many of the experiments as possible. When the experiments are finished, analyze the results and ask students to explain what they learned about plant needs and growing conditions.

**Plant Life Cycles**: Plants begin their life cycle as a seed that germinates and becomes a seedling maturing into a plant that then produces either a fruit or a cone containing new seeds (and the cycle begins all over again). Although the steps in this process are the same for all plants, the actual life cycles vary in length and schedule. There are two main categories of plants including annuals and perennials.
- **Annuals**: Annuals are plants that complete their life cycle during one growing season. Under normal conditions they begin as a seed, grow to full maturity, produce seed and then die during one growing season. The two main types of annuals are cool season (growing season from late fall to early spring) and warm season (growing season from late spring to early fall).

If placed in protected locations, annuals can live longer than one season. For instance an impatient is a warm season annual in New York and will die when the first freeze hits. However, if you bring it inside when cool weather arrives, it will survive longer. Even though it is alive inside during the winter, it is still considered an annual because it would not live for more than one growing season under normal conditions.
• **Perennials:** Perennials are plants whose life cycle is longer than one growing season. There are three different categories of perennials:
  o *Herbaceous Perennials:* Plants that live for many years after growing to maturity. The stems and leaves of herbaceous perennials die back each winter, but they come back from the roots in the spring. Herbaceous perennials do not make wood, although their stems may become wood-like in appearance. Examples include: daylilies, goldenrod, and coneflowers.
  o *Shrubs:* Shrubs live for many years after growing to maturity and the stems make wood. They usually have multiple trunks and their height is usually less than 15 feet.
  o *Trees:* Trees live for many years after growing to maturity and the stems make wood. They usually have a single trunk and are taller than 15 feet.

**Plants for Your Site:** Farmers grow plants adapted for their conditions because well adapted plants will have fewer problems with insects and diseases, will need fewer inputs such as additional water and fertilizer, will need less care and therefore usually result in a profitable harvest. Using the information gathered in the other activities in this module and by researching using the Internet (to provide technology link), horticulture books and seed catalogs, create a list of plants suitable for your school farm project. Remind students to match your environmental conditions (especially light available, temperature, room to grow and water) to the needs of the plants. Ask them to note whether plants are annuals or perennials.

For ideas and resources on outdoor crops for your area, contact your local Extension Office or visit:
  - Cornell Vegetable Growing Guides: http://www.explore.cornell.edu/scene.cfm?scene=home%20gardening%26stop=HG%20%20Find%20a%20Vegetable
  - Cornell Flower Growing Guide: http://www.explore.cornell.edu/scene.cfm?scene=home%20gardening%26stop=HG%20%20Find%20a%20Flower

For ideas and resources on indoor crops:
Check out the book *GrowLab®: A Complete Guide to Gardening in the Classroom and GrowLab®: Activities for Growing Minds* or visit:
  - http://gardening.wsu.edu/text/indoor.htm
  - http://aggie-horticulture.tamu.edu/interiorscape/index.html

**Assessment Activity**

Using clear overhead projector pages create a 4-layered overlay map of New York State indicating landforms, climate information and crop production on top of a base map. What do you notice about the relationships between climate, topography and crop production? Consider how topography and proximity to large bodies of water affects the climate and population distribution.
  - **New York State Map**
EXTENSION ACTIVITIES

- **Make an edible topographic map of New York State**
  - Using different colored layers of Jell-O
  - Using peanut butter dough
  - Using a New York-shaped cookie

  **Non-edible options:**
  - Using salt dough
  - Using Delta Foam

- **Contact a local soil testing lab** or your local Natural Resources Conservation Service (NRCS) office to find out what services and resources they provide. They may have posters, soil profiles and soil samples available for you to borrow. NRCS is an outreach service of the USDA providing educational assistance for land owners regarding conservation of soil, water, and other natural resources. You can use the USDA Service Center Locator at: http://offices.sc.egov.usda.gov/locator/app to contact your local office.

- **Can you grow your favorite fruit or vegetable here?**
  Ask students to research the needs (light, temperature, nutrients, etc.) of their favorite fruit or vegetable (the product’s origin will give clues to what conditions it needs to grow). Determine if it will be possible to grow it in your school garden (i.e. tomatoes), or if the climate could be modified to create the proper conditions (such as growing it in a school greenhouse, e.g. an avocado tree).

