25min Urban Agriculture Projects
Grade 9 Facilitator Notes

Objective: Students will learn about FoodShare's urban agriculture projects including small-scale aquaponics, a repurposed filing cabinet for growing sprouts indoors, a solar heater made of recycled materials and bike power! Students will participate in the building of a vegaquarium – a small-scale aquaponics system appropriate for a classroom.

Recipe Category: Plants and Gardening

Cooking Time: 25 mins

Level of Difficulty: Grade 9

Recipe Ingredients:

- Vegaquarium
- Tank
- Pump
- Grow Tray
- File a Sprout
- Mini Pop Can Solar Heater
- Pop Can
- *Boom Bike*
- Music player for Boom Bike

Curriculum Links:

Grade	Subject Area	Ontario Curriculum Links
8	Science and Technology	*Understanding Structures and Mechanisms: Systems in Action* Demonstrate an understanding of different types of systems and the factors that contribute to their safe and efficient operation. (O) - 3.1 Identify various types of systems. (S) - 3.2. Identify the various processes and components of a system that allow it to perform its function efficiently and safely. (S)
9	Geography	*Human Environment Interactions* Evaluate various ways of ensuring resource sustainability in Canada. (O) ▪ Evaluate solutions to environmental problems proposed by various groups. (S)
	Science	*Biology: Sustainable Ecosystems* Assess the impact of human activities on the sustainability of terrestrial and/or aquatic ecosystems, and evaluate the effectiveness of courses of action intended to remedy or mitigate negative impacts. (O) - B1.2 Evaluate the effectiveness of government initiatives in Canada and/or the efforts of societal groups or non-governmental organizations. (S) *Physics: The Characteristics of Electricity* Assess some of the costs and benefits associated with the production of electrical energy from renewable and non-renewable sources, and analyze how electrical efficiencies and savings can be achieved, through both design of technological devices and practices in the home. (O) - E1.2 Assess some of the social, economic, and environmental implications of the production of electrical energy in Canada from renewable and non-renewable sources. (S)

Introduction: (5 mins)

- Introductions:
    - Introduce yourself as a facilitator for the day. Share that you are from FoodShare, a non-profit community food security organization. FoodShare's mission is good healthy food for all! One way we work towards this goal is to develop and try out different ways of growing food that are sustainable and use renewable sources of energy.

- Give a brief outline of the subject matter for this workshop, for example:
    - Today we will be looking at some different ways that FoodShare grows food in sustainable ways. We will see our:
        - Vegaquarium, a very small scale aquaponics system, growing both fish and plants;
        - The File a Sprout – a repurposed filing cabinet that grows food inside;
        - Mini Pop Can Solar Heater, which produces energy from a renewable source that can be used to regulate the temperature in a greenhouse in the winter.
        - Boom Bike – an exercise bike that has been altered to produce electricity when someone pedals it.
    - We will learn about how these systems are sustainable – understanding how their components work together to create sustainable ways of producing food indoors in Toronto.

- Briefly define the key terms below, and any others the students may be unfamiliar with:
    - **Sustainable:** Something is sustainable when it can be done over and over again without harming current, or future, generations of people or the environment.
    - ***Re-purposing:*** Using items for a purpose other than what they were originally created for such as using wooden boxes for a bookshelf or making a dress out of curtains.
    - **Renewable vs. Non-Renewable Energy:** Renewable energy is energy that comes from natural resources that are naturally replenished such as sunlight, wind, rain, tides, and geothermal heat. Non-renewable energy is energy produced from resources that cannot be naturally replenished at the rate at which they are consumed such as coal, natural gas and uranium (nuclear power).

Urban Agriculture Show and Tell: (20 mins)

Facilitate a demonstration of how each of the following projects work. Be sure to outline their components, the materials used, how they function to create a sustainable system, and what about each makes them sustainable. Engage students by asking whether they can think of a way of improving each system in terms of efficiency *while maintaining or improving* how sustainable they are.

