Module 2: Winter Gardening Module

**Driving Question(s)**

Driving Questions: How can we produce crops outside all year long?

Examples of Sub-Driving Questions:

* What can we do to control the temperature outside?
* How are farms able to produce crops all year long?
* In science, how do we solve problems or make discoveries?
* What conclusions can we draw by looking at the temperature we have recorded over the past few weeks/months?

**Overview**

In this module, the students will prepare to grow crops in the winter weather. The students will set up a scientific test to compare two different low-tunnels. The students will track the temperature both inside their low tunnel and outside and make comparisons. The students will try to produce winter greens throughout the colder months.

These plants need to be in the ground well before the first freeze so that they can be seedlings before the weather gets to cold. It is suggested that you direct seed by the first week of October. If your bed is not ready outside then you could plant seedlings inside and transplant them once they have already started to grow (about 2 weeks later). See module 3 for more information about planting transplants.

**Major Products & Performances**

Lesson 1: Participation in discussion, science experiment outline in science notebook, recorded observations

Lesson 2: Drawing of the low-tunnel plan, help in constructing the class low-tunnel

Lesson 3: creation of a table and graph in Excel

Overall: outdoor winter garden bed and harvested crops

**Teacher Background**

About the Plants:

Among the hardiest cold weather greens are arugula, Vit (mache/corn salad) and claytonia. These plants do very well in the colder weather. If covered with a low-tunnel and horticultural fleece, you can still get crops even in snowy weather.

Here are some resources with more information about growing winter greens:

[Arugula -www.gardening.cornell.edu/homegardening/sceneb771.htm](http://www.gardening.cornell.edu/homegardening/sceneb771.htm)

Claytonia- <http://www.gardening.cornell.edu/homegardening/scene483b.html>

Kale- <http://www.gardening.cornell.edu/homegardening/scene483b.html>

You can also get information about a variety of plants from www.johnnyseeds.com

Setting up the Garden Bed:

Before planting make sure that the soil is moist but not wet.

For more information on starting a garden visit: <http://anr.ext.wvu.edu/lawn_garden/start_a_garden>

