Secondary Level Unit Plan
Potato Perspectives on Climate Change

The Big Question
How can growing potatoes encourage me to explore the climate change phenomenon?

Program
Delta Agriculture and Climate Change Outreach Education Pilot Project
(See Program Context section, page 2)

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Delta Adaptation Strategies Working Group: Delta Farmers’ Institute; BC Agriculture & Food Climate Action Initiative; Corporation of Delta; Delta Farmland & Wildlife Trust; BC Ministry of Agriculture; Jerry Keulen; Nancy Chong.

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Program Context

This is part of the Delta Agriculture & Climate Change Outreach Education Pilot Project.

This unit is meant to be taught alongside the BC Agriculture in the Classroom Foundation’s Spuds in Tubs Program. Find Program specifics at [www.aite.ca/bc/programs/spuds-in-tubs-2](http://www.aite.ca/bc/programs/spuds-in-tubs-2).

- To meet the goals and objectives of the Delta Agriculture & Climate Change Outreach & Education Pilot Project, all teachers must be prepared to complete Lessons 1–6.

- There are also Subject-Specific lesson ideas included in this curriculum package that can be used by teachers to further enhance this unit. (See Appendix 3.) The Appendix is organized by subject area and offers a number of short lesson ideas per subject area. Please note that these are not complete lesson plans, but simply guidelines for teachers to follow when looking for ways to connect their subject area to the previous 6 lessons on growing potatoes and climate change. It is not expected that teachers complete these lessons in addition to Lessons 1–6 to meet program requirements.

- More information on this project and the BC Agriculture & Food Climate Action Initiative can be found at [www.bcagclimateaction.ca/regional/lower-mainland/](http://www.bcagclimateaction.ca/regional/lower-mainland/).
At the time of publication of this Unit, standards for Grades 10–12 curriculum are still in DRAFT form and will not be implemented until the 2017 school year. As with K–9, redesigned Grades 10–12 curriculum is intended to support both disciplinary and interdisciplinary learning, encourage locally developed curriculum, as well as enable a variety of learning environments and school and classroom configurations. Each area of learning proposes unique ideas.

The core competencies along with literacy and numeracy foundations and essential content and concepts are at the center of the redesign of curriculum and assessment. Core competencies are sets of intellectual, personal, and social and emotional proficiencies that all students need to develop in order to engage in deep learning and life-long learning. Through provincial consultation, three core competencies were identified (extracted from https://curriculum.gov.bc.ca/competencies on October 2015):

1. **Communication**
   Encompasses the set of abilities that students use to impart and exchange information, experiences and ideas, to explore the world around them, and to understand and effectively engage in the use of digital media.

2. **Thinking**
   Encompasses the knowledge, skills and processes we associate with intellectual development. It is through their competency as thinkers that students take subject-specific concepts and content and transform them into a new understanding. Thinking competence includes specific thinking skills as well as habits of mind, and metacognitive awareness.

3. **Personal & Social**
   The set of abilities that relate to students’ identity in the world, both as individuals and as members of their community and society. Personal and social competency encompasses the abilities students need to thrive as individuals, to understand and care about themselves and others, and to find and achieve their purposes in the world.

**Subjects Covered**

- Arts Education 8–12
- Business or Marketing 8–12
- Comparative Civilizations 11–12
- English 8–12
- Home Economics & Foods 8–12
- Mathematics 8–12
- Physical & Health Education 8–12
- Science 8–12
- Social Studies 8–12
- Sustainable Resources 11–12
Rationale for the Project

Rapid increases of greenhouse gases in the atmosphere have been attributed to human activities; fossil fuel burning and deforestation (Grant and Littlejohn, 2001). Emissions come from our homes, factories, and automobiles and “On a per capita basis, North Americans stand out from the rest of the world as the most profligate consumers of energy and emitters of greenhouse gases,” (Grant et al., 2001, p. 2), emitting 80 times the average person living in India (approximately 23 metric tonnes of CO₂ and CO₂-equivalents per capita). These human activities have profound impacts on our earth, and in particular, on the earth’s climate.

Climate change is a significant issue, which will impact people throughout the world, particularly farming and agricultural communities. Projections about changing climate show massive agricultural impacts affecting not just farmers, but also consumers of food; specifically, this generation of students. The adverse effects that come along with changes in climate such as higher average temperatures in a country like Bangladesh for example, will lead to a rise in sea level and “a one
A one-meter rise in sea level [in Bangladesh] could displace 13 million people.\(^1\) However, when thinking about the impacts climate change will have on our local weather, most BC residents are not overly concerned, and do not believe that things such as a rise in sea level will be an issue for them. Even if major changes in climate occur sooner than expected, who would complain about warmer days and less rainfall in Metro Vancouver? On the contrary, a one-meter rise in sea level would impact residents of British Columbia, which is why in regions such as Delta there is research currently being conducted on local dikes and flood protection infrastructure to prepare for climate change.

The Pacific Climate Impacts Consortium (PCIC) has generated regional climate projections for the 2020s and 2050s based on a number of global climate models and tested against observed climate records. Projections for temperature include warming in all seasons, with the annual average temperature predicted to be 1°C warmer in the 2020s. Furthermore, “precipitation projections for seasonal conditions indicate drier summers and wetter winters.” Most striking is the research confirming the “increase in the magnitude, frequency, and intensity of extreme events in Delta, for both temperature and rainfall events.”\(^3\)

PCIC’s research suggests that as temperatures warm, the flows in the Fraser River will shift and there will be the potential for earlier peak flows in the spring and decreased flows in the summer. This will lead to a decrease of water availability for agricultural crops during a time when they will need water the most. At the same time, if the sea level rises as predicted; 1.2 meters by 2100, there will be more salt water farther up the Fraser River, resulting in an increase in salinity levels in the Fraser River. These combined effects (lower river flows and more sea level rise) will have negative effects on available fresh irrigation water for farmers in the lower Fraser area.

Specifically, it is explained that: “Hydrological modeling for the Fraser River system shows an increase in annual runoff and that the peak of spring runoff will occur earlier in the season as temperatures warm, leading to increasing spring flows and decreasing flows (and therefore water availability) in summer. Global climate change coupled with local subsidence (gradual sinking of the Delta land mass) [will] contribute to a projected sea level rise of 1.2 meters by 2100. This sea level rise also forces salt water farther up the Fraser River and has the potential to raise Delta’s water table, and contribute to increasing soil salinity.”\(^3\)

As well, residents will experience increasing annual precipitation and decreasing snowfall in the Fraser River Basin. If there is flooding with extreme rainfall events, farmers may experience interruptions to planting and harvesting if they can’t get equipment on the flooded fields.\(^5\) Also, there may be a decrease in productivity and quality of crops on the farms, and livestock will be under stress due to flooded or saturated pastures. Economically, farmers may face inconsistent prices due to inconsistent productivity, quality of crops, and crop losses. Moreover, there will be an increase in overall costs of production due to building maintenance and damage costs, cooling and ventilation costs while fulfilling the need to store crops and manage livestock differently.
All of these changes; increases in seasonal temperatures, increases in extreme rainfalls, decreases in summer precipitation, will also affect pest presence in fields. Farmers may see an increase in existing and new pests on their fields due to the weather changes. Warmer and wetter winters are expected to result in persistence of pests and diseases that would normally be kept at bay through low winter temperatures. Too many unmanageable pests and disease could cause considerable damage to crops.

Another major concern is the potential for pollinator health and timing to be impacted – for example delayed or reduced pollination due to wet spring conditions. Pollination helps plants create seeds from their flowers. One out of every three mouthfuls of our food depends on pollination and if bees don’t pollinate our crops, we won’t have the variety of food choices we enjoy today.

What needs to be understood is that local weather events are a product of the earth’s climate, and global climate change is also impacting local average conditions and other extreme weather conditions such as floods, droughts and increased rainfall. Climate (average weather conditions such as the temperature, precipitation, and humidity over a long period of time) is also important to our food supply since the climate of a region determines the suitability of land for agriculture. Thus, climate change will have a significant impact on farmers here in British Columbia, and the summer of 2015 is a good indication of issues farmers may continue to face.

The summer months of 2015 were the hottest on record globally, with cities such as Osoyoos, BC reaching temperatures of 40.4°C on June 27 whereas the previous record was only 36.9°C back in 2006. On June 28 in Cranbrook, BC, “The town made it to 36.8°C, a smidgen higher than its old record in 1925, and the hottest day it has ever experienced, in any month, since record-keeping began in 1901 — at a time when Canada had only seven provinces.” In addition to the hot weather, there were also water issues throughout the province. The summer months in British Columbia overall were extremely dry leading to wildfires, water restrictions in some major cities across the province, and drought conditions. Specifically in the Lower Mainland, Sunshine Coast and Fraser Valley, the provincial drought rating was raised to its highest category, Level 4.

