25min Power of the Sun
Grade 11 Facilitator Notes

Objective: Students will connect their personal food experience with larger food security issues.

Recipe Category: Plants & Gardening

Cooking Time: 25 mins

Level of Difficulty: Grade 11

Recipe Ingredients:

Photosynthesis:
- ☐ Potted Plant
- ☐ Diagram to explain photosynthesis in plants

Solar thermal (water and air):
- ☐ Diagrams and photos of various solar thermal installations
- ☐ Tall clear container and shallow black container

Solar Cooking:
- ☐ Diagrams and photos of solar cookers (panel cooker, box cooker and concentrator cooker)
- ☐ Model solar cooker
- ☐ Instructions for making solar cookers

Solar PV:
- ☐ Diagrams and photos of various solar PV installations
- ☐ Mini solar PV panels
- ☐ Experimentation supplies – volt-meters, lights, motors, etc

Curriculum Links:

Grade	Subject Area	Ontario Curriculum Links
11	Environmental Science	*Conservation of Energy* Demonstrate an understanding of energy production, consumption, and conservation with respect to a variety of renewable and non-renewable sources. (O) ▪ Design and construct a working model of a device that uses and alternative energy source. (S) ▪ Explain the historical significance of a variety of energy sources. (S) ▪ Describe methods of energy production and conservation intended to reduce greenhouse gas emissions. (S)

Introduction: (5 mins)

- TREC stands for the "Toronto Renewable Energy Co-operative" – we focus on sustainable energy generation and energy conservation, and offer educational programming through our "Kids' World of Energy" program.
- Today, we're going to discuss the amazing power of the sun, and I'm going to show you some examples of how we can use the sun's energy can be harnessed in several different ways in our everyday lives.
- Question: Why is the sun so important to life as we know it on earth?
    - Provides heat and light energy, which allows the earth to sustain life!
- Question: What are some of the ways we can use the sun's energy everyday?
    - Growing plants
    - Drying clothes
    - Providing a natural source of light, during the day (for our homes, buildings and streets)
    - To produce energy: both heat energy (solar thermal) and electrical energy (solar "Photo-Voltaic" or PV)
    - Cooking food (on a solar oven)
- Question: Does anyone know how the sun makes energy?

- The sun's light is made up of photons; a photon is a bundle (or quantum) of light energy.
- Photons are constantly moving, and when a photon from the sun hits a molecule, it gives it a shove and causes it to move faster, producing heat energy (or electrical energy in the case of silicon PV panels).
- Everything in the universe is made up of tiny molecules, and various materials and surfaces are made up of different molecules so they absorb the sun's energy differently.
- "Photo" stands for light – ie. photograph, photosynthesis, and Photo-Voltaic (electricity from light) We'll explore the latter two in the next activities.

1. **Photosynthesis – growing plants (3 min)**
   - Discuss the meaning of "Photo-synthesis" (light + synthesis / together") – a process that converts carbon dioxide into organic compounds, using the energy from sunlight. Plants use photosynthesis to produce the nourishment they need to grow. When they do this, they release oxygen into the atmosphere.
   - Show a diagram of this effect and an example of a plant that uses the sun to produce it's energy
2. **Solar Thermal – heating water and air (6 min)**
   - Solar thermal means harnessing the energy of the sun to produce heat that we can use, usually to heat either water or air.
   - Solar thermal technology ranges from simple to complex. Show some diagrams and examples of simple and more complex solar thermal technologies (ie. solar shower bag for camping, beer bottle water heater for bathing, solar thermal panels or evacuated tubes for residential homes or pools, and large-scale solar thermal concentrator and furnace).
   - Explain that all materials and surfaces are made up of various types of molecules, which absorb the sun's energy differently. Hold up two containers, a shallow black container and a tall clear container – ask: if we were to fill each container with the same amount of water and place them outside on a sunny day, which container do you think will heat up the water the fastest? (the shallow black container – black absorbs heat better, and the shallow surface spreads out the water over a larger surface)
3. **Solar thermal – heating food (3 min)**

- Another application for solar thermal is solar cooking, which usually absorbs and/or concentrates the sun's heat to heat or cook food. Show several examples of solar ovens (panel cooker, box cooker and concentrator cooker) and hand out instructions to students who wish to make their own parabolic concentrator cooker at home or school.

4. Solar Photo-voltaic – producing electricity from the sun (6 min)

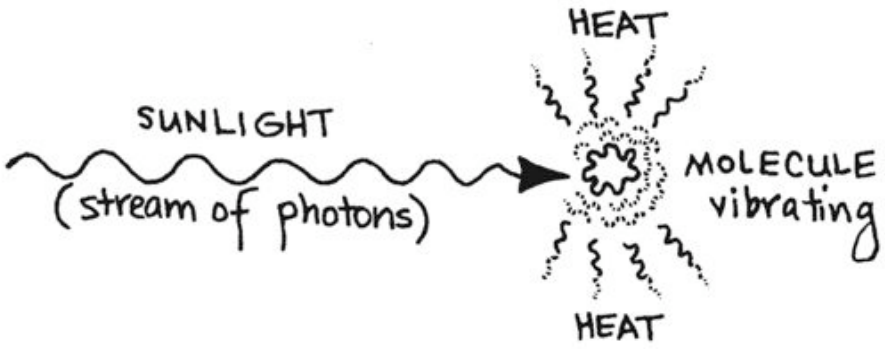
- Discuss the meaning of solar "photo-voltaic" (electricity / volts from light)
- Solar cells are made up of silicon. When photons from sunlight hit the cells, the electrons in the silicon speed up, producing electricity we can use for various applications.
- Show various examples of solar PV technologies from around the world (solar satellite, parking meter, home in Toronto, etc)
- Show students a mini solar PV panel, allow them to connect a volt-meter to measure the voltage produced in partial / full sun, and test a light bulb / motor.