- **Making weather-tracking tools**
  Visit http://www.kidsgardening.com/Dig/DigDetail.taf?ID=1042&Type=Art to learn how to build a weather station to measure local short-term changes in the weather and track more long-term climate information or attain data from a local weather station (or access NOAA weather information) to determine what will grow there. (This will help explain why we do not produce large quantities of bananas and coconuts in New York State).
Use the following graphic organizer to categorize the different types of maps you discover in your classroom and around your community.

<table>
<thead>
<tr>
<th>What is the title of your map?</th>
<th>What does the map show?</th>
<th>What type of map is this?</th>
<th>In your opinion, how could this map be helpful to a farmer?</th>
</tr>
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</table>
Maps Venn Diagram worksheet

Using the Venn diagram below, list the similarities and differences between the historic and modern maps of your town. Note what has changed and remained the same; be sure to look for natural boundaries, county boundaries, and town names.
Landform maps show the ways that land can be divided by natural boundaries such as mountains, rivers, lakes, and valleys. New York State’s terrain is indicated on this map. Farmers can use landform maps when they map out their fields.

1. List the natural boundaries shown on this map.
   ____________________________
   ____________________________

2. Using a dictionary, define the following landforms
   Highland _______________________
   Mountain ______________________
   Plain __________________________
   Plateau _________________________
   Topography ______________________
   Valley __________________________

3. Find your region on the map, what is the landform definition of your region?
   ______________________________
USDA Hardiness Zone Map – New York

Sources:

Hardiness zones indicate the average minimum (low) temperature in a region. This information helps farmers determine if a crop will survive the winter conditions in their region. When you visit a garden center, hardiness zones are listed on a plant’s tag or on the seed packet.

1. How many hardiness zones are there in New York State?

_______________________________________________________________________________

2. Find your county on the map, what is the low temperature range for your county?

_______________________________________________________________________________

3. Looking at the Landforms map, which region has the lowest annual temperature?

_______________________________________________________________________________

4. How do hardiness zones relate to the Landforms map above?

_______________________________________________________________________________
In New York, precipitation comes in the form of rain, snow, sleet and hail. Farmers use the average annual precipitation information for their region to help them plan what crops to plant and to decide when to do their planting so they can use natural precipitation to water their crops.

1. Looking at your Landforms map, which natural region in New York experiences the greatest average annual precipitation?

_______________________________________________________________________________

Find your county on the map, what is the average annual precipitation in your region?

_______________________________________________________________________________

Why is being able to estimate the annual precipitation so important to farmers?

_______________________________________________________________________________
A Soil map tells us what the soil is made up of throughout New York. The soil’s content is dependent upon the parent material (rocks & minerals), climate, local vegetation, the area’s topography and time. Farmers use this information to determine which crops will naturally grow best in their soil or to determine if they will need to use additives to change the soil on their farm.

1. Find your region on the map, what is the soil category in your area?

_______________________________________________________________________________

How many soil categories are listed for New York?
_______________________________________________________________________________

Is there another area in the state that has the same soil characteristics as your region?
_______________________________________________________________________________
The Climatic Regions map is a summary of the weather conditions that characterize a region throughout the course of a year. Weather can vary enormously from day to day. Climate remains relatively constant but does change slowly. Farmers depend on climatic information when deciding which crops to plant and when to help ensure a successful harvest.

1. How many climate regions are listed in New York State?

_______________________________________________________________________________

2. Find your county on the map, how is the climate defined in your area?

_______________________________________________________________________________

_______________________________________________________________________________

3. Reviewing the Precipitation map and the Hardiness Zones map which region has the most moderate climate?

_______________________________________________________________________________

_______________________________________________________________________________
The Agricultural products maps show us the counties which are producing the greatest amount of an agricultural product throughout New York.

According to the New York Agricultural Statistics Service
- Dairy products are New York’s top agricultural product – accounting for almost half of the total agricultural production in New York
- Corn, oats and wheat are the top field crops in New York
- New York ranks third nationally in maple syrup production
- Apples are the fourth leading agricultural product in New York
- New York ranks third nationally in juice and wine production from grapes
- The leading vegetables grown in New York are cabbage, sweet corn and onions

1. Using the blank map:
   a. Trace the counties which produce milk products in blue.
   b. Trace the counties which produce grapes in purple.
   c. Shade the counties which produce wheat in brown.
   d. Shade the counties which produce maple products in green.
   e. Polka dot the counties which produce apples in red.
   f. Polka dot the counties which produce cabbage in yellow.