Farmers were also adversely affected by the hot weather and the early season. Summer temperatures came about a month early with the warm weather causing crops to ripen much earlier than normal. Some field vegetables such as spinach and lettuce went to seed before they could even be harvested! The early season also forced many farmers to leave their crops on the plants due to a labour shortage. For example, in the berry industry, strawberries, raspberries, and blueberries are normally harvested throughout the summer, with strawberries being picked in June, raspberries in July, and blueberries being picked in the end of July and August, with minimal overlapping. This year, all three berry varieties were being harvested during a close period of time with more than usual overlapping, leaving farmers scrambling for labour. The summer of 2015 is a good example of kinds of conditions that are expected to become more common, however the writer is not suggesting that all summers will be like this one.
Today, Delta’s geographical location; near the ocean and the mouth of the Fraser River, makes it an ideal place for growing crops. Farmers love to grow food in Delta because it has very productive agricultural land and the ocean helps summer and winter temperatures stay moderate. According to the 2011 Census of Agriculture, in 2010 Delta had around 9,400 hectares (23,228 acres) of land identified as Agricultural Land Reserve (ALR), with 80% of this land being associated with agricultural activities. Delta also has higher light levels than other parts of the Lower Mainland, which is why you see so many greenhouses here. In Delta you will find over 50% of BC’s potato acres, over 50% of BC’s green beans, and 90% of BC’s tomatoes. Also, Delta is located in close proximity to Vancouver, Deltaport, and the US border which gives Delta farmers increased market access.

Despite the advantages of farming in Delta, there are a few challenges its farmers are currently facing including; (1) soils hold water and are prone to ponding in winter, (2) there is aridity in the summer, and (3) soils are prone to salinity. Thus, at the farm level, some adaptation will be required to address the predicted climate change impacts. Furthermore, the authors of *Delta: BC Agriculture & Climate Change Regional Adaptation Strategies* suggest, “broader collaboration is required for land use, infrastructure and resource-related decision-making and action.”
Teaching about climate change may seem like a daunting task to any educator, especially if not from a science background. Even the scientists who are researching climate change have a difficult time explaining this phenomenon, so how can a classroom teacher be expected to cover this complex and multifaceted issue in one unit? Despite these challenges, teaching about climate change, or at least raising awareness of the challenges to come is something all educators should try to bring into their classrooms. By working with the generation of students who will be impacted by climate change, teachers have the opportunity to address this issue in any classroom setting; whether it be English (narrative stories), Social Studies (political decision-making, geography), Science (water systems, climate, greenhouse gas emissions, photosynthesis), Health (agriculture and food), Foods and Home Economics (food security), or Technology (tracking energy systems), it is an opportunity to engage students and a chance for them to become literate in a major global issue of our time.

To aid educators, this unit, *Potato Perspectives on Climate Change*, has been designed to implement in any subject area. There are a variety of lesson plans included that educators can alter to suit their own classroom needs. Through this unit, students will contribute to a meaningful project, where they are planting, growing, maintaining, and harvesting a tub of potatoes. Students will be responsible for maintaining their crops by hillling, watering, and feeding as needed inside and outside of allocated class time. Teachers can monitor the groups and their plants weekly, and provide feedback on the tasks completed in the Potato Perspectives on Climate Change Booklet. The unit will build food security into everyday living and learning and will promote environmental education with an introduction to the climate change phenomenon. The focus of the project itself will be to develop research and data collection skills, basic speaking and listening skills, and a cooperative learning classroom community. The outcome of the project will be multifaceted; with the major component being a potato harvest, preparing the potatoes for a classroom feast, and producing a final project highlighting learning around climate change.

This Unit Plan could be used as an introductory approach where students get an overview, or a big picture of the main causes of climate change and its impacts, and how they can adapt to the predicted changes. It is important for students to understand what is known about climate change, and explore ways in which they can personally make changes in their own lives to address the issues, create solutions, and find ways to adapt to upcoming challenges. At the secondary level, this unit may require some collaboration among educators in different subject areas.
References


Additional Resources:


Overview

The Big Question

How can growing potatoes encourage me to explore the climate change phenomenon?
LESSON 1
Introduction to Farming & Agriculture in Delta, BC

Scheduling

*Complete this lesson before Spring Break.*

Essential / Driving Question

What do we know about farming and agriculture in Delta?

Materials / Preparation

- Internet access, computer, projector, speakers
- Pencil crayons or markers
- Potato Perspectives on Climate Change Booklet (Page 1, 2) – Appendix 1

Introduction / Objectives

Students will link existing with new knowledge of agriculture and climate change

- Ask students: What do you know about farming and agriculture in Delta, BC? What kinds of farms are there here? (size of farms, crops grown, why so many farms in the region)
- Ask students: What do you know about the climate change phenomenon? (What is it, when is it happening, how will we be affected?)
- Students brainstorm and have discussion about what they know (K) and wonder (W) about agriculture in Delta and climate change
- Complete this brainstorm on K/W/L chart, 2–3 points in each column, leave L empty (Potato Perspectives on Climate Change Booklet, Page 2)
Application / Activity

- Teacher shares videos about agriculture in Delta:
  - Video 1: The Inside Scoop on Manure – Meet Your Farm Neighbours
  - Video 3: Dividing into Cranberries – Meet Your Farm Neighbours
  
- While watching videos, students should complete the Agriculture LEARN column in their KWL charts

- Teacher shares a series of videos about Climate Change
  - Video 1: Weather versus Climate Change by National Geographic (2:09mins)
  - Video 2: Climate Change Report in 60 seconds by BBC News (1:04mins)
  - Video 3: Climate Change in Animation by Green College Online (5:06mins)
  - Video 4: An Introduction to Climate Change in 60 seconds by The Royal Society (1:39)
  - Video 5: Morgan Freeman’s Powerful Climate Change Short Film (3:37)

- While watching videos, students should complete the Climate Change LEARN column in their KWL charts

- Teacher can also share facts and statistics about agriculture and climate change in Delta (refer to Rational for notes)

- Closure: Ask students to contribute ideas about the question: How will agriculture be affected by Climate Change? based on the videos watched. (Record answers on board)

- Explain that next class we are starting a project that will help us understand how climate change will affect agriculture in Delta

- Students create a title page for their booklet (Potato Perspectives on Climate Change Booklet, Page 1)
  - Must be organized and neat
  - Must represent ideas about farming in Delta
  - Due at the end of next class
Evaluation / Assessment

- Assess if students were able to link new knowledge to existing (Potato Perspectives on Climate Change Booklet, Page 2)
- Assess title page (Potato Perspectives on Climate Change Booklet, Page 1) for organization, neatness, and completion

Homework / Assignment

- Finish title page for next class (collect at end)

Closure / Extension

- On the way home, students should look around the community and try to find new information about farms in Delta (signs, roadside stands, farmers markets, farms, farm vehicles)
LESSON 2
Planting Potatoes

Scheduling

Complete this lesson immediately BEFORE you leave for Spring Break

Essential / Driving Question

What do we know about growing potatoes?

Materials / Preparation

- Internet access, computer, projector, speakers
- Potato Perspectives on Climate Change Booklet, Pages 3 & 4
- Spuds in Tubs Step-by-step Guidebook
- Spuds in Tubs kit
- Jugs for water, water

Introduction / Objectives

Students will link existing with new knowledge of potatoes

- Ask students: what do humans need to grow?
- Possible responses: water, food, air, shelter, love
- Ask students: what do plants/crops need to thrive and grow properly?
- Possible responses: water, food: soil and nutrients, air and space, sun (light)
- Students complete Mind Map (Potato Perspectives on Climate Change Booklet, Page 3) answering question; what do plants need to grow?
- Teacher shares notes about what plants need to grow (students add to Mind Map)
  » Agriculture is dependent on soil, water, and climate of the region
  » The way farmers care for soil and water greatly influences the world’s food supply
Soil is important to our food supply as it provides crops with water, nutrients, and support for their roots.

Water and minerals are taken from the soil through roots. Soil provides support for the plant and an anchor for the roots. Decaying plants leave minerals in the soil (good for future plant growth).

Water is needed by crops to grow and survive. It helps transport important nutrients through plants to their leaves and helps store food.

Light from the sun is needed to heat the air and ground, and give plants light energy to grow.

Photosynthesis: when plants use light energy from the sun to change carbon dioxide from the air and water from the soil into food substances (sugars) and release oxygen back into the air.

Crops also need air to breathe and space to spread and grow.

Students complete questions on handout (Potato Perspectives on Climate Change Booklet, Page 4)

What is a potato? Where do potatoes come from? Are there any potato farms in Delta? What are the nutritional benefits of eating potatoes? How do you like your potatoes cooked? How are they grown?