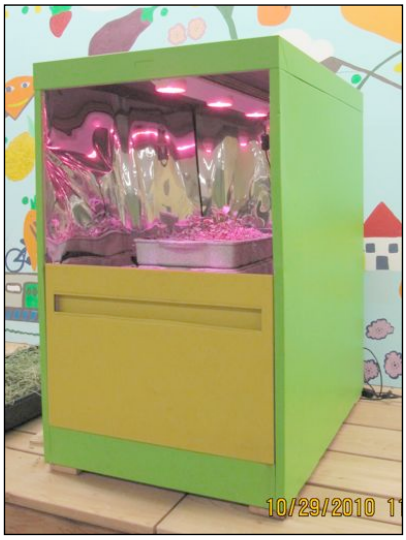
Be sure to allow room for questions and check often for understanding as you explain.

Vegaquarium:

- Aquaponics is the integration of aqua culture (raising fish) and hydroponics (growing plants without soil). Both vegetables and fish are grown and the recycling of nutrients and water filtration are linked. There are three key roles in this system: fish produce the waste, bacteria turn that waste into nitrates, and plants consume the nitrates thus filtering the water for the fish. Aquaponic systems range in size from a small 5-gallon fish tank and grow bed setup to a large 10,000-gallon greenhouse operation.
- Benefits include:
    - no soil, fertilizers, pesticides, or weeding
    - when running efficiently, a system requires only 1/10 the water of a comparably sized garden
    - grow beds can be planted up to four times more intensively
    - edible fish such as tilapia, catfish and perch can be raised
    - reduced emissions from food packaging production and driving to buy food;
    - an improved understanding of the complexity of nature.
- The vegaquarium is a small example of an aquaponic system
- Show students the vegaquarium
- Point out the materials used: Fish tank, pump, grow tray, grow light, hydroton
- Note where the fish and plants are located and explain how they function in a symbiotic relationship – the plants filtering the water for the fish and the fish provide nutrients for the plants. There are three key roles in this system: fish produce the waste, bacteria turn that waste into nitrates, and plants consume the nitrates thus filtering the water for the fish. Using the tank, pump and grow tray, have a student volunteer come to the front and put together the vegaquarium.

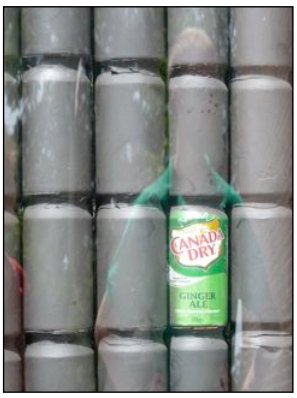
- With a Grade 8 group, emphasize how these separate components form a system.
- With Grade 9 students, have the group consider the energy inputs and outputs of the system. (Electricity, fish food, light) After you identify these, ask if there are any points in the system that could be made more sustainably (ie. have the pump run off of solar power.)
- After concluding the workshop, take apart the pieces of the Vegaquarium you constructed with the students so that it is ready for the next rotation.
- Helpful resources:
    - General Information and Systems:
        - Nelson and Pade: https://www.aquaponics.com/aquaponics/aquaponicsoverview.php
        - Backyard Aquapoincs: http://www.backyardaquaponics.com/
        - Growing Power:http://www.growingpower.org/aquaponics.htm
    - Videos:
        - Flood and Drain System: http://www.youtube.com/watch?v=FwMEulvJ2Ps
        - Raft System: http://www.youtube.com/watch?v=cSTYgpHZ3wQ

File a Sprout:

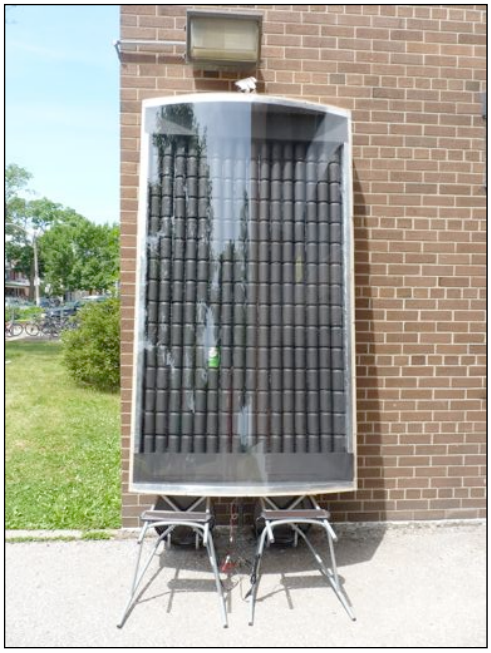


- Show students the File a Sprout and identify the different materials used (filing cabinet, grow light, bin, growing medium and tray, mylar, seeds)
- Again, outline how the different components work together to create a system for growing food in the classroom.
- Note that the grow light used is an LED grow light, which is more efficient and provides a full spectrum of light. Plants use particular colours for different things: blue is for leaf growth and red is for fruiting. (http://extension.missouri.edu/publications/DisplayPub.aspx?P=G6515)
- Have students imagine alternative materials that could be repurposed in this way, boxes, bathtub etc. Encourage them to get creative in thinking of other sustainable options.