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| Title | Lesson 1: Scientific Practices |
| Overview | In this lesson the students will learn about the scientific practices as they set up an experiment to test two different low tunnels to see which one will produce the most crops.  Duration: ongoing throughout entire module |
| Standards | Science and Engineering Practices:   * Asking questions and defining problems. * Planning and carrying out investigations. * Analyzing and interpreting data. * Using mathematics and computational thinking. * Constructing explanations and designing solutions. * Engaging in argument from evidence. * Obtaining, evaluating and communicating information   21st Century Skills: 21C.O.3-4.1.LS.1  Student identifies information needed to solve a problem or complete an assignment, conducts a search and prioritizes various sources based on credibility and relevance, retrieves relevant information from a variety of media sources, and uses this information to create an effective presentation.  21st Century Skills: 21C.O.3-4.1.LS.3  Student articulates thoughts and ideas accurately and effectively through oral, written or multimedia communications.  21st Century Skills: 21C.O.3-4.2.LS.1  Student engages, with teacher assistance, in a critical thinking process that synthesizes knowledge and ideas.  21st Century Skills: 21C.O.3-4.2.LS.3  Student engages in a problem solving process that promotes questioning, planning investigations and finding answers and solutions.  21st Century Skills: 21C.O.3-4.2.LS.4  Student generates ideas for solutions to problems and asks questions in order to create unusual, unique or clever products. Student begins to cognitively recognize the skills of adapting, improving, modifying and expanding existing thoughts or ideas to create products.  21st Century Skills : 21C.O.3-4.3.LS.4  Student appreciates, accepts, and works cooperatively with others, in both academic and social contexts, shares responsibility for continued improvement of the academic performance and climate of the school, and exhibits ethical behavior while working alone or communicating with others.  21st Century Skills: 21C.O.3-4.3.LS.6  Student focuses on the larger goal of a project, frames appropriate questions related to the goal, develops and initiates a plant of action with specific tasks and appropriate benchmarks, and completes the project on time. |
| Materials/Advance Preparation Needed | Materials:   * computer, * projector, * science notebooks, * seed packets (arugula, vit, and claytonia) or other cold hardy greens   Advance Preparation: Review information about low-tunnels before starting this lesson.  Background information: Once it is late December or January, you will need to lay horticultural fleece with frost protection over the plants and under the low-tunnel. |
| Procedures/Steps:  (Emphasis on students making inquiry, e.g., posing questions/problems and working towards answers and solutions) | Determine what the students already know about how we do science. Ask the students how we solve problems and make discoveries in science. Why would all scientists follow the same process when conducting an experiment?  Together develop the steps that will help them solve a science problem. Have students help to explain what happens in each step.  Science Practices:  1. Ask questions and define problems  2. Develop and use models  3. Plan and carry out investigations  4. Analyze and interpret data  5. Use mathematics and computational thinking  6. Construct explanations and design solutions  7. Engage in arguments from evidence  8. Obtain, evaluate, and communicate information  1. Ask students how grocery stores are able to stock produce all year long when it is cold in the winter. Students might explain shipping produce from warmer locations and the use of greenhouses. Explain to students that they are going to use a low-tunnel to help grow crops in the colder months. The question they are going to test is which low-tunnel works best.  OR  Have students research how to grow crops all year long and encourage students to find a “human solution” to how we can produce crops in the colder weather. Bring the class back together and discuss what they found. Lead the students to the idea of low-tunnels and explain that they are going to set up an experiment to test two different low tunnels.  2. Optional –Have students do some research on different low-tunnels.  OR  Complete some research together. Show students what a low-tunnel is and how it works. Then the students can come up with possible ways to alter the two low-tunnels.  OR  Have students research how to grow crops all year long. Help direct students research so it will lead them to “human solutions”. Then guide the class towards doing an experiment to test two different low tunnel designs.  Sample websites: http://www.mofga.org/Default.aspx?tabid=833 |
| Procedures/Steps (continued) | Remind the students that when you are doing an experiment we want to keep everything the same except for one factor which is what is being tested. In this case the students are testing which low-tunnel produces more crops. Therefore the students need to determine how to alter the two low tunnels.  Possible options: low-tunnel constructed out of 2-L bottles, using different thickness of greenhouse plastic, different sizes of height of low-tunnels, etc.  \*\* Complete Construction of Low-Tunnel- See Low-Tunnel Lesson\*\*  3. Have students use their science notebook to record their hypothesis on which low tunnel they think will produce the most crops. Students can also make a hypothesis about which low-tunnel will have warmer temperatures \*\* connects to lesson on collecting temperatures\*\*    4. Set up low-tunnels and direct seed greens into the garden bed according to seed package directions (could also use Garden Map Lesson from Module 1 Lesson2). Over the next few weeks the students will collect data from observations of the garden bed. Specific observation criteria can be developed by the students (you might want to include height of plants, number of leaves, color, etc.). Make sure students are making good observations in their Science Notebook (Module 1 Lesson 1). The students will also collect temperature data in Module 2 Lesson 3.  5. Students will review the graphs with the temperature and create a table to show greens production. Students will draw conclusions from the table and graph along with their observation notes in their science notebook.  6. Students will write a paragraph sharing the results of what happened in their experiment. This could be used in the summer gardening module if you decided to start early and use a low-tunnel. |
| Assessment (What will be the evidence of student learning?) | Students will be assessed in their participation in the class discussions as they work through the science practices. Students observations and data collection in their science notebook will be assessed using the attached rubric. The students will also be assessed in the completion of a paragraph that explains the results of what happened in their experiment, what they learned, and how it can be applied to future gardening experiences. |