Teacher goes over a few student responses on the board

Teacher shows videos:

» The Nutritional Benefits of Potatoes (1min, 40sec)
  www.youtube.com/watch?v=3qCh8KZw_e0

» Health Benefits of Potato (1min, 33secs)
  www.youtube.com/watch?v=qT3__coWMFg

» Video 2 The Harris Potato Harvest – Meet Your Farm Neighbours
  www.youtube.com/watch?v=J9S6GnPhIbw&list=PLYRlJzcWH9isnXsr_rtcOBVflWrR299o

Students add new information learned through video to their answers

Application / Activity

Planting your Spuds in Tubs
(Please see the Step-by-Step guidebook for more details:

Teacher introduces the Spuds in Tubs project (overview)
• Divide students into 5 groups, assign each group one tub; label each tub (Tub 1, Tub 2 etc.)
• Give each student one seed potato to observe
• Students must take off the dominant sprout so other sprouts can grow better
• When planting in tubs indoors, lay the plastic drop sheet on the floor to protect the floor
• Empty one bag of soil into each tub
• Mix 1 scoop (4 tablespoons) of Potato Plant Food thoroughly into the soil for each tub
• Dig five small wells in the soil of each tub evenly in a circle around the tub, about 10 cm from the outside edge
• Place five seed potatoes into the small wells from step 8, sprouts facing UPWARDS
• Cover the potatoes with more soil from the tub
• Choose a cool, safe INDOOR location for the tubs
• Give your tubs a good drink of water
• Leave them alone, in your classroom for the entire Spring Break! (up to 2 weeks)

**Evaluation / Assessment**

• Assess if students were able to link new knowledge to existing
• Collect Potato Perspectives on Climate Change Booklet and mark Pages 1–4

**Homework / Assignment**

• n/a

**Closure / Extension**

• Collaboration: students can make up group names; The Dirt Boys (they will work in these groups for the duration of this project
LESSON 3
Experimenting with our Spuds in Tubs in Light of Climate Change

Scheduling

*Complete this lesson after Spring Break when it is warm enough to move your tubs outdoors.*

Essential / Driving Question

How will crops be impacted by climate change?

Materials / Preparation

- Computer, projector, camera if needed
- Jugs for water, water, salt
- Rulers
- Climate Change Brainstorm (Potato Perspectives on Climate Change Booklet, Page 5)
- Experiment Handout (Potato Perspectives on Climate Change Booklet, Pages 6–8)
- Experiment Answer Key (Appendix 2)

*After Spring Break, the Tub groups should be tending to their tubs in and outside of class time. Please see the BCAITC Step-by-Step Guidebook for further instructions.*

When to water:

- Check to see if the plants are dry by feeling the soil or observing if the soil is pulling away from the side of the tub.
- Wilted potatoes will slow down production, so water well when the pots are dry
- If there is water running out of the drainage holes, the plants have enough water
- A fun way to check if the tubs need water is to have your students plunge a finger into the soil being careful not to harm the plants. If their finger comes out with soil stuck to it then the tub should not need water. If their fingers are clean then the soil is dry and it is time to add water.
When to hill:

- As the potato sprouts grow, add soil to cover most of the stem, leaving a few leaves from each sprout stretching above the soil.
- Watch the potato sprouts daily. As they grow, add more soil around the stem.
- Repeat steps 1 and 2 for the next few weeks until the tubs are filled to the top with soil.

Introduction / Objectives

**Students will understand the growing needs of plants.**

- Ask students:
  - What would happen to humans if they no longer had air? Ask students to hold their breath. Discuss feelings and responses to having no air.
  - What would happen to our plants if we did not water them enough? Record answers on the board.
- Students brainstorm how climate change will affect life in general, agriculture and the things around them. Go over example provided on chart. (Potato Perspectives on Climate Change Booklet, Page 5)
- Teacher shares notes on the challenges climate change may bring to Delta Farmers (teacher must get relevant notes from the Rationale for this Project section)
- Students record new information learned from teacher onto their brainstorm (Potato Perspectives on Climate Change Booklet, Page 5)

Application / Activity

- Explain to students that in order to understand the impacts climate change will have on farmers’ crops in Delta in the next few decades, we will conduct an experiment with our tubs.
- Discuss how to conduct experiments.
  - To design an experiment we need to have three or more trials (5 tubs), a control (Tub 1, Tub 2), a variable that will be changing (excess water for Tub 3, added salt for Tub 4, not enough water for Tub 5), while keeping all other variables consistent (water, sunlight, temperature, location).
- Students will create a climate change experiment using their spuds in tubs
  - Tub 1- Control Tub (treat it normally; see below)
  - Tub 2- Control Tub (treat it normally; see below)
» Tub 3 – add excess water (extreme rainfall and flooding early in the season)
» Tub 4 – add salt (5 cups) into the soil (sea level rises, causes water with high salinity levels)
» Tub 5 – add less water than required (not enough precipitation in the summer)
• Each Tub needs to be labeled according to the impacts climate change has had on it
• Teacher should help students complete the experiment handouts (Potato Perspectives on Climate Change Booklet, Pages 6–8) (See Appendix 2 for Answer Key)
• This step can be completed with student input, or with teacher giving more answers, depends on student levels. This can be completed using a document camera or other forms.
• Once the tubs have the experiments conducted and handouts completed, move outdoors.
• Moving Tubs outdoors:
  » Measure plants. When the largest plant reaches 15 cm above the rim of the tub and weather permitting, proceed.
  » Sprinkle another scoop of Potato Plant Food on the top of the soil. Gently scratch the surface to work it into the soil. (Only for Tub 1 and Tub 2, Tubs 3–5; see above additions)
  » Move the tubs to a safe OUTDOOR location that includes: a. A south-facing wall that will absorb heat and light from the sun b. Protection from the wind c. If a. and b. are impossible, perhaps a neighbor will keep them on their property in similar conditions
  » For the first week, loosely drape the drop sheet provided over the tender potato plants for the night to protect them from frost. Be sure to remove the sheet during the day to avoid burning the plants from direct sunlight.

**Evaluation / Assessment**

• Collect and Evaluate Climate Change Brainstorm and Experiment Handouts (Potato Perspectives on Climate Change Booklet, Pages 5–8)

**Homework / Assignment**

• None at this time

**Closure / Extension**

• None at this time
LESSON 4
Exploring Climate Change

Scheduling

*Complete this lesson after Spring Break when tubs have been outside for several weeks.*

Essential / Driving Question

What is Climate Change?

Materials / Preparation

- Internet access
- Projector, speakers
- Student computers for research via mobile lab, computer Lab, iPads
- Potato Perspectives on Climate Change Booklet (Page 9)

*Even though the tubs have been moved outside, students still need to tend to the plants every week. Please see BCAITC Step-by-Step Guidebook for further details.*

Introduction / Objectives

**Students will understand elements of climate change**

- Students start outside observing their tubs. Do they notice any difference between tubs that were experimented with compared to the control tubs?
- Complete Experiment Handout (Potato Perspectives on Climate Change Booklet, Page 9)
- Could add extra water to Tub 3, more salt to Tub 4, and less water than required to Tub 5 (teacher choice based on how the plants are surviving)
Application / Activity

- In Tub Groups, students will research climate change
- Focus on questions such as: When did it start? What is it? Why is it happening? How is it impacting the world around me; specifically agriculture?
- The most important question to address will be: What can I do to slow it down?
- Direct students to websites:
  » www.delta.ca/agriculture
  » www.bcagclimateaction.ca/overview/why-adaptation/
  » www.bcagclimateaction.ca/overview/why-mitigation/
- Share with students simple things they can personally do to reduce greenhouse gas emissions right now. (Ideas taken from David Suzuki Foundation, downloaded September 2015 from www.davidsuzuki.org/what-you-can-do/top-10-ways-you-can-stop-climate-change/)
  » Getting around: Walk or ride your bike to school, or carpool since transportation contributes to 25 per cent of Canada’s greenhouse gas emissions
  » Energy: Conserve energy by turning off lights, change light bulbs to LEDs or compact fluorescents, unplug electronics, wash clothes in cold water and hang dry
  » Food: Buy locally grown, unpackaged, unprocessed foods.
  » Garbage: compost kitchen scraps, garden trimmings, and RECYCLE paper, plastic, metal, glass. Purchase items with minimal or recyclable packaging. Garbage in landfills produces methane; a potent greenhouse gas.
  » Vacations: Try to travel close to home on buses or trains and not on airplanes. Air travel leaves behind a huge carbon footprint!
  » Plant a tree, plant a school garden
  » Conserve water while brushing teeth, taking a shower, watering lawns in the summer
- Review expectations for the research project: proper website research techniques, how to find quality sites, paraphrasing versus pasting, plagiarism…
- Review steps on how to create and/or share samples of a Power Point, Prezi, iMovie, poster, storyboard, book report, pamphlet, or other artistic forms such as a skit, news report or play
- Groups must be prepared to present their findings using different mediums of their choice; Power Point, Prezi, iMovie, poster, storyboard, book report, pamphlet, or other artistic forms such as a skit, news report or play (due in two classes)
Evaluation / Assessment

- Evaluate on-task behavior during group research
- Teacher must create rubric for the group project

Homework / Assignment

- Continue research at home if needed

Closure / Extension

- None at this time
LESSON 5
Presenting our Research

Essential / Driving Question
How can we share our learning about climate change?