Mini Pop Can Heater:

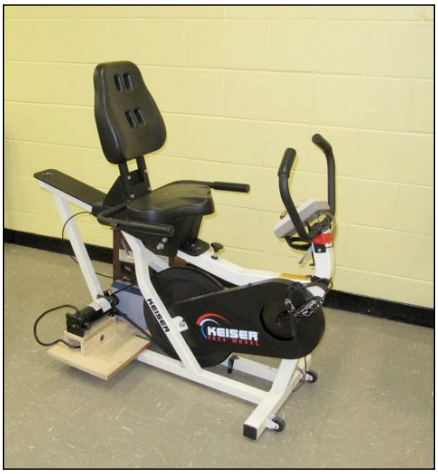


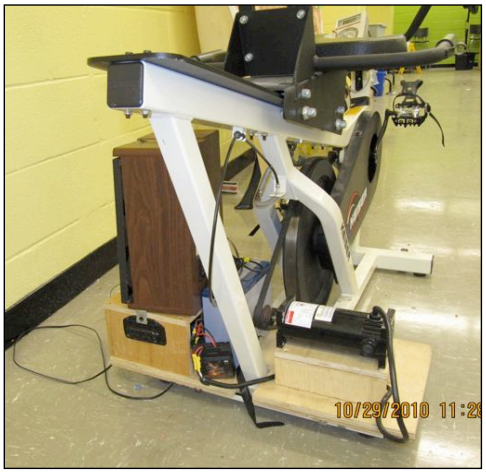
- A pop can solar heater harnesses the energy of the sun to heat a space. The heater works when cold air, drawn into the unit by a fan, enters the aluminium pop can chambers and is heated by the sun's rays. Convection occurs and the heated air is forced upwards where it is directed into a room. These units can be mounted on the side or roof of a home, shed or greenhouse.
- Show students the mini pop can heater. Ask students if they recognize the materials that are used. Show them the individual pop can.
- Explain the process of creating the pop can heater:
    - cut off the top and bottom of the pop can
    - glue the pop cans together in rows
    - paint the cans with a dark BBQ paint
    - place the cans in a box with a clear plastic surface and holes at the top and the bottom
- Note the role that each material plays – aluminum transferring heat, insulation keeping in the heat, reflective materials, fan and solar panel
- Note how FoodShare has a much larger model that is designed to heat our off the grid greenhouse on our property. Show pictures of our heater and others, how to attach it to a house etc. Ask students to guess how hot the air temperature gets where the air exits the top of the solar heater – share that at FoodShare temperatures over 100 degrees Celsius were reached.



Boom Bike:

- Identify the components of the Boom Bike. (Battery, motor, bike, amp, charge controller which regulates the power so you don't kill the amp or the battery)
- Talk about how the Bike generates energy. Usually, you run electricity into an electric motor and the shaft of the motor turns to carry out some sort of task. If instead, you reverse this process and turn the shaft of the motor, electricity will be produced. By making use of the mechanical advantage inherent in a bicycle, you can transfer the effort of your pedalling to spin the shaft of the motor, which converts this kinetic energy into electricity. The electricity can be used directly or stored in a battery.
- Ask students to think of why this is a sustainable system? How could it be made even more sustainably? Ask students to consider how this form of energy generation could be used in the production of food? Take a few ideas from the group.
- Ask for a volunteer to test out the bike, playing some music for the group with pedal power.
- Helpful resources:
    - The Human-Powered Home: Choosing Muscles over Motors by Tamara Dean (www.thehumanpoweredhome.com) provides detailed instructions for building a pedal-powered generator and many other human-powered devices.
    - There is also a wealth of valuable resources on the Internet to guide you on your way, including many instructional videos. Below are two comprehensive sites:
        - www.pedalpowergenerator.com
        - www.los-gatos.ca.us/davidbu/pedgen.html





Serving Suggestions: