



# Ready, Set, Go: A Science Skills Primer for Grade 9 Students

## *Activity 1: The Scientists' Approach*

### OBJECTIVES

1. Learn the scientific method of conducting experiments
2. Practice the scientific process
3. Introduce POE (Predict, Observe Explain strategy)

### BACKGROUND INFORMATION

All scientific experiments must follow a logic sequence to be informative and valid. Every experiment start with the formulation of a hypothesis, then an experiment is conducted and conclusions are drawn. This approach of 'predict, observe, explain' is essential for a good experiment. All experiments should also aim to isolate only one testing variable, and to be valid replicates and controls should also be used. The variation of only 1 variable ensures that an experiment will assess the effects of various testing conditions without the doubt whether another variable is causing the result seen. In short, everything else remains constant, so any effects seen can be traced to the one variable that was changed. Experiment replicates are also important to ensure that the result seen was not a random event, simply 'luck'. Controls also show that a result observed was not due to luck, since it provides a clear comparison to demonstrate the change seen under various testing conditions.

### VOCABULARY

Hypothesis: An educated guess, a prediction.

Variable: A factor or condition that is subject to change

Control

Replicate

Verification

## MATERIALS

- Marbles
- Toilet paper tubes
- Pennies
- Droppers
- Toilet paper
- Canola/ mineral/ olive oil
- Coffee filters
- 1 Funnels
- 7 beakers
- Graduated cylinder
- Food colouring
- Station cards
- POE worksheet

## INTRODUCTORY DISCUSSION

1. Assess the students' prior knowledge of:
  - What do you think is science?
  - What do you think is to be a scientist?
  - How do you think scientists' discover things? (by observing the natural world)
  - Who do you think can be a scientist? (anyone that can observe the world in any way!)
2. Hook – Run an 'obvious' experiment model the POE method
  - Make holes in a paper/disposable cup
  - Ask them to predict what will happen when you pour water in the cup
  - Invite a student to pour water into the cup and have them observe and write their observations
3. Introduce the idea of Scientific Process
  - How exactly do you think scientists' learn about the world?
  - Predict = hypothesis = educated guess (connection with vocabulary)
  - Observe = experiment, gather data
  - Explain = conclude
4. Discuss the idea of controls and replicates
  - Use the class demonstration to introduce the idea of controls, variables and replication:
    - e.g., repeat the activity with a cup with larger holes .....
    - or, repeat with a cup without holes .....
  - Ask what added information can be gained by repeating the experiment? (we can be sure that it is the holes that are causing the water to drain because the intact container is keeping the water; we know it has nothing to do with the specific first container because other identical containers with holes behave the same way)

## ACTIVITY

Provide instructions for the rest of the lesson and the safety guidelines & make copies of the student handout- What do you Think.

Students will form groups and go to a station, where each student should have a turn at doing the experiment in that station (if simple) or work together (if complex).

### STATION 1: HOW MANY MARBLES CAN A TOILET PAPER TUBE HOLD?

Using a toilet paper tube and marbles (or any solid object) have the students guess based on the size of the tube and the marbles how many can be fit into the tube. They should then add the marbles and conclude.

### STATION 2: DO ALL OILS BEHAVE THE SAME WAY AS CANOLA OIL WHEN MIXED WITH WATER?

Predict whether all types of oil behave the same way when mixed with water. Mix the different types of oil (mineral oil, olive oil, canola oil) with water.

**STATION 3: HOW MANY DROPS OF WATER CAN A PENNY HOLD?**

Estimate the number of water drops that can be fit on a penny, add the water by droplet counting until overflow.

**STATION 4: DOES FOOD COLOURING AFFECT THE SPEED WITH WHICH WATER MOVES THROUGH A PAPER FILTER?**

Add food colouring to a given small amount of water and filter it through a section of paper filter. How does it compare with the rate at which only water gets through the filter?

**CLOSURE DISCUSSION**

1. What was your favourite experiment?
2. What was common between all stations? (only 1 variable was tested)
3. Pick two groups that liked the same station and ask them to compare their findings

**STATION CARDS:**

Place cards on lab bench with appropriate materials. Students, in partners, rotate through each station and complete a POE – What Do You Think worksheet at each. Multiple stations can be made to accommodate class sizes.