Materials / Preparation

• Computers, iPads, internet access, projector

Introduction / Objectives

Students will be able to:

• Review expectations for respectful behavior while watching presentations
• Review criteria for the project

Application / Activity

• Allow groups 5–10 minutes to prepare; groups will present their findings to the class by sharing their Power Point, Prezi, iMovie, poster, storyboard, book report, pamphlet
• Students continue watering and hillling their plants as needed

Evaluation / Assessment

• Evaluate on-task behavior during group presentations, ensure each member has played an equal part
• Cross reference their findings
• Collect booklets and give marks for brainstorms, research and group work, Pages 10–11

Closure / Extension

• Take fieldtrips to local farms throughout the unit
• Invite local farmers to come in and speak about their operations etc.
LESSON 6
Enjoying our Potato Harvest Despite Climate Change Impacts

Scheduling
Complete this lesson early to mid-June.

Essential / Driving Question
How can we harvest our crops despite climate change?

Materials / Preparation
• Scale
• Rulers
• Bucket or box to put harvested product into
• Potato Perspectives on Climate Change Booklet (Page 12–13)
• Journal activity (Potato Perspectives on Climate Change Booklet (Page 14)

When to harvest:
• You will know it is time to harvest because the plants will wilt and turn yellow.
• If the plants do not wilt and turn yellow, you will still have to harvest them.

Introduction / Objectives
Students will understand the steps to harvesting potatoes
• Explain the steps of the harvest (see below)
• Students must complete Experiment Conclusions, Potato Perspectives on Climate Change Booklet (Page 12–13) while they observe each tub harvest
Application / Activity

- Lay out the plastic drop sheet on the ground (outdoors)
- Students form a wide circle around the sheet
- Group 1, Tub 1 goes into the center of the circle with their tub
- Tip the tubs onto the plastic sheet
- Count the number of spuds in your tubs and put into a small bucket
- Weight the total
- Share all numbers with the class who are observing and recording their findings
- Each Tub group repeats the steps above
- See if the students can find their original seed potato
- The leftover soil can be added to existing shrub beds in a sunny location around the school
- Wash the tubs and put away to re-use next Spring
- Wash the potatoes thoroughly, scrubbing off all the soil
- Students can go back to class and complete their concluding journal activity (Potato Perspectives on Climate Change Booklet (Page 14))

Evaluation / Assessment

- Collect and Evaluate Experiment Handouts and Journal next class (Potato Perspectives on Climate Change Booklet, Page 12–14)

Homework / Assignment

- None at this time

Closure / Extension

- Ways to enjoy your harvest:
  - Steam or boil the potatoes until they pierce easily with a fork. Keep warm in a crock pot if you need to delay eating. Add butter, serve and enjoy
  - Depending on yields, have each groups prepare a meal with their potatoes and serve to class
» Donate the potatoes to the local Food Bank or take home and share with families

» Upon harvest, conduct a taste test of their local, Zero Mile Diet potatoes versus imported potatoes

» Multicultural meals: Students can compare this classroom potato feast with their own family food celebrations and share in a written or oral form. Have students bring in potato meals from their own cultural background.
APPENDIX 1
Potato Perspectives on Climate Change Booklet

The following 14 pages make up an activity booklet for the students.
Potato Perspectives
On Climate Change

Student Name: ___________________________________________________________
# Know, Wonder, Learn Chart

<table>
<thead>
<tr>
<th>Know</th>
<th>Wonder</th>
<th>Learn</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Agriculture</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Climate Change</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Mind Map:
What do Plants Need to Grow?
Potato Questions

1. What is a potato?
________________________________________________________________________
________________________________________________________________________

2. Where do potatoes come from?
________________________________________________________________________
________________________________________________________________________

3. Are there potato farms in Delta? If yes, where?
________________________________________________________________________
________________________________________________________________________

4. What are some nutritional benefits of eating potatoes?
________________________________________________________________________
________________________________________________________________________

5. How do you like your potatoes cooked?
________________________________________________________________________
________________________________________________________________________

6. How do potatoes grow? (sketch below)
## Climate Change Brainstorm

<table>
<thead>
<tr>
<th>Climate Change</th>
<th>How I will be affected</th>
<th>How farms will be affected</th>
<th>How other people/things in my life will be affected</th>
</tr>
</thead>
<tbody>
<tr>
<td>No rain all summer (Example)</td>
<td>• I can spend more days at the beach</td>
<td>• farmers will face issues with irrigation</td>
<td>• trees in my area will dry up and die</td>
</tr>
<tr>
<td></td>
<td>• water restrictions</td>
<td>• moisture from soil in fields will evaporate</td>
<td>• there will be less crops to harvest</td>
</tr>
<tr>
<td></td>
<td>• My lawn will die</td>
<td></td>
<td>• food prices may go up</td>
</tr>
<tr>
<td>Warmer and drier summer</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low river level in late summer and fall</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increase in annual precipitation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increase in magnitude and frequency of intense rainfall events</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Doubling in number of summer “warm” days</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rise in sea level and flooding</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Spuds in Tubs
& Climate Change Experiment

Student Name: ___________________________________________________________

Question:
________________________________________________________________________
________________________________________________________________________

Hypothesis:
________________________________________________________________________
________________________________________________________________________

Materials:
________________________________________________________________________
________________________________________________________________________

Method:
1. ______________________________________________________________________
________________________________________________________________________
2. ______________________________________________________________________
________________________________________________________________________
3. ______________________________________________________________________
________________________________________________________________________
4. ______________________________________________________________________
________________________________________________________________________
DAY 1 – Observations After Moving Tubs Outdoors

Measure in centimetres (cm)

<table>
<thead>
<tr>
<th></th>
<th>TUB 1</th>
<th>TUB 2</th>
<th>TUB 3</th>
<th>TUB 4</th>
<th>TUB 5</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Normal</td>
<td>Normal</td>
<td>Excess Water</td>
<td>Excess Salt</td>
<td>Less Water</td>
</tr>
<tr>
<td>Stem Length</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stem Width</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stem Colour</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Leaf Shape</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other Observation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other Observation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Diagrams/Observations:
DAY 2 – Observations After Moving Tubs Outdoors

Measure in centimetres (cm)

<table>
<thead>
<tr>
<th></th>
<th>TUB 1</th>
<th>TUB 2</th>
<th>TUB 3</th>
<th>TUB 4</th>
<th>TUB 5</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Normal</td>
<td>Normal</td>
<td>Excess Water</td>
<td>Excess Salt</td>
<td>Less Water</td>
</tr>
</tbody>
</table>

- Stem Length
- Stem Width
- Stem Colour
- Leaf Shape

Other Observation

Diagrams/Observations:

<table>
<thead>
<tr>
<th>MY TUB</th>
<th>ONE OTHER TUB</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Other things I noticed:
________________________________________________________________________
________________________________________________________________________
Research Project:
What is Climate Change?

Within your tub groups, research elements of climate change. Focus on questions such as:

- When did it start?
- What is it?
- Why is it happening?
- How is it impacting the world around me?
- How is it impacting my region?
- How is it impacting agriculture?
- What can I do to slow it down?

The way you present your findings is your choice. As a group choose from Power Point, Prezi, iMovie, poster, storyboard, book report, pamphlet, or other artistic forms such as a skit, news report or play.

Group Members:
__________________________________________________________
__________________________________________________________

Ideas for the Presentation:
__________________________________________________________
__________________________________________________________
__________________________________________________________
__________________________________________________________
__________________________________________________________
__________________________________________________________
__________________________________________________________
__________________________________________________________
__________________________________________________________
Research:
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
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________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
## Experiment Conclusions

Measure the Mass of Potatoes:

<table>
<thead>
<tr>
<th></th>
<th>TUB 1 Normal</th>
<th>TUB 2 Normal</th>
<th>TUB 3 Excess Water</th>
<th>TUB 4 Excess Salt</th>
<th>TUB 5 Less Water</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total Mass at</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Harvest (in lbs)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total Number</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>of Potatoes</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(big &amp; small)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Diagrams/Observations Harvest Day:

<table>
<thead>
<tr>
<th></th>
<th>TUB 1</th>
<th>TUB 2</th>
<th>TUB 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>TUB 4</td>
<td></td>
<td></td>
<td>Observations</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>while we</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>harvest</td>
</tr>
<tr>
<td>TUB 5</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Conclusions:

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

Sources of Error:

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

Other Questions:

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________
Concluding Journal

Complete each statement with your own thoughts and ideas.