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| Title | Lesson 2: Low Tunnel with Greenhouse Plastic |
| Overview | The students will use their skills in math to create a low tunnel that can be used to grow crops during the colder months.  Duration: 1 day |
| Standards | Science and Engineering Practices:   * Asking questions and defining problems. * Developing and using models. * Planning and carrying out investigations. * Analyzing and interpreting data. * Using mathematics and computational thinking. * Constructing explanations and designing solutions. * Engaging in argument from evidence. * Obtaining, evaluating and communicating information   M.4.OA.3: solve multi-step word problems posed with whole number and having whole-number answers using the four operations, including problems in which remainders must be interpreted, represent these problems using equations with a letter standing for the unknown quantity and assess the reasonableness of answers using mental computations and estimation strategies including rounding.  21st Century Skills: 21C.O.3-4.2.LS.4  Student generates ideas for solutions to problems and asks questions in order to create unusual, unique or clever products. Student begins to cognitively recognize the skills of adapting, improving, modifying and expanding existing thoughts or ideas to create products.  21st Century Skills : 21C.O.3-4.3.LS.4  Student appreciates, accepts, and works cooperatively with others, in both academic and social contexts, shares responsibility for continued improvement of the academic performance and climate of the school, and exhibits ethical behavior while working alone or communicating with others.  21st Century Skills: 21C.O.3-4.3.LS.6  Student focuses on the larger goal of a project, frames appropriate questions related to the goal, develops and initiates a plant of action with specific tasks and appropriate benchmarks, and completes the project on time. |
| Materials/Advance Preparation Needed | Materials:   * galvanized steel wire (6.5 ft pieces of “standard row cover hoops” are available from [FarmTek or Growers Supply](http://www.farmtek.com/farm/supplies/prod1;ft_high_tunnels_cold_frames;pg110053.html)), * greenhouse film (available from any horticultural firm), * sandbags (or another form of weight). * Measuring tape   Advanced Preparations: Have the materials prepared for the students. Make sure the garden soil is already prepared for the winter garden.  Note: The quickest way to build a low tunnel is to use galvanized steel wire (6.5 ft pieces of “standard row cover hoops” are available from [FarmTek or Growers Supply](http://www.farmtek.com/farm/supplies/prod1;ft_high_tunnels_cold_frames;pg110053.html)), greenhouse film (available from any horticultural firm), and sandbags (or another form of weight). |
| Procedures/Steps:  (Emphasis on students making inquiry, e.g., posing questions/problems and working towards answers and solutions) | Have students work in teams of 2-4 students with the help of an adult to insert each end of the pieces of galvanized steel wire at least 6 in. into the soil forming hoops over the area that you want to protect.  Space the hoops about 2 feet apart.  Have students work with their teams to measure the distance from the ground across and over the loop to the other side. Then students will add 3 feet to their measurement to the get width of the greenhouse film. Next have students measure the length of the bed (they should know this from Module 1) and add 6 feet to get the length of the greenhouse film. Students can help measure the greenhouse film and make the dimensions. Remind students that they should always check their measurements before they cut. Then cut a piece of greenhouse film that is at least 6 ft longer than the tunnel and 3 ft. wider than the “hooped” width of the tunnel.  Have students work together to drape it over the hoops and weight down the sides and the end with the sandbags.  You can make the film to be a tighter fit by drawing together at each end the excess film and twisting it a bit, then placing a heavy sandbag over the twisted material that sticks out at the end.  An alternative to using sandbags at each end is to use a clamp at each end.  The low tunnel should be vented on days when the outdoor temperature exceeds 55○F (especially on a sunny day) by opening up the ends or uncovering the entire tunnel, then covering it back up in the evening.  Once you are into late spring, you will need to remove the greenhouse film entirely. However, if you want protection from insects (e.g., cucumber beetle) into the late spring and summer, you can cover your low tunnel with horticultural fleece (also known as garden fleece,  Reemay® cloth or Agribon®).  Keep in mind that cucumbers, squash, and melon will need to be hand-pollinated if you keep the horticultural fleece over the tunnel once the female flowers emerge.  To obtain additional protection from the cold in early spring or late fall and winter, you can place underneath the greenhouse film and directly over the vegetables a “floating row cover” of horticultural fleece (various thicknesses are available to provide different degrees of protection).More sturdy designs for low tunnels employ PVC pipe, iron rebar, and wood.  Here are some links to these designs and more information about floating row covers as well as regulating temperature:   1. [http://www.motherearthnews.com/organic-gardening/low-tunnel-construction-mini-hoop-house.aspx#axzz36zcRxtLn](http://www.motherearthnews.com/organic-gardening/low-tunnel-construction-mini-hoop-house.aspx) 2. <http://groworganic.com/organic-gardening/articles/how-to-build-a-low-tunnel-hoop-house> 3. <http://extension.umd.edu/sites/default/files/_images/programs/hgic/Publications/not_updated/GE004FloatingRowCoverrevised.sm_.pdf> 4. <http://www.youtube.com/watch?v=EecDuJB0WYE> (Oklahoma State University) |
| Assessment (What will be the evidence of student learning?) | Students will be assessed using teacher observation as they participate in class discussions while using the science and engineering practices. The students will also be assessed by their use of math to help them create the low tunnels. Students will work together to create a completed low tunnel. |

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| Title | Lesson 3: Weather Data Collection |
| Overview | The students will learn about the effect of low-tunnels on gardening as they collect data about the weather inside and outside of the low –tunnels. The students will make an excel document with the temperature every day. Then students can use Excel to create graphs of the weather and explain the trends of the weather  Duration: 1 day to set up and then data collection continue throughout the whole module |
| Standards | Science and Engineering Practices: Asking questions and defining problems; Analyzing and interpreting data; Engaging in argument from evidence; Obtaining, evaluating and communicating information  Reading/Language Arts: ELA.4.R.C3.3: interpret information presented visually, orally, or quantitatively and explain how the information contributes to an understanding of the informational text in which it appears.  21st Century Skills:21C.O.3-4.1.TT.3  Student uses menu options in software applications to create documents, simple spreadsheets and presentations and to save files to various locations. Student begins to use e-mail to exchange documents with other teachers and students. Students know how to organize files through the use of folders.  21st Century Skills: 21C.O.3-4.1.TT.5  Student uses word processing software to create and format a document, use Edit menu to cut, copy, paste and change font type, size and color, select and highlight text, and other common editing features.  21st Century Skills: 21C.O.3-4.1.TT.6  Student enters data into a spreadsheet, performs simple calculations, aligns data, applies different formats, and creates simple graphs and charts using the chart wizard. |
| Materials/Advance Preparation Needed | Materials:   * weather station for inside and outside of the low-tunnel, * computer with excel   Advanced Preparation: students should already be introduced to how to use Excel, collect data, make a table and create a graph |
| Procedures/Steps:  (Emphasis on students making inquiry, e.g., posing questions/problems and working towards answers and solutions) | Explain to students that they are going to collect data about the weather (temperature, relative humidity, cloud cover, precipitation) over the next few months. This data will be used to see trends in the weather and compare the temperature inside and outside of the low-tunnel. Have the students help set up a data table for the temperature collection. Show the students how to use the weather station to find the daily temperatures. Discuss the importance of collecting the information at the same time every day. Have students help determine a schedule for when and how to collect the data.   * I recommend having students sign up for a day of the week to find and record the temperature in Excel. You can print out a monthly calendar and have students sign up for a day. It is important to have students sign up with a partner. This ensures that a day is not forgotten because of a student’s absence. It will also help with accuracy because students will be able to check each other’s work.   Students will continue to collect data over the next few weeks. At the end of each month, use Excel to create a graph. Have a discussion with the class about the trends in the graph and then have students record their thoughts in their science notebook. |
| Assessment (What will be the evidence of student learning?) | Students will be assessed through their data collection of the weather and creation of a data table and graph. The students will also create statements in their science journal about the trends in the graph. |