**Station 1:**  
**How many marbles  
can a toilet paper  
tube hold?**

**Station 2:**  
**Do all oils behave  
the same way as  
canola oil when  
mixed with water?**

**Station 3:**  
**How many drops of water can a penny hold?**

**Station 4:**  
**Does food colouring affect the speed with which water moves through a paper filter?**

# **WHAT DO YOU THINK?**

Name: \_\_\_\_\_

Description of focus of demonstration

Predict

Explain

Observe

Explain

Extension

***ACTIVITY 2: What do you Think – a POE activity***

The Predict, Observe, Explain or POE is a strategy often used in science. It works best with demonstrations that allow immediate observation. It can be used to find out student's prior knowledge, introduce new concepts, motivate students, generate discussion or provide teachers with information about student problem solving abilities.

Asking students to predict what will happen before conducting an experiment will help to engage and motivate them and focus their observation skills. Misconceptions can be identified and discussed, providing an opportunity for assessment as learning.

**WHAT DO YOU THINK?**

Name: \_\_\_\_\_



Description of focus of demonstration:

What will happen when you put an upside down beaker over a lit candle?

Predict

What do you expect will happen to the flame?

Explain

Write your reasons for your prediction.

Observe

Describe what was observed.

Explain

Use your knowledge of gases and the fire triangle to explain your observations.

Extension

Describe one real world example of your observations.



### Activity 3: It's in the Numbers (Standard Atomic Notation)

#### OBJECTIVES

- Understanding and applying mathematical concepts and reasoning
- Analyzing and using numerical data
- Conceptualizing

#### BACKGROUND INFORMATION

How do we communicate information about atoms and relate it to the periodic table? Scientists use standard atomic notation to convey information about atoms. This format uses the element symbol, the atomic number, and the atomic mass.

A (number of protons and electrons added together)

X (element symbol)

Z (number of protons or electrons)

e.g.  $^{27}_{13}\text{Al}$  #protons=13, #electrons=13, #neutrons=14

#### VOCABULARY

Electron

Proton

Neutron

Standard atomic notation

#### MATERIALS

Periodic table

#### INTRODUCTORY LESSON

Review terminology in regards to the atom (protons, neutrons, electrons)

How do you know how many protons, neutrons, and electrons an atom has? Refer to periodic table. Look at legend on periodic table.

Give students format for standard atomic notation and show a couple of examples. Refer to background knowledge above.

#### ACTIVITY

1. Have students make table below.

Element Name	Standard Atomic Notation	#electrons	#protons	#neutrons

2. Model for the students how to fill in the chart for the first couple of elements. Have the students fill in the rest of the chart.

**CLOSURE DISCUSSION (EXIT CARD)**

1. What is a standard atomic notation? Give one example.
2. From your example, show how many protons, neutrons, and electrons your element has.

**EXTENSION**

This lesson links directly to making Bohr Rutherford diagrams.

**Activity 4: A FOREST ECOSYSTEM****OBJECTIVES**

1. To analyze food webs
2. To accurately distinguish different trophic levels of a food web
3. To predict what might happen to a food chain if one of its members were removed

**BACKGROUND INFORMATION**

Food webs are an accurate way to illustrate the interactions of its various members within it. Determining the trophic levels of the organisms within a food web can explain why certain ecosystems are viable within their ecological niche. Food webs can be a complex arrangement of consumers feeding on many species. However, if a species that is at a lower trophic level is suddenly removed from this particular web, the effects could be catastrophic to consumers throughout the web. Knowing the dynamics of a food web will help understanding of the importance of biodiversity within an ecosystem.