1. With the harvest of each tub I noticed that...
   ______________________________________________________
   ______________________________________________________
   ______________________________________________________
   ______________________________________________________
   ______________________________________________________

2. Due to the negative impacts “climate change” had on each tub, I’m afraid...
   ______________________________________________________
   ______________________________________________________
   ______________________________________________________
   ______________________________________________________
   ______________________________________________________

3. Overall, this project has taught me that...
   ______________________________________________________
   ______________________________________________________
   ______________________________________________________
   ______________________________________________________
   ______________________________________________________

4. Other concluding thoughts:
   ______________________________________________________
   ______________________________________________________
   ______________________________________________________
   ______________________________________________________
   ______________________________________________________
Question

• Will the average mass of a tub of potatoes change when they are impacted by climate change?

Hypothesis

• Students must complete this section on their own. (Insert percentage)

• Sample Hypothesis: The mass of potatoes in the tubs that are impacted by Climate Change will be 50% less than the tubs that are treated normally.

Materials

• 5 tubs
• 1 container of plant food/fertilizer with measuring scoop
• 13 bags of soil
• 25 seed potatoes
• 1 plastic drop sheet
• 5 rulers
• Sign on Tubs that have been impacted by climate change
• Water
• Salt

Method

• Follow Stage 1 and Stage 2 in Spuds in Tubs Guide Book
• Choose and label tubs:
  » Tub 1 – Control Tub (treat it normally; see below)
» Tub 2 – Control Tub (treat it normally; see below)
» Tub 3 – add excess water (extreme rainfall and flooding early in the season)
» Tub 4 – add salt into the soil (sea level rise, and water with high salinity levels)
» Tub 5 – add less water than required (not enough precipitation in the summer)

- On the day of the harvest, for accurate measurements, students must harvest each tub separately.
- They must wash all soil off the potatoes completely and dry the potatoes.
- Then they must weigh the harvest from each tub separately.
- They must also count the total number of potatoes that came from each tub.

Data/Observations Day 1 and Harvest Day (including graphs, charts)
- Ongoing throughout the growing cycle.
- Observe the stem lengths and widths, and colours and shapes of the plants.
- This should be completed on the Experiment handouts, (Page 8–9)

Conclusions
- Students must answer Yes or No to the question asked above; Will the average mass of a tub of potatoes change when they are impacted by climate change?

Sources of Error
- Work with students to identify any possible sources of error; i.e. outside sources adding things to the tubs on weekends (animals and insects landing in tubs, people throwing litter) etc.

Other Questions
- Work with students to brainstorm any additional questions that have come out of this experiment.
APPENDIX 3
Subject Specific Lesson Ideas

The lesson ideas found in this Appendix can be used by teachers to further enhance their Climate Change Unit. The Appendix is organized by subject area and offers a number of short lesson ideas per subject area. Please note that these are not complete lesson plans, but simply guidelines for teachers to follow when looking for ways to connect their subject area to the previous 6 lessons about growing potatoes and climate change. It is not expected that teachers complete these lessons in addition to Lessons 1–6 to meet program requirements.

SOCIAL STUDIES LESSON IDEAS

• Social Studies curriculum standards are the perfect venue for the exploration of farming, agriculture and climate change.

• Students can connect this project to topics around Geography, land use, and current issues with the Agriculture Land Reserve in BC.

• Whether it be a study of ancient Egypt, the Medieval Ages, or Mesopotamia, students can also explore how ancient civilizations thrived due to advances in agriculture.
  » Through farming, people were able to stay in one location and develop communities of living rather than always searching for food.
  » Power and authority, social order, religion, art, culture and economic structures were rooted in the ability to farm.

• The following lessons can be used in a Social Studies classroom for students to explore ancient civilizations by examining the elements and characteristics that contribute to the foundations of civilizations.

• Students can link agriculture and climate change to the past, present and think critically about the future while growing potatoes in their classroom.

• Depending on what civilization you are teaching about, students can compare the growing of potatoes to the crops that were grown back then.
SOCIAL STUDIES LESSON IDEA 1 —
CLIMATE CHANGE & MY REGION

Introduction

• Ask students to consider what would happen to specific outdoor crops grown in their region if there was flooding or extreme rainfall

• Possible answers:
  » Extreme storm would make crops rot and be ruined before harvest
  » Farmers’ machinery would get stuck on fields

• Also consider the affects these climate events would have on dikes, drainage systems, roads, and other buildings

Application / Activity

• Ask students to choose a specific crop grown in Delta and explore how this crop would be affected by changes in climate

• Students must research things such as:
  » Minimum amounts of rainfall needed for this crop to thrive and grow properly
  » Maximum amounts of rainfall this crop can tolerate
  » Range of temperature this crop can tolerate
  » Number of frost free days needed for maturation

• Information around days of sun, annual precipitation, temperature can be obtained from local weather websites

Closure / Expansion

• Students could devise plans on how to adapt to one of these affects

• Students will need to research crops grown in their region and ideas on adaptation

• Students can also consider what changes they would need to make to their personal lives such as diet, type of clothing they wear, the activities they partake in etc. to adjust to changes in climate.
SOCIAL STUDIES LESSON IDEA 2
AGRICULTURE TIMELINE

• Students can explore the time line of agricultural and settlement events starting at 1,900,000 years ago

• Students can focus on specific significant events in time such as creation of the Agriculture Land Commission, creation of irrigation systems

• Find the handout at http://www.aitc.ca/bc/uploads/agriculture-timeline.pdf

SOCIAL STUDIES LESSON IDEA 3
A MAP OF AGRICULTURE IN BC

• Students can explore specific commodities of food grown in BC

• Find the Agriculture, Fish and Food in BC Map at http://www.aitc.ca/bc/resources/posters

• Download for free the accompanying Scavenger Hunt Handout called Finding my Food at http://www.aitc.ca/bc/uploads/resources/FindingmyFood-MiddleSecondary.pdf

SOCIAL STUDIES LESSON IDEA 4
COMPARING FARMING AROUND THE WORLD

• Students can compare potato farming in BC versus PEI, India, Ireland etc.

• Focus on climates, environment, soil, water availability, agriculture industry

• Compare fertile lands such as those in BC to lands around the world such as deserts in Africa.

• Discuss soil erosion, climate change, agriculture, land quality needed to grow potatoes

• Research issues and ideas about agriculture in BC, specifically potato farming.
**SCIENCE LESSON IDEAS**

- The scientific method is an important concept for students to understand as it allows them to be critical in data analysis and also diligent in data collection.
- Using the scientific method for The Spuds in Tubs program will allow students the opportunity to propose many different hypotheses.
- Students are also forced to think about the obstacles and setbacks they might encounter which is crucial when designing an experiment.
- The students will also present to the rest of the class and invite any suggestions or modifications which helps students feel invested in other group’s progress as well.
- The Spuds in Tubs experiment with climate change could be supported with many different mini experiments where students begin to feel comfortable and understand the expectations of an open-ended experiment such as this one.
- This unit will also give students a greater appreciation of agriculture, plants, and the connections between themselves and the rest of the world.
- This unit can also be used to provide students with an overview of:
  - the parts of plants and an explanation of photosynthesis
  - life cycles of the plants encouraging students to explain their understanding in cycles
  - difference between sexual and asexual reproduction of plants

**SCIENCE LESSON IDEA 1**

**BASIC PLANT PARTS & PHOTOSYNTHESIS**

**Introduction**

Go over the basic parts of the plant and their functions

1. Leaves:
   - Photosynthesize: manufacture food for the plant
   - Photosynthesis Reaction: Sunlight + Carbon Dioxide + Water > Oxygen + Carbohydrate (Glucose)
   - Transpiration: allows movement of water from soil > up the plant > into the leaves
2. Flowers:
   - purpose is reproduction
   - Contain male and female reproductive organs
   - Allows for sperm (in the pollen) to reach the ovules (in the ovary) during pollination

3. Fruit:
   - is produced so plants can disperse their seeds
   - Fruit is a ripened ovary and serves like a “mother’s womb” for the embryo of the baby plant
   - Fruit nourishes and protects the seed

4. Stem:
   - support - holds up the plant
   - transport – carries water, minerals and photosynthesis products

5. Seeds:
   - Contain the baby plants (embryo)
   - Produced once the ovule is fertilized by the pollen (sperm)
   - Endosperm: food supply for the embryo
   - Monocot plants: begin life with 1 leaf
   - Dicot plants: begin life with 2 leaves

6. Roots:
   - Help anchor the plant
   - Absorption of water and minerals from soil
   - Store extra food for extra use

Go over elements of potato plants and how they work
- Tubers are enlarged underground stems
- They are used to store extra energy (starch) for the plant
- Multiple Tubers are produced
- Develop from seed potato
- Rhizomes – the specialized name given to the UNDERGROUND stems or roots of the potato plant
**Application / Activity**