2. According to the maps, what agricultural products are grown in your county?
_______________________________________________________________________________
_______________________________________________________________________________

3. Look at the Landforms map. Based on the Agricultural Products map you colored, what is the topography of the region producing the greatest number of products?
_______________________________________________________________________________
_______________________________________________________________________________

4. How do the agricultural products relate to the natural boundaries?
_______________________________________________________________________________
_______________________________________________________________________________
The New York Population map – shows us the number of people that were living in each county of New York in the year 2000. The U.S. Census Bureau conducts a census for the entire country every 10 years.

1. What is the name of the county you live in?

_______________________________________________________________________________

Find your county on the map. How many people live in your county?

Between ___________ and ____________

2. Find the major cities in New York State on the map – mark an X on your map to indicate Albany, Buffalo, New York City, Rochester, Syracuse, and Yonkers.

What do you notice about the population in the counties surrounding these cities?

_______________________________________________________________________________

What does this tell you about the population of cities compared to other areas?

_______________________________________________________________________________

3. Why do you think the biggest populations live near the major cities?

_______________________________________________________________________________

_______________________________________________________________________________

4. Look at the counties with the greatest population and compare it with the maps of agricultural production. Is there a common connection between agricultural production and the areas with the largest populations?

_______________________________________________________________________________

5. Why do you think rural areas have not become more populated?

_______________________________________________________________________________

_______________________________________________________________________________
Shake It Up Worksheet

Once your “mudshake” settles, answer the following questions:

1. Measure the height of the settled soil in inches and centimeters:
   ___ Inches    ____ Centimeters

2. What type of soil particles are in each layer?
   Bottom Layer: _________________
   Middle Layer: _________________
   Top Layer: _________________

3. How tall is the bottom layer?
   ___ Inches    ____ Centimeters

4. What percentage of the total soil is the bottom layer?
   (= height of bottom layer ÷ height of all layers X 100)

5. How tall is the middle layer?
   ___ Inches    ____ Centimeters

6. What percentage of the total soil is the middle layer?
   (= height of middle layer ÷ height of all layers X 100)

7. How tall is the top layer?
   ___ Inches    ____ Centimeters

8. What percentage of the total soil is the top layer?
   (= height of top layer ÷ height of all layers X 100)

9. What are the particles floating on the top of your container?

10. How do these results compare to your ribbon test?
Drainage Experiment

Use this chart to record data during the drainage experiment in Activity #1.

<table>
<thead>
<tr>
<th>Pot #</th>
<th>Type of Potting Mix or Soil</th>
<th>Amount of time for the first drops of water to drain from the bottom of the pot</th>
<th>Amount of water that drained from the pot</th>
<th>Do you think this potting mix has good drainage?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pot # 1</td>
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<td>Pot # 2</td>
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<td>Pot # 3</td>
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<td>Pot # 5</td>
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<td>Pot # 6</td>
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<tr>
<td>Pot # 7</td>
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</tbody>
</table>

Which potting mix or soil do you think had the best drainage? Why do you think so?

What potting mix or soil do you think had the worst drainage? Why do you think so?

What potting mix or soil do you think will be best for our garden? Why do you think so?
Site Analysis Worksheet—Outdoor Garden

Utilities: Are there any utility lines on the site? If so, mark them on your sketch.

Accessibility: How can you get to your site? Is there a path? Is it easy to get to?

Water: Locate the nearest water source and mark it on your map. How will you be able to get water to your plants?

Drainage: Are there any wet areas on the site? Are there any signs of how water drains?

Topography: Are there any slopes on the sites? High spots or low spots?

Sunlight: The sun rises in the East and then moves to the West each day. Find out which direction is East and which direction is West to determine the path of the sun over your garden. How much sunlight does your spot receive each day (you may need to monitor the site at different times of the day to confirm)?

Wind: Is there a direction the wind always blows? If so, mark it on your sketch.

Surrounding the Site: Are there any major road ways or safety hazards near the site? Does the garden need a fence to protect it from animals or people?

Soil: What does the soil look like? Is it compacted?

Existing Plants: Are there any existing plants that need to remain on the site?