**VOCABULARY**

Producer

Consumer

Decomposers

Food web

Biodiversity

Trophic level

Ecological niche

Ecosystem

**MATERIALS**

“A FOREST ECOSYSTEM” worksheet

**SEQUENCE**

1. Assess the students’ prior knowledge of:
  - What are the different trophic levels of an ecosystem
  - What the purpose of the feeding relationships within a food web are
2. Check for understanding
  - Have students assess the food web and accurately identify the producers, consumers, and decomposers of the food web
3. Making connections
  - Pose the question as to what would happen to the ecosystem if one of its members were suddenly removed

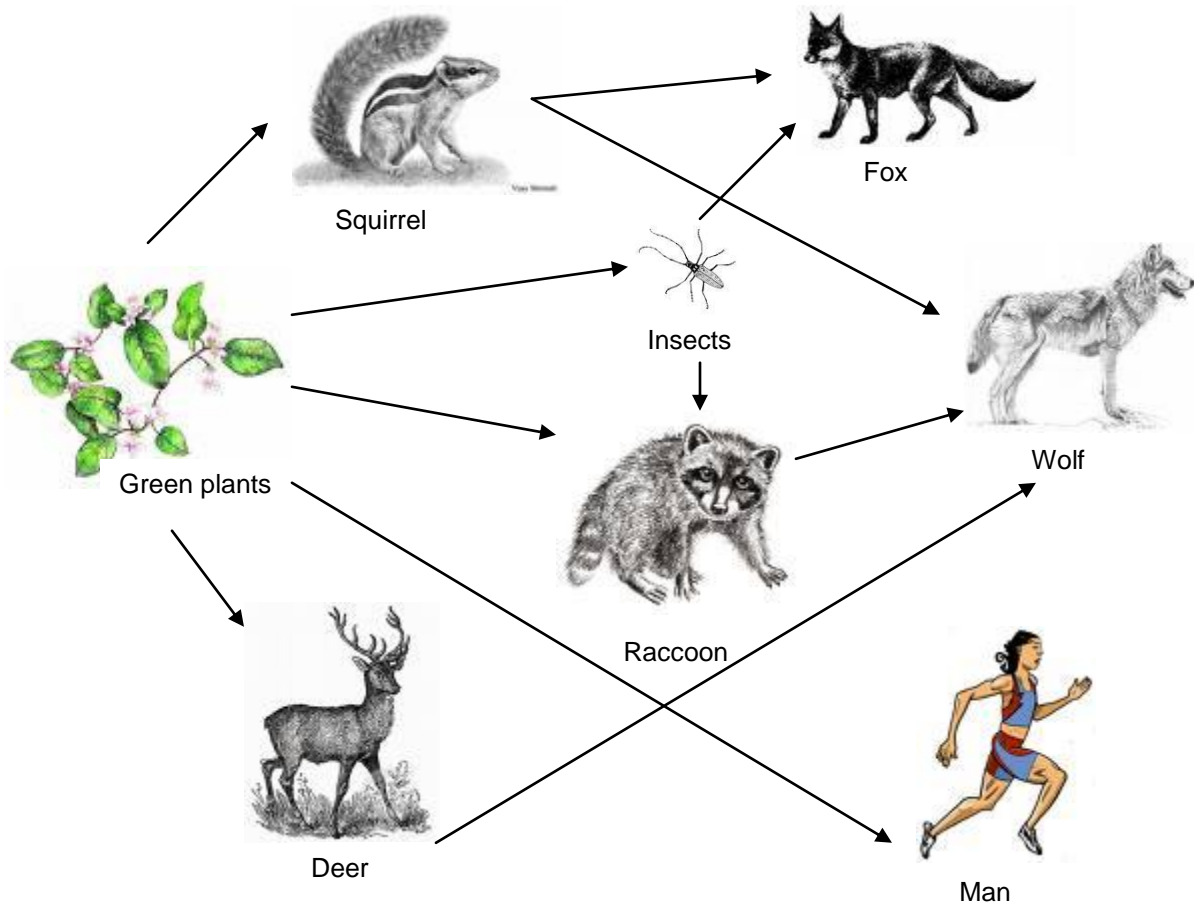
**ACTIVITY**

After teaching the lesson on food webs and ecological niches, have students complete the activity titled ‘A FOREST ECOSYSTEM’.

## STUDENT WORKSHEET: A FOREST ECOSYSTEM

A group of plants and animals at the local environment they live in are called an ecosystem. Use this diagram of a food web in a forest ecosystem to answer the following questions. Notice that all of the arrows in the food web point to consumers.

### FOREST FOOD WEB



Original work by S. DiGregorio, COPYRIGHT FREE

NOTE: All dead organisms are decomposed by bacteria and fungi, and their nutrients return to the soil to be used by plants

1. What are the producers in this food web?
2. What are the primary consumers?
3. What are the secondary consumers?
4. What are the decomposers?
5. A serious illness affects all of the green plants in this ecosystem, killing them instantly. Explain some of the effects this event would have on this particular ecosystem.

## **Activity 5: EFFECTS OF PESTICIDES ON OUR ECOSYSTEM**

### **OBJECTIVES**

1. To assess prior knowledge on ecological niches and food chains
2. Enhance literacy and support critical thinking and problem solving skills
3. Become more cautious about human impact on the environment

### **BACKGROUND INFORMATION**

Human beings can have a major impact on the earth's biosphere in a negative way. Although sometimes our intentions are good, humans can have a direct or indirect on the terrestrial and aquatic ecosystems through their actions. Sometimes, the human impact on our surroundings can dramatically change the make-up of the ecosystem, and can even eliminate some of the species that live within it through bioaccumulation. It is important for humans to realize how their actions can have a trickle-effect on the ecological niches of organisms, and how one event can dramatically change the feeding patterns and sustainability of certain organisms.

### **VOCABULARY**

Terrestrial

Aquatic

Food chain

Bioaccumulation

Eutrophication

Ecosystem

Sustainability

### **MATERIALS**

- Worksheet: Effects of pesticides on our ecosystem
- Enviro Stats article: “Canadian lawns and gardens: Where are they the ‘greenest’?” (Fall 2007)

### **SEQUENCE/ACTIVITY**

1. Assess the student's prior knowledge of Food chains/webs
2. Have students read “Canadian lawns and gardens: Where are they the ‘greenest’?”
3. Have students answer the questions on the worksheet titled: Effects of pesticides on our ecosystem
4. Discuss the chain reaction that occurs when one negative variable is introduced/eliminated from an ecosystem
5. Discuss other ways that humans are effecting our local ecosystems

### **CLOSING ACTIVITY**

Discuss ways that students can become stewards of the environment within their local communities and develop an action plan to make their neighbours in their community aware of the negative effects that pesticides have on their local ecosystems.

**STUDENT WORKSHEET****EFFECTS OF PESTICIDES ON OUR ECOSYSTEM**

You have a beautiful vegetable garden in your backyard that you use to feed your family. You have noticed that some of the vegetables are either missing or half-eaten, so you place an animal-control device around your garden. This is successful in keeping out animals, but a few weeks later, you notice that your vegetables are looking brown in colour and are dying.

1. Using your knowledge on the food chain, predict what effects your decision on keeping the animals away from your garden could have.
2. What other measures could you take to keep pests/rodents out of your garden?
3. What are some of the ecological effects that your preventative measures have
  - a. On the food chain
  - b. On the surrounding environment

Read the article “Canadian lawns and gardens: Where are they the ‘greenest’?” and answer the following questions:

4. The Atlantic provinces (Newfoundland, PEI, and New Brunswick) have the highest concentration of lawns per home, however the Prairie provinces (Saskatchewan, Manitoba and Alberta) led the country in pesticide use. Explain why you believe why pesticide usage would be higher in the Prairie provinces?
5. What are some environmental concerns that can arise if lawn fertilizers are used improperly?
6. Eutrophication is when lakes and other surface water bodies become enriched with nutrients. The result is excessive growth of plants and algae in water bodies. Why is this a problem for aquatic ecosystems?
7. What water-conservation techniques can regions who experience dry summer weather conditions take to ensure that they have sufficient water for their lawns and gardens?
8. Develop a list of pros and cons for pesticide use on humans and the environment.
9. Draw a five-member food chain, with tomato leaves being the primary producer. What would happen down the chain if tomato plants were treated with pesticides that were not toxic to humans, but were toxic to a beetle? Using your knowledge of bioaccumulation, how would this affect the rest of the food chain?