- Have students label and identify potato plant parts
- Have students make a diagram of a potato plant and photosynthesis at work
- Ask students to brainstorm how changes in climate could affect each part of the plant
  > Pollination windows can be shortened by variable spring conditions
  > Flowers can be lost in extreme rain events; less fruit forms
  > Fruit could ripen too quickly, or all at the same time in extreme heat and result in some of crop not being harvested (due to spoilage, lack of storage capacity, or lack of labour supply for harvesting)
  > Roots can be damaged if soil becomes oversaturated due to flooding

**Closure / Extension**

- Have students write or draw 1 new thing they learned today
- Have students put up the sticky notes on the white board (or alternate board).
Resources for this Lesson

POTATO PLANT

flower
inflorescence
leaf
fruit
lateral stem
main stem
underground stem
mother
stolon
tuber
roots
tuber

Potato Perspectives on Climate Change • A Secondary Level Curriculum
SCIENCE LESSON IDEA 2
SEXUAL & ASEXUAL REPRODUCTION OF PLANTS

Introduction

• Clarify for students that plants may be capable of reproducing in more than one way.
• Clarify for students the differences between sexual and asexual reproduction
• Emphasize the difference between the offspring produced through the two methods.
• Incorporate types of asexual reproduction (binary fission, budding, fragmentation, vegetative reproduction, etc.)
• Also, clarify the advantages and disadvantages of each method

• Sexual Reproduction:
  » Involves male and female (parents)
  » Involves fertilization of egg cell (female sex cell) by sperm cell (male sex cell)
  » Results in fertilized egg = embryo
  » Occurs through process of meiosis
  » Offspring contains ½ the genetic material of each parent
  » Produces a plant which is genetically different from its parent
  » Example: new potato plant will have genetically unique potatoes

  » Advantages:
    » Brings genetic diversity in potato plants
    » Resistance to disease due to greater genetic diversity
    » Seed dispersal reduces competition between other potato plants
    » Seeds can be dormant until good conditions arise

  » Disadvantages:
    » Complex
    » Depends on seed dispersal
    » Slow growth of plant to reach maturity
    » Wasteful (petals, pollen, fruit)
Asexual Reproduction:

- Involves only 1 original cell (1 parent, not 2)
- Occurs through mitosis
- The resulting cell is an identical copy of the parent
- No egg or sperm cell involved

Different forms of asexual reproduction are:

- Budding: The “eye” of the potato is able to produce a NEW potato.
- Have you ever had a potato that begin to bud?
- Have you put part of a potato in the garden compost only to have it grow a new potato?
- Fragmentation
- Binary Fission
- Spore Formation

Vegetative Reproduction:

- The Seed Potato contains “eyes” that can bud new shoots that will develop a new potato
- Occurs by mitosis
- The Seed Potato is also called the Mother Potato

Advantages:

- Simple process
- No seed dispersal needed
- Growth is rapid
- Not much waste
- Could be natural or artificial

Disadvantages:

- No variation – could be advantageous with good potato, but bad if potato has disease. Genetically all the same
- All plants are susceptible to the same disease (no unique resistance)
- Competition if overcrowding with other plants
Application / Activity

- While teacher gives notes above, students should be completing the Potato Plant Reproduction handout (see below)

Closure / Extension

- Handout is due next class

Resources for this Lesson

- Handout is on the following 3 pages.
Potato Plant Reproduction

1. **What are the two different forms of reproduction?**

   ___________________ & ___________________.

2. **How are these two methods different?**

   ________________ Reproduction
   
   • Involves ___________ and ______________ (Parents)
   
   • Involves ______________ of ______ Cell (Female Sex Cell) by ____________ Cell (Male Sex Cell)
   
   • Results in Fertilized Egg = ______________ or in the case of the potato = __________
   
   • Occurs through process of M______________
   
   • Offspring contains _______ the ______________ material of each parent.

   ________________ Reproduction in the Potato Plant
   
   • Produces a plant which is genetically ______________ from its ________________.
   
   • Will it form the same potatoes as its parent plant? _____________

   ________________ Reproduction
   
   • Involves only _______ Original Cell (1 ______________, not _____)
   
   • Occurs through M______________
   
   • The resulting Cell is an I__________________ Copy of the p______________
   
   • No E_______ or S___________ Cell involved.
3. **Recall: What are the different forms of Asexual Reproduction?**
   - B________
   - F________
   - Binary F________
   - Spore F________
   - V________ Reproduction

4. **The Potato Plant:**
   - Reproduces ______________ to produce a new potato plant that is ____________ from parent
   - Begins with a Potato ______________
   - Reproduces ______________ to produce an ______________ potato plant
   - Begins with a ______________ Potato

5. **Asexual – Vegetative Propagation**
   - The “________” of the potato is able to produce a _______ potato.

6. **Vegetative Reproduction**
   - The S________ Potato contains “________” that can ______ new shoots that will develop a new potato
   - Occurs by m____________
   - The S________ P________ is also called the M________ P____________.
7. Why reproduce sexually?
   - G_____________ D______________ in Potato Plants
   - R______________ to d_____________ due to greater genetic diversity
   - Seed d_______________ reduces c_______________ between other potato plants
   - Seeds can be d____________ until good conditions arise

8. Disadvantages
   - C______________ (requires more time and energy)
   - Depends on S____________________________
   - S______________ growth of plant to reach m______________
   - W_______________ (petals, pollen, fruit)

9. Asexual Reproduction
   - S____________ process
   - ______ seed dispersal needed
   - Growth is _____________
   - Not much _________________
   - Could be n_____________ or a _________________

10. Disadvantages
    - No_______________ – could be advantageous with ________ potato, but bad if potato has ________________
    - All plants are s_______________ to the same d____________ (no unique r__________)
    - C_________________ if o_______________ with other plants
SCIENCE LESSON IDEA 3
THE POTATO STORY

“The Potato Story” Adventure allows students to explore the Plant Life Cycle at their own pace and to test their knowledge about plants. While the website may be designed for younger students, this can still be an appropriate place to start for junior science students.

Introduction / Objectives

• On the overhead, show students “The Potato Story” website and discuss the activity details.
  www.thepotatostory.co.uk

Application / Activity

• View “The Basics of Plant Growth {Years 5 and 6}” Animation and follow the guiding questions
• Complete the Lifecycles Quiz
• Click on Growing Plants and complete the Plants and Growth Quiz
• Click on Healthy Potatoes – Play the Potato Detective Game and complete The Great Potato Quiz
• Complete the Potato Story Handout while you watch the videos (see below)

Closure / Extension

• Handout out 1 sticky note
• Have students write or draw 1 new thing they learned today though the website
• Have students put up the sticky notes on the white board (or alternate board).

Resources for this Lesson

• Handout is on the following 5 pages.
The Potato Story Adventure

Name: ______________________

Use website www.thepotatostory.co.uk/default.aspx?section=lifecycles

Part A — Potato Trivia Questions

As you complete this task, the website will share with you Potato Trivia.

See how many of the questions you can answer below.

1. How much does the largest potato weigh? _______________________

2. Potato is _____ % water and ____% solid.

3. How many countries worldwide grow potatoes? _______________________

4. What part of the potato plant is edible? _______________________

5. Why is the potato also called a spud? _______________________

6. Where were potatoes first discovered? _______________________

7. What's the most unique place where potatoes have been grown? _______________________

8. What country produces the most potatoes today? _______________________


Part B — Click on “The Basics of Plant Growth” Years 5 & 6

Watch the “Fantastic Plants” animation and answer the questions below.

Scene 1:

1) How do plants grow? (What do they need?)

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

2) What job does each part of the plant have?

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
Scene 2: Flower Parts & Their Functions.

1) Label the Parts of the flower and record their function(s).
**Scene 3: Plant Life Cycle**

1. Watch the animation(s).

2. Draw your own diagrams to represent the Plant Life Cycle.

3. Provide a brief description about each stage.

<table>
<thead>
<tr>
<th>Draw Diagram</th>
<th>Write Brief Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 – Germination</td>
<td></td>
</tr>
<tr>
<td>2 – Male Adult Plant</td>
<td></td>
</tr>
<tr>
<td>3 – Pollen Dispersal</td>
<td></td>
</tr>
<tr>
<td>4 – Fertilization</td>
<td></td>
</tr>
<tr>
<td>5 – Seed Dispersal</td>
<td></td>
</tr>
<tr>
<td>6 – Seed Planting</td>
<td></td>
</tr>
</tbody>
</table>
Part C: Healthy Potatoes

1. Play “The Potato Detective” Game.

2. Make a list of new things you learned about potatoes.
   • _______________________________________________________________________
   • _______________________________________________________________________
   • _______________________________________________________________________
   • _______________________________________________________________________
   • _______________________________________________________________________
   • _______________________________________________________________________

Part D: Growing Plants

1. Play the “Growing Plants Game”

2. Take the “Plants and Growth Quiz”. My score was: ________________
SCIENCE LESSON IDEA 4
ECOSYSTEMS & AGRICULTURE

Introduction

• Go over the importance of healthy ecosystems for our food supply (i.e., our soil, water, pollinators such as bees, stable climate = ecosystem)

• Go over ideas from the Rationale for this Project section on how each of these things can be affected by climate change

• Also ask students to consider how climate change will affect certain species of animals

• Explain how:
  » Weather will impact habitats
  » Small animals depend on habitats for protection against predators, food, shelter, and water

Application / Activity

• Students must brainstorm, research and present ideas on how climate change will affect the ecosystem and thus our food supply

• Students can also choose a specific species of animal and brainstorm, research and present ideas on how climate change will affect this species

Closure / Extension

• Students can present their findings to the class in an interesting way (play, skit, news report, poster, power point etc.)
ENGLISH LESSON IDEAS

Currently the Big Ideas created for the new 10–12 English Learning Arts curriculum include:

- Text and story deepen understanding of complex and abstract ideas
- The exploration of text and story deepens understanding of one’s identity, others, and the world
- People understand text differently depending on their worldviews and perspectives
- Texts are social, culturally, geographically, and historically constructed
- Language shapes ideas and influences others.