Storage: Is there a place to store tools close by?
**Site Analysis Worksheet—Indoor Garden**

**Place:** How much room do you have for an indoor garden? Mark where it will be located on your sketch.

**Safety Considerations:** What are the exit paths for the room in case of emergency? Mark them on your sketch. Is the proposed garden spot in the way?

**Sunlight:** Where are the windows? How many hours of sunlight do you get each day?

**Water:** Is there a source of water in the room?

**Electricity:** Where are the electric plugs in the room? Mark them on your sketch.

**Temperature:** Where does the heat and/or air conditioning come out? What is the normal temperature of the room? Is it extremely hot or cool by the window?

**Floor:** What type of flooring is under the space? Does it need to be protected from water and soil?

**Storage:** Is there a place to store tools and supplies?
**Plant Needs Experiment Worksheet**

Plants have 5 basic needs including:
- Water
- Light
- Nutrients
- Air
- A place to grow

Use this worksheet to help design an experiment to test the importance of these elements.

1. Choose an element from the 5 listed above to test: ____________________________
   This will be your experimental variable. You will treat plants to different amounts of this element to decide if it is important.

2. What are the other 4 elements: ______________________________________________
   _________________________________________________________________________
   These will be your controlled variables. You must keep all of these constant meaning you must give your plants the same amount of each of these variables in your experiment.

3. How will you test your experimental variable? How will you give your plants different amounts of this variable?

4. How many plants do you need for your experiment?

5. Where will you grow your plants?

6. How will you make sure all the other variables are constant?

7. How much time will you need for your experiment?
8. How will you measure your results?

9. How often will you check on your plants?

10. How will you compare your plants?

11. What do you think will happen in the experiment? (This is also called a hypothesis)
**EXTENSION ACTIVITY**

*Create Your Own 3-dimensional Map of New York State*

All directions indicate a topographic map but this activity could be transformed to represent the agricultural resources of New York. Each product could be identified by a specific candy. (i.e. milk chocolate chips for dairy, candy corn for corn, gummy fruit for apple, grape regions, etc)

**New York State Salt Dough Map**
Adapted from [www.proteacher.com](http://www.proteacher.com)

**Materials:**
- Large outline map of New York adhered to a piece of cardboard or heavy poster board
- Several cups of salt
- Several cups of flour
- Food coloring – 4 colors
- Water

**Directions:**
1. On large outline map of New York identify the 4 topographic features we have identified (Mountains, Plains, Plateaus, Valleys)
2. Mix salt and flour using **2 parts salt to 1 part flour**.
3. Stir in enough water to make a smooth heavy paste.
4. Divide the paste into 4 parts.
5. Add a different color food coloring to each part.
6. Place dough onto the outline to form a relief map of New York’s regions.
7. Include a color-coded map key of the regions.

**Details:**
1. Paint and label rivers, lakes and canals.
2. Paint and label the surrounding states.
3. Paint and label the Atlantic Ocean.

**New York State Edible Peanut Butter Dough Map**
Adapted from [www.atozteacherstuff.com](http://www.atozteacherstuff.com)

**Materials:**
- Large outline map of New York adhered to a piece of cardboard or heavy poster board
- Plastic wrap
- Peanut butter
- Powdered milk
- Powdered sugar
- Corn syrup
- Licorice strings
- Candies to represent topographic features

**Dough recipe:**
- 2 cups smooth peanut butter
- 2 1/2 cups powdered milk
- 2 1/2 cups powdered sugar
- 2 cups white corn syrup

**Directions:**
1. Make ahead - a batch of the edible dough
2. Cover a large outline map of New York with plastic wrap
3. Identify the 4 topographic features we have identified (Mountains, Plains, Plateaus, Valleys)
4. Cover the map with the peanut butter dough
5. Add different candies to define each of the topographic features
6. Outline bodies of water with licorice strings
7. Include a map key of the regions

New York State Edible Cookie Map

Materials:
Large sugar cookies – cut out shape using large outline map of New York State
Large outline map of New York – same size as the cookie
Colored icing – to represent landforms, water, surrounding state boarders
Candies to represent topographic features

Directions:
1. Make ahead – sugar cookies shaped like New York State
2. Using the outline map of NY, identify the 4 topographic features we have identified (Mountains, Plains, Plateaus, Valleys)
3. Frost the cookies to define landforms, water, and bordering states
4. Add different candies to define each of the topographic features
5. Include a map key of the regions