## Activity 6: SAVING ONTARIO'S WILDLIFE

### OBJECTIVES

1. To assess prior knowledge of sustainable ecosystems
2. To make students aware of the affects of human impact on certain species within Ontario
3. To understand the classification of species
4. To enhance research and literacy skills

### BACKGROUND INFORMATION

Ontario's biodiversity is under attack due to the fact that many species both plant and animal are dwindling in numbers. Their habitats are being destroyed through human measures, such as deforestation, pollution, urban sprawl, over fishing/hunting, and climate change. Although species extinction is a natural event of nature, this process is being expedited because of human influence. Species extinction can dramatically affect the biodiversity of an ecosystem and therefore have ecological consequences. Ecological niches will no longer be able to fulfill their population requirements if the number of species decline. It is important for students to realize the human impact on Ontario's wildlife and the measures that they should take to ensure that these populations are protected in order to assure biodiversity within their communities.

### VOCABULARY:

Biodiversity

Species richness

Extirpated

Endangered

Threatened

Extinct

Food chain

Biodiversity

Ecological niche

### MATERIALS

- Saving Ontario's Wildlife introduction activity accessed from:
- *Statistics Canada EnviroStats Catalogue no. 16-002-XIE Fall 2007*
- Fact Sheet project and rubric
- Internet access/library book resources

### SEQUENCE/ACTIVITY

1. Have students complete the first page of the "Saving Ontario's Wildlife" activity to discuss the effects of population control.
2. Discuss the effects that human impact can have on the biodiversity of ecosystems.
3. Have students research an at-risk species located within Ontario and develop a fact sheet outlining various facts about the species, its reason for endangerment, and strategies/methods to protect these species.

## **Activity 7: WATT does it COST to use it?**

### **OBJECTIVES**

1. Analyzing and using numerical data
2. Execute mathematical operations accurately

### **BACKGROUND INFORMATION**

Energy plays an important role in our everyday life. However, we often use electronics or appliances without considering the electric costs of running such devices. After understanding how much energy particular appliances require to operate, students can compare the energy use to that of more energy efficient appliances. Using energy wisely helps reduce energy bills and also helps conserve the limited supply of resources used to make energy. The students will calculate the energy costs of common household appliances and examine ways to promote energy efficiency.

### **VOCABULARY**

Watt (W)

Kilowatt (kW)

Kilowatt-hour (kWh)

Joule (J)

### **MATERIALS**

- Electrical appliance (eg. Toaster, mini microwave, iron, hair dryer, blender)
- Piece of bread,
- microwave popcorn,
- shirt, pants
- Variety of fruit, ice cream/yogurt, ice
- Stop watch
- Station cards
- POE worksheet
- Calculator and pencils

### **INTRODUCTORY DISCUSSION**

Assess the students' prior knowledge of:

- Set up a blender to make smoothie and describe what the appliance will be doing.
- What materials do you think are needed to complete the task?
- How much energy is needed to complete the task?
- What will it cost?
- What information would be needed in order to determine the cost of energy used?

Hook – Run an “obvious” experiment model the POE method

- Have a student examine the appliance and locate its power consumption information in watts.
- Use the blender to make the smoothie, and record the time taken.
- Have them observe and conclude with showing how the calculation works (electricity used, daily cost and annual cost)

Introduce the unit conversions needed, calculations required

Introduce the idea of EnerGuide Ratings

Discuss the idea of comparing costs and energy conservation

**ACTIVITY:**

- Provide instructions for the rest of lesson.
- Students will form group and will go to a station, where each student should complete the calculations by extracting data from the table provided, using appropriate form and units on their POE worksheet.

*STATION 1/2: Is It Time for a Change?*

Using the data table provided, have students complete the problem on the station card.

*STATION 3/4: Energy Consumption at Home*

Using the data table provided, have student complete the problem on the station card.

**CLOSURE DISCUSSION**

How can you reduce the cost of energy?

Discuss the idea of energy efficient appliances.

How can you save on your energy bills?

**EXTENSION OF LESSON PLAN**

Have students research and present their findings on energy efficient appliances.

Compare the energy use and cost between incandescent light bulbs and compact fluorescent light bulbs.

**REFERENCES**

[www.consumersenergy.com/uploadedFiles/Kids/The Cost of Electricity.pdf](http://www.consumersenergy.com/uploadedFiles/Kids/The_Cost_of_Electricity.pdf)

[www.ase.org/section/ audience/educators/lessons/high](http://www.ase.org/section/audience/educators/lessons/high)



**STATION CARDS**

Place station cards on lab bench with appropriate materials. Students, in partners, rotate through each station and complete POE – What Do You Think worksheet at each. Multiple stations can be made to accommodate class sizes.

**STATION 1: *Is it Time for a Change?***

TYPICAL ENERGUAGE RATINGS FOR MAJOR APPLIANCES (KWH/YEAR)				
TYPE OF APPLIANCE	1983	1991	1998	2003
FRIDGES	1458	1043	663	513
WASHING MACHINES	1243	1216	929	779

1. The price of electric energy is 9.0¢/kWh. How much would it cost to use a fridge produced in 2003 for one year?
2. The average lifespan of a fridge is 17 years? What is the cost of using the fridge over its lifespan?

**STATION 2: *Is it Time for a Change?***

TYPICAL ENERGUAGE RATINGS FOR MAJOR APPLIANCES (KWH/YEAR)				
TYPE OF APPLIANCE	1983	1991	1998	2003
FRIDGES	1458	1043	663	513
WASHING MACHINES	1243	1216	929	779

1. The price of electric energy is 10.0¢/kWh. How much would it cost to use a washing machine produced in 1983 for one year?
2. The average lifespan of a washing machine is 18 years? What is the cost of using the washing machine over its lifespan?

**STATION 3: *Energy Consumption at Home***

ELECTRIC DEVICE	POWER RATING (W)	ELECTRIC DEVICE	POWER RATING (W)
Clothes dryer	5000	Dishwasher	1300
Coffee maker	900	Electric kettle	1500

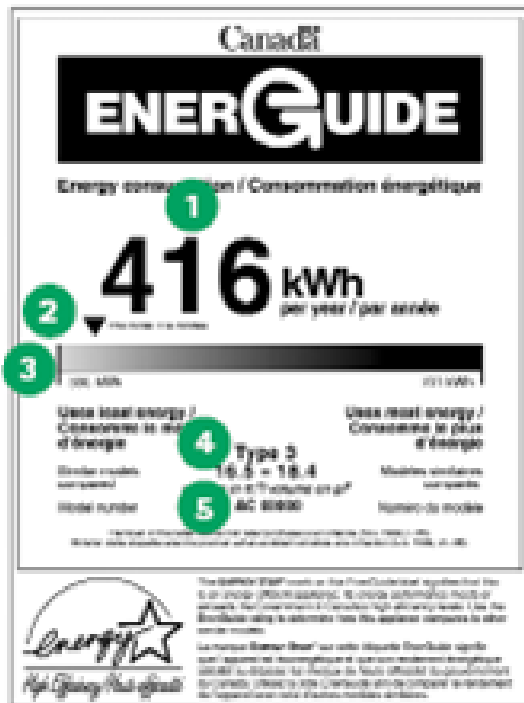
1. Choose ONE electric device your household uses the most.
2. Convert the power rating from watts to kilowatts.
3. Estimate how much your household uses the electric device every day in hours.
4. Calculate the energy used per day (kWh).
5. Calculate the energy used per month (kWh).
6. The price of electric energy is about 8.0¢/kWh. How much money does your household spend in a month to run this device?

**STATION 4: *Energy Consumption at Home***

ELECTRIC DEVICE	POWER RATING (W)	ELECTRIC DEVICE	POWER RATING (W)
Personal computer	200	TV (LCD, 32 inch)	100
Stove	12 500	TV (analogue, 32 inch)	200

1. Choose ONE electric device your household uses the most.
2. Convert the power rating from watts to kilowatts.
3. Estimate how much your household uses the electric device every day in hours.
4. Calculate the energy used per day (kWh).
5. Calculate the energy used per month (kWh).
6. The price of electric energy is about 8.0¢/kWh. How much money does your household spend in a month to run this device?

## THE BLACK AND WHITE ENERGUIDE LABEL



1. Average annual energy consumption of the appliance in kilowatt hours (kWh)
2. Annual energy consumption range for models of this type and size. The small number under the scale indicates the energy efficiency of the appliance relative to similar models.
3. Energy efficiency of the appliance relative to similar models
4. Type and size of the model
5. Model number

## Activity 6: How Far From Here?

### OBJECTIVES

1. Analyzing and using numerical data
2. Conceptualizing
3. Execute mathematical operations accurately

### BACKGROUND INFORMATION

The distance between objects in space is vast and very difficult for most students to grasp. The values for these distances are awkward for astronomers and scientists to use. So scientists use a unit of measurement called an astronomical unit.

An astronomical unit is the average distance between the Earth and the Sun approximately 150 million kilometres. Using a scale model to portray the distances of the planets will help the students begin to understand how big space is.

Astronomers soon found that even the astronomical unit was not large enough to measure the distance of objects outside of our solar system. For these distances, the parsec is used. A parsec is a unit of light-years. A parsec equals approximately 3.3 light-years. (Keep in mind that a light-year is the distance light travels in one year – 9.5 trillion km – and that light travels 300,000 km per second!)

### VOCABULARY

Astronomical Units

Light years

Celestial objects

### MATERIALS

- calculators
- meter stick
- Planet pictures
- Adding machine tape
- Tape
- Scissors
- Scale map of Canada (overhead or on computer-smart board)
- Scale map of Ontario (overhead or on computer-smart board)
- Student Table-see appendix

### INTRODUCTORY DISCUSSION

*Assess the students' previous experience with material:*

What is a celestial body?

Hook – Questions students to determine students' familiarity of information:

- How far to your locker, your house, a vacation spot?
- How much time does it take?
- How did you know how long it takes you to get home?
- Discuss units of measure and prefixes. Which units are appropriate for which distances?
- How fast does light travel to the sun? (300 000 km/s)
- How fast does it travel to Mars? Mercury? Venus?
- Discuss astronomical unit-distance from earth to sun. 15 000 000 km
- To explain scale show map of Ontario. Show map of Canada. How would we use a scale for space?

Show clip <http://www.nikon.com/about/feelnikon/universcale/index.htm>

*Discuss the idea of speed, distance, appropriate units*

Use the Hook –run activity to introduce the idea of speed, distance, appropriate units i.e. How far is Mercury to sun in AU? Venus? Mars? etc...

To explain scale, show map of Ontario. Show map of Canada. How would we use a scale for space?

**ACTIVITY:**

Students will be provided with a piece of adding machine tape approximately 4 metres long. They will bring this to each station. They will draw in the Sun on the very left side of the paper. Each student should have a copy of the table (see appendix)

**CLOSURE DISCUSSION (EXIT CARD)**

1. What is an AU?
2. Why did we use the scale that we did for our model?
3. Why do astronomers have to use AU's to measure distances in space?

**EXTENSION OF LESSON PLAN**

1. Having the students model the diameters of the planets to scale. They could colour them the correct colours and place them on their adding machine tape or cut them out of construction paper.
2. Asteroids, comets, and meteors could also be added to the model. Suggestions of substances to use: powdered drink mix (comet tail, dust), salt crystals, sugar (ice of comet), whole oats (ice of comet), cotton balls (gas around comet), rice vermicelli noodles (comet tail), brown or red coloured spices such as paprika and cinnamon (red iron), poppy seeds, tea leaves (carbon), sand, cinnamon (dust, rock)
3. Research what careers are associated with measurement in space and what instrumentation they use.

## Appendix

**STUDENT DATA TABLE**

PLANET NAME	DISTANCE TO SUN (EARTH = 1 AU)	DISTANCE TO SUN (1 AU = 1 METER)	DISTANCE TO SUN (1 AU = 10 CM)
Mercury			
Venus			
Earth			
Mars			
Jupiter			
Saturn			
Uranus			
Neptune			

**TEACHER ANSWER TABLE**

<b>PLANET NAME</b>	<b>DISTANCE TO SUN (EARTH = 1 AU)</b>	<b>DISTANCE TO SUN (1 AU = 1 METER)</b>	<b>DISTANCE TO SUN (1 AU = 10 CM)</b>
Mercury	0.4	0.4	4.0
Venus	0.7	0.7	7.0
Earth	1.0	1.0	10.0
Mars	1.52	1.52	15.2
Jupiter	5.2	5.2	52.0
Saturn	9.5	9.5	95.0
Uranus	19.2	19.2	192.0
Neptune	30.1	30.1	301.0

## REFERENCES

<<http://e-missions.net/mmab/pdf/Lessons/lesson3.pdf>, [Wheeling Jesuit University/Center for Educational Technologies](#) Accessed May 25, 2009.