(Downloaded from: https://curriculum.gov.bc.ca/sites/curriculum.gov.bc.ca/files/pdf/ela_10–12.pdf)

Using a variety of texts, teachers can connect students with climate change and agricultural concepts in a more informal way using fictional and factual forms of literature. The following lesson ideas could aid teachers in achieving a number of these Big Ideas in the classroom.

ENGLISH LESSON IDEA 1
EXPLORING THE FUTURE OF FARMING & AGRICULTURE IN LIGHT OF CLIMATE CHANGE

Introduction

- Go over elements of a short story: setting, point of view, characters, theme, plot, climax, rising action, falling action, resolution, conflict etc.
- Read aloud: Pete’s Potato Angels by Alix MacNeil as students follow along (Download from: http://aitc.ca/bc/programs/spuds-in-tubs-2/spuds-program-resources/; find it under Spuds in Tubs Supplement, Pete’s Potato Angels)

Application / Activity

- Write an extension of the story (1 page) answering this question:
  - Describe Pete looking out his window 50 years from now. What are his issues now? (Potato Perspectives on Climate Change Booklet (Page 17))
  - The story must include at least 2 impacts that Pete the farmer faces because of climate change. See notes on Page 9 of Potato Perspectives on Climate Change Booklet
Closure / Extension

• Continue writing at home if needed
• Be prepared to share finished story next class

ENGLISH LESSON IDEA 2

DEBATING THE ISSUE OF CLIMATE CHANGE

Introduction

• Students can work in their tub groups for this lesson
• Discuss elements of a good debate, debate structure etc.
• Can show a clip from the movie “The Great Debaters (2007) starring Denzel Washington

Application / Activity

• Students must research information about climate change in their region and beyond
• Students must research the political and scientific points of view around the topic; what the scientific and political communities have been debating about
• Students will then devise plans on what the solutions can be; political, scientific, or a combination of both?
• Possible debate topics could be:
  » Can humans adapt to climate change or is this impossible?
  » Is agriculture the most vulnerable sector to climate change? (versus cities, versus forestry, versus fisheries and marine impacts

Closure / Extension

• Students present their findings during a debate against the opposing perspective; they can focus on ways to address climate change in their regions
• All positions offered must be supported by facts and evidence found through research
• At the end of the debate presentations the student can each vote on the best way to address climate change
• Teacher can assign each team a pro or con side of the debate, or leave it open for each group to choose a side
MATH LESSON IDEAS

Applying math concepts to daily life can be a challenge. In the typical math classroom, there is a rush to get through the content and often experiments where data is collected are rare as they can be time consuming. There are connections between units but extension activities are not as common. Having a real experiment where students determine what, how and when they collect data allows for student autonomy and is important in stimulating engagement and ownership.

The following lessons can be used to enhance a graphing unit. Students should be familiar with linear relations and since this lesson requires consistent data collection, the simplest would be to measure potato plant height. However, an extension could be made with number of leaves produced, growth of leaves, colour etc. A lesson on a control variable might be introduced here as well. Since this lesson is simply touching upon a relationship between time and plant height, an extension lesson could discuss what factor or condition contributed to the greatest growth and how that can be measured with confidence.

With 5 spuds per tub, and approximately 5–6 students per tub, each student can take one spud and measure that and contribute to the group that way. The tub would have to be under the same conditions so an average of the height of all 5 plants would be have to be measured and from this another lesson on mean, mode and median could be introduced.

MATH LESSON IDEA 1
APPLYING LINEAR RELATIONS TO SPUDS IN TUBS

Materials / Preparation

- It is expected that students have completed their graphing unit and are familiar with vocabulary related to graphing
- This lesson should be completed in May when potato plants have been planted and are growing outdoors

Introduction

- Review lesson on dependent and independent variable
- Review important features of a graph
• Review general formula for a linear relationship:
  » \( y = ax \)

• Independent Variable:
  » Something that you measure that isn’t affected by other things you are trying to measure
  » Always labeled on the x-axis of the graph
  » Example: age, minutes, days,

• Dependent Variable:
  » Something that you are measuring that IS affected by other factors
  » Always labeled on the y-axis of the graph
  » Example: your height, population

**Application / Activity**

• Students create their own data table to collect data
• Students to determine how often to collect data and have a reason for this
• Students must record findings on large paper to post up in the class so other groups can see each other’s progress

**Closure / Extension**

• If available, data can be collected electronically and students can use excel or logger pro to graph their data
**Rubric for Graph**

<table>
<thead>
<tr>
<th></th>
<th>Exemplary</th>
<th>Accomplished</th>
<th>Developing</th>
<th>Beginning</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Presentation</strong></td>
<td>The presentation is exceptionally attractive in terms of design, layout and neatness.</td>
<td>The presentation is attractively attractive in terms of design, layout and neatness.</td>
<td>The presentation is acceptably attractive though it may be a bit messy.</td>
<td>The presentation is messy or very poorly designed.</td>
</tr>
<tr>
<td><strong>Graph presentation</strong></td>
<td>All features are neatly labeled including title, x-axis, y-axis.</td>
<td>All features are neatly labeled including title, x-axis, y-axis.</td>
<td>Most features are labeled.</td>
<td>Most features are labeled.</td>
</tr>
<tr>
<td></td>
<td>Exceptionally well designed, neat and attractive. A ruler and graph paper (or graphing computer program) are used.</td>
<td>Neat and relatively attractive. A ruler and graph paper (or graphing computer program) are used to make the graph more readable.</td>
<td>Lines are neatly drawn but the graph appears quite plain.</td>
<td>Appears messy and “thrown together” in a hurry. Lines are visibly crooked.</td>
</tr>
<tr>
<td><strong>Data table</strong></td>
<td>Data in table is well organized, accurate and easy to read.</td>
<td>Data in the table is organized, accurate and easy to read.</td>
<td>Data in the table is accurate and easy to read.</td>
<td>Data in the table is not accurate and/or cannot be read.</td>
</tr>
</tbody>
</table>
MATH LESSON IDEA 2
MONEY & CLIMATE CHANGE

Introduction
- Ask students to consider the economic impact of climate change

Application / Activity
- Students could consider:
  » the economic consequences the local region would face if farmers had lower harvests due to climate change
  » Food prices would go up, people would lose their jobs at farms, manufacturing companies, food processing companies, marketing agencies…
  » Locals who work in the industry would have less money to spend, leading to local businesses suffering
- Students could also consider:
  » The economic costs of upgrading local infrastructure to adapt to climate change
  » Local dike system, irrigation systems, buildings, roadways

Closure / Extension
- Students could present their findings to the class in groups
ARTS EDUCATION LESSON IDEAS

ARTS EDUCATION LESSON IDEA 1
LEAF ART

Materials / Preparation

- 3–5 different colours of paint
- Paint brushes or sponges
- Foil trays, pie pans, or bowls
- White paper
- Coloured construction paper
- Glue
- 3–5 green leaves per student off of your potato plants

Introduction / Objectives

Students will create art using materials from their potato plants.

- Students will go outside and check on their potato plants.
- Water as needed.
- Each student must carefully pick 3–5 leaves off of their plants.
- Ask them to pick leaves that have a lot of texture/lines on the bottom.
- Take leaves back inside.

Application / Activity

- Explain that they will be making art that can be referred to as ‘environmental’ or ‘recycled’ art. This is because they are using existing or old materials (leaves) to create new art (Leaf picture).
- Explain that they will be making a picture using ‘leaf printing’ or ‘leaf stamping’ techniques.
• Steps:
  » Teacher must pour different coloured paints into foil trays, pie pans, or bowls (wide enough to fit a leaf inside). Groups can share each of these trays.
  » Teacher must demonstrate how to stamp/print the leaf
  » Dip sponge or brush into the pan full of paint
  » Paint the bottom side of the leaf (side with veins)
  » Gently stamp that leaf onto your white paper, and remove it
  » You should see the pattern of your leaf painted onto your sheet
  » Too much paint will leave a glob of paint with no lines showing
  » Use the same colour as many times as you’d like
  » Each leaf can be spread around the page or layered on top of the previous colour
  » Once dry, students can glue their white paper onto a coloured piece of construction paper

**Evaluation / Assessment**

• Collect final art project and evaluate for its presentation, organization, neatness, creativity etc.

**Homework / Assignment**

• Students who were unable to complete can do so after school and hand in next class.

**Closure / Extension**

• Students may glue some of their green leaves right onto the pictures for a more natural affect
• Students may paint designs onto cardboard boxes, and then fill these boxes with their potato harvest and take them home as gifts for their families or for Father’s Day
• Using button eyes, and other facial parts from craft stores, students may create their own Mr. Potato Head
• Students may brainstorm and create their own art project that could be made with their potato plants using the leaves, peelings etc.
APPENDIX 4
Complete Lesson for Ancient Civilizations or History

This lesson is a mystery item activity, using Mesopotamia as an example, but teachers can adjust based on what civilization is being studied.

Materials / Preparation

- 4 to 6 items of about agriculture from your civilization focus, such as:
  - item 1 – recipe tablet
  - item 2 – Standard of Ur
  - item 3 – Sumerian Farmer’s Almanac
  - item 4 – table of stages in the agricultural calendar
  - item 5 – (added at your discretion)
  - item 6 – (added at your discretion)
- 4 to 6 envelopes (place each item in an envelope)

Introduction / Objectives

Students will make interpretations based on inferences, ask good questions, know how to fulfill their roles as recorder, task master, facilitator, summarizer, presenter, as well as work collaboratively in groups.

• Discuss the importance of farming and agriculture to ancient civilizations (adapt to your level and civilization being studied).

Application / Activity

• Ask students to sit in their Tub Groups.
• Tell students they should have (4–6) envelopes that each contain different clues to the mystery of Mesopotamia.
• Tell students that they may only use the images, therefore no electronic devices may be used, to find out more information.

• Have students make inferences on the items they discover, record their thoughts about the items, and offer ideas about what these traces and accounts reveal.

• Have the recorder record the groups’ inferences of each item onto poster paper.

• Circulate and encourage group discussion, facilitate if necessary.

• Questions to answer:
  » Who made this source?
  » What kind of source is this?
  » How was it made?
  » When was it made?
  » For whom was it made?
  » Where was it made?

Closure / Extension

• The presenters of each group will have 3 minutes to defend their inferences and share their conclusions as to what the mystery box reveals about Mesopotamia.

• Go over any similarities and differences in group inferences and conclusions.

• Go over each of the items in the shoe box using the Information Details for each of the items.

• Discuss what the mystery images of Mesopotamia are trying to reveal (“AGRICULTURE”)

• AGRICULTURE played a significant role in the first civilization of Mesopotamia. Agriculture dictated the calendar months, the recipes they followed, the art they created and what was depicted in their art, as well as the advice that was passed down from generation to generation. Moreover, agriculture also dictated the order of society where individuals were ranked according to their role in agriculture, for example a farmer versus a royal.

Resources for this Lesson

• Items 1–4 are available on the following 3 pages
Item 1

A recipe for *kanasu* (meat and vegetable) broth carved on a clay tablet from ancient Mesopotamia, which occupied the land between the Tigris and Euphrates rivers.

Item 2

The *Standard of Ur*, from the Royal Tombs of Ur, made of shell, limestone, lapis lazuli, and bitumen, shows peacetime and agriculture.
Item 3

Excerpt from Sumerian Farmer’s Almanac

- “When you are about to take hold of your field, keep a sharp eye on the opening of the dikes, ditches, and mounds, when you flood the field the water will not rise too high in it. When you have emptied it of water, watch the field’s water-soaked ground that it stay virile ground for you. Let shod oxen trample it for you; After having its weeds ripped out the field made level ground, dress it evenly with narrow axes weighing two-thirds of a pound each. Let the pickax wielder eradicate the ox hooves for you, Smooth them out; Have all crevices worked over with a drag, and have him go with the pickax all around the four edges of the field.

- (13–21) While the field is drying, let your obedient prepare your tools for you, make fast the yoke bar, hang up your new whips on nails, and let the hanging handles of your old whips be mended by the artisans. Let the bronze … your tools “heed your arm”; let the leather “headbinder”, goad, “mouth-opener”, whip uphold you; let your bandu-basket crackle; will make a mighty income for you.

- (22–40) When your field has been supplied with what is needed, keep a sharp eye on your work. After adding an extra ox to the plow-ox — when one is harnessed to another ox, their plow is larger than plow – make them … one bur; they will make for you a … like a storm, so that three gur barley will be planted in that one bur. Sustenance is in a plow! Having had the field worked with the bardil-plow – the bardil-plow – having had it worked over with the shukin-plow, repeat. Having had it harrowed, raked three times and pulverized fine with a hammer, let the handle of your whip uphold you; brook no idleness. Stand over them during their work, brook no interruptions. Do not [distract] your field workers. Since they must carry on by day, Heaven’s stars for ten, Their strength should be spent on the field. They are not to dance attendance on you.

- (41–47) When you are about to plow your field, let your plow break up the stubble for you. Leave your “mouth-cover” of the plow …, leave your … on a narrow nail. Let your moldboards spread to the side, set up your furrows — in one garush, set up eight furrows. Furrows which have been deeply dug — their barley will grow long.

- (48–63) When you are about to plow your field, keep your eye on the man who puts in the barley seed. Let him drop the grain uniformly two fingers deep, Use up one shekel of barley for each garush-one. If the barley seed does not sink in properly, change your share, the “tongue of the plow”. If the ..., plow diagonal furrows where you have plowed straight furrows, Plow straight furrows where you have plowed diagonal furrows. Let your straight furrows make your borders into tulu-borders; let the lu-furrows make straight your borders; Plow ab-furrows where ...; Let all its clods be removed; all its high spots be made into furrows; all its depressions be made into low furrows — will be good for the sprout.
Item 4

Stages in the Mesopotamian agricultural calendar for the city of Girsu.

“The basic triad of sheep, goat and cattle predominated in Southern Mesopotamia, and mention should be made to them because Nanna the Moon was seen as the protector of the cow herders. In special, cattle were employed consistently as draught animals for ploughing, and thus of fundamental importance for agriculture. Meat or milk products were not consumed as part of the regular diet in Mesopotamia because such animals were too valuable to be slaughtered in a regular basis. Sheep and goats, on the other hand, were kept principally for the fleece and hair they provided for the textile industry. As for meat consumption, at Old Babylonian Ur sheep and goat appear only as an offering to the temple on the occasion of special festivities. Likewise during the Neo-Babylonian period for Uruk and Sippar.” (Lishtar, 2009)

<table>
<thead>
<tr>
<th>MONTHS IN MESOPOTAMIA</th>
<th>GREGORIAN MONTHS</th>
<th>AGRICULTURAL YEAR</th>
<th>HARVEST-FALLOW YEAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>NISSANNU</td>
<td>March–April</td>
<td>Last irrigation; harvest may start</td>
<td>Flooding (leaching)</td>
</tr>
<tr>
<td>AJARU</td>
<td>April–May</td>
<td>Harvest</td>
<td>Survey of web fields</td>
</tr>
<tr>
<td>SIMANU</td>
<td>May–June</td>
<td>Cutting, drying, stacking</td>
<td></td>
</tr>
<tr>
<td>DU’UZU</td>
<td>June–July</td>
<td>Transport and storage of grains</td>
<td>Inactivity</td>
</tr>
<tr>
<td>ABU</td>
<td>July–August</td>
<td>Harvest ends</td>
<td>Inactivity</td>
</tr>
<tr>
<td>ELÜLU</td>
<td>August–September</td>
<td>Beginning of ploughing, sowing</td>
<td>Inactivity</td>
</tr>
<tr>
<td>TASHRITU</td>
<td>September–October</td>
<td>Ploughing, early sowing</td>
<td>Inactivity</td>
</tr>
<tr>
<td>ARASHAMNA</td>
<td>October–November</td>
<td>Late sowing; end of ploughing</td>
<td>Inactivity</td>
</tr>
<tr>
<td>KISSILIMU</td>
<td>November–December</td>
<td>Late sowing</td>
<td>Inactivity</td>
</tr>
<tr>
<td>TEBETU</td>
<td>December–January</td>
<td>Inactivity; end of late sowing of cereals</td>
<td>Preparation of fields</td>
</tr>
<tr>
<td>SABATU</td>
<td>January–February</td>
<td>First seedlings appear; irrigation</td>
<td>Preparation of fields</td>
</tr>
<tr>
<td>ADDARU</td>
<td>February–March</td>
<td>Irrigation</td>
<td>Inactivity</td>
</tr>
</tbody>
</table>