Wrap-up (2 min)

- Ask students to think about all of the ways that we use the sun's energy, and to consider harnessing the sun's potential to produce or conserve energy (ie. open a window to let the light in, hang laundry outside to dry).
- Take any questions and ideas following the activities.

Serving Suggestions:

1. Photons at work:



2. Diagram of Photosynthesis:

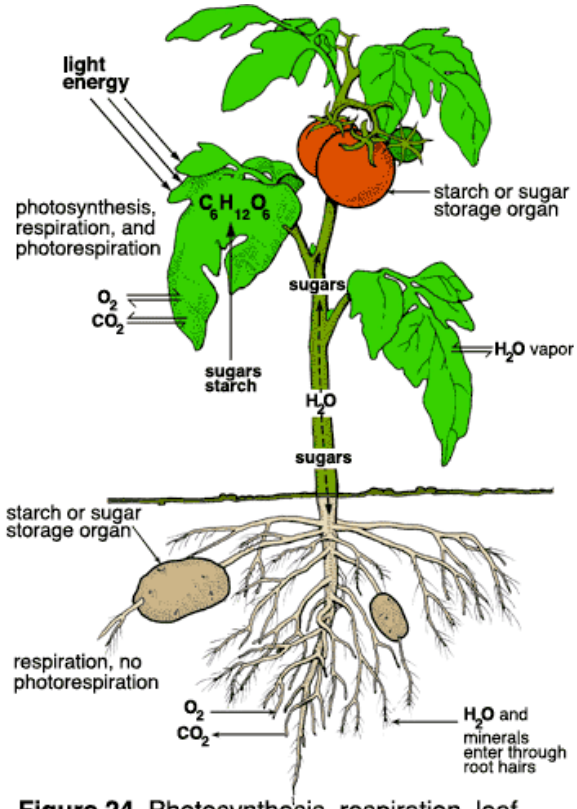
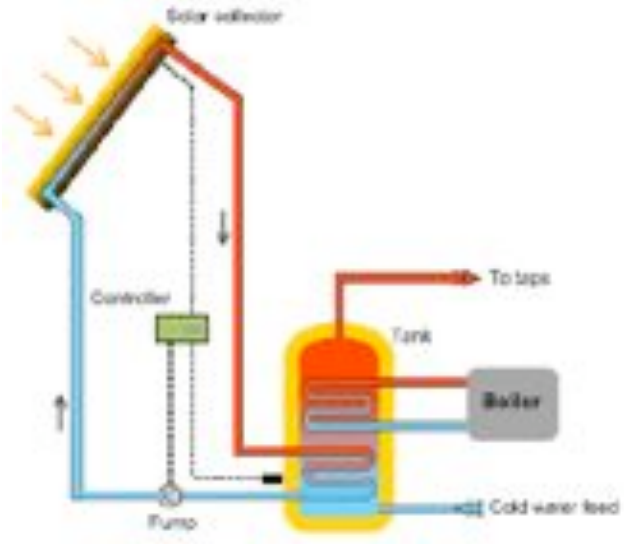


Figure 24. Photosynthesis, respiration, leaf water exchange, and translocation of sugar (photosynthate) in a plant.

3. Solar thermal (water & air):



5. Solar thermal (cooking food):

6. Solar PV (Photo-voltaic):

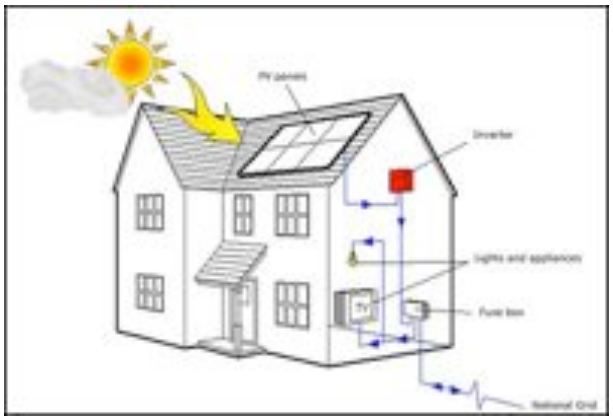
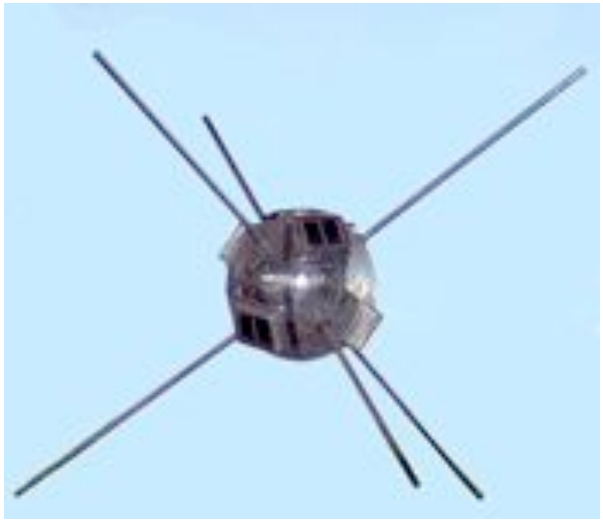


Diagram of how solar panels are connected in a typical home.



Vanguard 1, 1958 – First Solar powered satellite.

Home in Toronto using PV panels to produce their electricity.