Unit 7: Day 1: Are you "eco"logical?

MCT 4C

Minds On: 15
Action: 35
Consolidate:25
Total = 75 min

Learning Goal:
- Learn of their impact on the environment
- Devise a plan on how they can reduce, reuse and recycle
- Hypothesize on the role mathematics and the various function models(exponential, sinusoidal and polynomial) play in the study of energy, waste and water consumption

Materials
- BLM 7.1.1-7.1.10

			Assessment Opportunities
	Minds On…	**Whole Class → Discussion** Post BLM 7.1.1 and engage students in a spirit read. **Individual → Activity** Students complete BLM 7.1.2. **Groups of 4 → Discussion** Students discuss their responses to BLM 7.1.2.	A spirit read is begun by the teacher and other students join in and read along when they are ready. The articles on environmental conservation, one copy per group of each article should be made and put into protective covers to be collected at the end of the lesson for re-use in the future. Possible video resources: *An Inconvenient Truth* *The Corporation* BLM 7.1.9 — enlarge and put on ledger sized paper Websites of interest: www.davidsuzuki.org www.earthcarecanada.com
	Action!	**Groups of 4 → Jigsaw/Home Group** Students select one of the articles (BLM 7.1.3 - 7.1.6) to read and complete BLM 7.1.7 for their specific article. Remind students that they will be sharing the information with their group and they should record the "big ideas" only. **Small Group → Jigsaw/Expert Group** As students read in their Expert Group, they will complete BLM 7.1.7. They should discuss with their group mates to ensure they have captured the "big ideas". **Groups of 4 → Jigsaw/Home Group** Students share the 'big ideas' from their article and takes notes on the other articles presented by group members. Then each student will select a card from BLM 7.1.8 and read their card outloud. Students will discuss the statement using knowledge from the article and their experiences. **Whole Class → Discussion** Discuss the idea of an "Environmental Footprint" **Groups of 4→ Brainstorm** Independently, students record all the factors in their daily life that affect their Environmental Footprint in their section of BLM 7.1.10. Students share their factors and repeated factors are circled. Groups come to consensus on 5 factors that they believe are the MOST significant in and list these factors in the centre of the foot. Distribute 5 "feet" (BLM 7.1.9) to each group. Students transfer each factor onto a separate foot and then decide which heading on the board their "feet" will be posted under: water consumption, waste production, energy consumption. **Learning Skills/Teamwork/Checkbric:** Teamwork can be assessed during jigsaw activity.	
	Consolidate Debrief	**Whole Class → Discussion** By considering the guiding questions, lead a student discussion about the cluster of cards. • What patterns catch your attention based on the card cluster? • What surprises you about the data "feet"? concerns you? • Where are you struggling as conservationist? • Which of these areas can you do something about right away? • Which of these areas do you hear the group saying is the lowest priority? • Which of these areas do you hear the group saying is the highest priority? • How can we improve on the highest priority areas as "eco-conscious" citizens?	
Exploration Application		**Home Activity or Further Classroom Consolidation** Choose a manageable number of priority areas for environmental improvement (four or less). List your priorities and how you plan to decrease the ecological damage. How will the mathematical models that you learned this year help to study waste, water and energy consumption in Ontario?	

7.1.1: Are you “eco” logical?

Background Information (Source: http://www.ecologicalfootprint.org)

Ecological footprints provide a way to systematically measure the area of the Earth needed to sustain a nation’s annual consumption patterns. Food, fossil fuels, paper, and every other good or service generates a footprint. Footprint size varies depending on how goods are made and how much we consume. If a nation’s footprint exceeds its biocapacity, it is said to be engaging in ecological overshoot. Nearly 50% of countries in our Footprint of Nations 2005 update exhibited a sustainable footprint, while the remaining 69 countries' footprint resulted in a net overshoot of their biocapacity.

A nation's footprint is calculated by adding the footprint attributable to imports and subtracting the footprint of exports from domestic production: Total footprint = production footprint + imports footprint – exports footprint. This is computed for 72 product categories such as grains, timber, coal, oil, and cotton. This figure is divided by yield factors to calculate the footprint. A nation’s footprint can be compared to the global average to provide perspective.

The time series data provided on this site were generated using Footprint 2.0 (the latest approach to footprinting developed by RP's Sustainability Indicators staff in tandem with academic expert reviewers). Although the new protocol is still evolving, we are making these data sets available now in the spirit of open scientific inquiry and welcome your feedback on their accuracy and usefulness. All figures are expressed in global hectares per capita (2001 data).

7.1.2: Are you "eco" logical?

Myth or Reality?

Read through each statement and determine whether it is a myth or a reality. Write an **M** or **R** to indicate your choice. You can work individually or with a partner.

1	For a standard incandescent light bulb, 90% of its energy use is devoted to heat.	
2	In a residential community, 65% of all water consumption occurs in the bathroom.	
3	Aviation has the greatest climate impact of all modes of transportation.	
4	Sweden generates about 1.7 kg of waste per person per day per capita, this is about twice as much as in Canada.	
5	Canadians are water hogs. For household purposes, the average Canadian uses 343 litres of water per day. That's almost twice as much as France	
6	Standard toilets in Canada use just six litres of water.	
7	Recycling one aluminium can, saves enough money to run a television for 3 hours.	
8	In 2000, aviation was responsible for 4 to 9% of the climate change impact of global humanity.	
9	If all of the earth's water could fit into a 3.87L jug, only 15 mL(approx. 1 tablespoon) of it (1%) would be fresh water	
10	A refrigerator that is produced today uses 50 % less energy than models produces prior to 1993.	

7.1.3: Are you “eco” logical?

(source: www.davidsuzuki.org)

Switch Green: Promoting Energy Efficient Appliances

Some appliances use 50% more energy than others to do the same job--there’s no difference in how well they clean clothes or wash dishes.

Efficiency allows us to get the same quality of lifestyle and the same utility from the same amount of energy. It’s a no brainer!

Making it easier to buy energy efficient appliances has many benefits: reductions in greenhouse gases, savings on utility bills, reduced demand for coal fired electrical plants, and less impact on the environment—all in one fell swoop.

Switch Green: Energy Star Appliance Feebate, calls for a simple policy shift to make the most efficient machines more affordable. Following its recommendations would cost government nothing, yet would have dramatic positive implications for the environment, including:

- Reducing greenhouse gas emissions by 275 thousand tonnes per year
- Reducing the pollutants that cause smog
- Reducing household energy costs by $80 million annually
- Reducing water consumption
- Maintaining a revenue neutral outcome for government

In all, this policy would reduce household energy consumption by 1,440 gigawatt-hours—*that’s like taking 120,000 homes off the electricity grid.*

Switch Green is one of a series of reports by the David Suzuki Foundation on ecological fiscal reform (EFR). EFR, shifts the burden of tax from good environmental practices onto polluting activities.

This type of economic incentive has been proven in many places around the world. By using economic disincentives to pollution and waste and economic incentives to conserve and protect, Canada can avoid falling further behind in its environmental performance.

Currently, Canada lags behind most other industrialized nations in the use of green economy measures, or ecological fiscal reform. Canada’s slow adoption of this type of policy undermines both the economy and the environment.

According to the OECD, the annual rate of productivity and GDP growth of many OECD countries surpasses Canada’s. And 27 of 30 OECD countries now rank ahead of Canada on environmental performance.

The policy outlined in Switch Green offers a consumer rebate on Energy Star appliances, while levying a modest fee on appliances that do not meet the Energy Star standard. Although the price differential between appliances can be quite small, it is often enough to prompt consumers to select an inefficient product, despite long-term savings. Switch Green eliminates or narrows the price gap between efficient and inefficient appliances, making choices for the consumer less onerous.

7.1.4: Are you “eco” logical?

(source: www.earthcarecanada.com and www.davidsuzuki.org)

Energy and You:

What you can do:

- Reduce your home heating and electricity use. A more energy-efficient home will lower your utility bills and reduce the emissions that cause climate change. Find out how you can increase energy efficiency in your home through the EnerGuide for Houses program. Standard light bulbs give off 90 per cent of their energy as heat. New compact fluorescent "spiral" bulbs are 75 per cent more efficient and fit in standard sockets. If you combined all the "heat leaks" in an average Canadian home, you would have a hole the size of a basketball! Proper weather stripping and caulking of doors and windows can reduce heating bills by 25 per cent.

- Choose energy-efficient appliances. New refrigerators, for example, use 40 per cent less energy than models made just 10 years ago.

- Check the Canadian government’s Auto Smart ratings for the next car you intend to buy to make sure it’s fuel efficient and low polluting. A typical SUV uses almost twice the fuel – and releases nearly twice the emissions – of a modern station wagon, although both seat the same number of passengers..

- Walk, bike, carpool or take transit to get to one of your regular destinations each week.

- The impacts of air travel and consider vacationing close to home. Although aviation is a relatively small industry, it has a disproportionately large impact on the climate system. It presently accounts for 4-9% of the total climate change impact of human activity.

  Compared to other modes of transport, such as driving or taking the train, travelling by air has a greater climate impact per passenger kilometer, even over longer distances. It’s also the mode of freight transport that produces the most emissions.

- If you are moving, choose a home within a 30-minute bike, walk or transit ride from your daily destinations. A convenient place to live reduces the amount you drive, which means you’ll lower your greenhouse gas emissions and other pollutants.





- Take care of your trash. Composting all organic waste – and recycling paper, cardboard, cans and bottles – will help reduce the greenhouse gas emissions associated with landfills.

- Eat wisely. Choose foods that are local, organic and low on the food chain whenever possible. Make the most of seasonal foods.

- Go Carbon neutral!

- Recycling one aluminum can saves enough money to run a TV for 3 hours.

7.1.5: Are you “eco” logical?

(source: www.davidsuzuki.org)



Most of us have too much stuff. Stuff that needs dusting. Stuff that needs fixing. Stuff that clogs up our basements and garages.

With summer here, it's time to get tough with your stuff!

This newsletter is all about ways to minimize the clutter in your life so you can face the rest of the summer with a song in your heart - and enough space in your garage for a barbecue

Zen and the art of summer cleaning

Summer cleaning forces us to reevaluate why we bought things in the first place. Did you really need the cowboy boots because you vowed to take line-dancing classes? Why do you still have a stash of free America Online CDs?



Yeah, we’ve all been there.

But fear not! There are some great lessons to be learned from a good cleaning session.

- Lesson #1: Purchase products that can be recycled or reused.
  Stretch your dollar! The rarely used champagne bucket could make a nice pot for plants, and those old plastic videocassette holders are handy for storing spare screws, thumbtacks, and nails.

- Lesson #2: Buy locally produced goods.
  Smog is choking our cities and damaging our health. Buying locally manufactured products helps Canada’s economy and reduces air pollution from shipping imported goods to your local retailer.

- Lesson #3: Say no to excess packaging.
  You’ve probably got a closet full of paper and plastic bags from your last shopping spree. In the future, tell store clerks that you don’t want all the excess packaging and stop those empty bags from taking over your valuable closet space.



Give it away, give it away, give it away now (How to donate.)

One person’s trash is another person’s treasure. At some point you’ll face the problem of looking at a pile of stuff you no longer want. So what do you do with it?

Thankfully, there are several places to give away your unwanted stuff so it ends up in a good home.

Here’s an exhaustive list of organizations across Canada that accept donations. (You can even arrange to have larger items collected from your home.)

7.1.5: Are you “eco” logical?(continued)

Before you give anything away, keep these tips in mind:

- Organizations that accept donations don’t accept everything. Call ahead to see if they’ll take the items you want to donate. Very few people want a two-wheeled tricycle or an old Walkman that mangles cassettes.

- Donating computers can be tricky business. Computers without operating systems can be a burden to charities and nonprofit groups. For more tips on donating computers, visit: http://www.microsoft.com/education/TenTips.aspx

- The best things in life are free. Make someone in your community happy by posting items you no longer need on the Freecycle.org website. Membership is free, and all you need to sign up is a valid e-mail address. For info, visit: http://freecycle.org/

Waste not, want not(source: www.earthcarecanada.com)

- Canadians generate about 1.7 kg of waste per person per day. Per capita, this is about twice as much as in Sweden.

- We use 50 million tons of paper annually, consuming more than 850 million trees.

- Use of email causes an average 40% increase in paper consumption. The demand for reams of white paper is putting a huge strain on the world's forests.

- The pulp and paper industry is the third-largest industrial polluter in both Canada and the United States, releasing more than 220 million pounds of toxic pollution into the air, ground, and water each year.

- The cost of a truck to dump a garbage container and a recycling container are almost the same.

- On average, a 10% reduction in recycling pickups would save a board ~$5000 per year; a 10% reduction in garbage pickups would save ~$17,000 per year.

- A 750-watt computer (really too old and expensive to be kept) costs $0.077/hour to operate. Left on for 6 hours a day, it would cost $89.63/ computer. Left on for 24 hours, the cost will be $358.51/computer.

- You may not be able to choose only the newest model for your computer, but you can still save dollars by choosing how you will operate them.



Don’t just sit there—DO something!

This month’s Take Action, should you choose to accept it, is to send an e-mail asking the government to make manufacturers responsible for minimizing the pollution and waste that comes from using their products.

Europe has passed “extended producer responsibility” laws that require manufacturers to be responsible for their packaging and products - from creation to disposal. It’s a model Canada should follow.

7.1.6: Are you “eco” logical?



The 3 Rs of water use

It’s time for a new version of the three Rs mantra:
Reduce! Repair! Retrofit!

Reduce the water you use each day in your home! Nearly 65% of all residential indoor water use occurs in the bathroom. (Bathing and showering account for about 35%, while toilets are responsible for about 30%.)

- Take a shower instead of a bath. Short showers use less water than baths. By minimizing the duration of your showers you’ll also reduce the amount of energy used to keep that water nice and hot.

- Water your lawn in the evening and use a soaker hose instead of a sprinkler. (If a particular plant needs more water, give it what it needs but don’t water the whole lawn.) Fifty percent of the water used on lawns is lost to evaporation or run-off due to over-watering. This is prime water that’s been brought up to drinking water standards only to be washed down the street.

- When you wash your car, fill a bucket and use a sponge before rinsing quickly with a hose. (By adding a spring-loaded nozzle, you won’t waste water when you aren't using the hose.) In Vancouver, the local water authority estimates that as much as 400 litres of water is used to wash a car.

Repair all leaky faucets and toilets. A leak of one drop per second results in about 10,000 litres of water lost over a year – the equivalent of 70 baths.

Retrofit by adapting or replacing older water-using appliances and devices with newer ones that are more efficient:

- Installing a low-flow showerhead costs as little as $20, and still does the job while reducing water flows by half.

- Replacing your toilet with an ultra low volume (ULV) model. Standard toilets in Canada use 18 litres of water per flush, while ULV toilets reduce the amount of water flushed by 70%. Also check out dual flush models which allow you to control the water required to flush. And see if your local water authority provides rebates for replacing your old toilets with water efficient models.

- If you’re thinking of purchasing or replacing a washing machine, buy a model with the Energy Star label. These washers use 35-50% less water and half the energy per load than a regular washer, which saves money on water and energy bills.

- If all of the earth’s water could fit into a gallon jug, only a tablespoon of it (1%) would be fresh water.

- 2% of the earth’s water is contained in glaciers and icecaps that are not readily accessible.

- Canadians use, on average, 390 litres of water per day, about twice as much as the average European.

- A tap that drips once every second wastes ~10,000 litres of water per year.

7.1.7: Are you “eco” logical?

Switch Green: Promoting Energy Efficient Appliances	**Energy and You:**	**Summer Sweep Up Clean your house and your conscience**	**The 3 Rs of water use**
Here’s what (what information do I need to know?)	Here’s what (what information do I need to know?)	Here’s what (what information do I need to know?)	Here’s what (what information do I need to know?)
So What? (Why is this information important to me?)	So What? (Why is this information important to me?)	So What? (Why is this information important to me?)	So What? (Why is this information important to me?)
Now what? (What can be done?)	Now what? (What can be done?)	Now what? (What can be done?)	Now what? (What can be done?)

7.1.8: Are you "eco" logical?

Did you know…

littered glass and aluminium containers will last more than 1000 years.

Did you know…

the greatest amount of fresh water on Earth is found at the Polar Ice Caps

Did you know…

that 62.5 million newspapers are printed every day.

Did you know…

a human being can only survive 3 days without water.

Did you know…

that an adult will generate 600 times his/her weight in garbage in their lifetime.

Did you know…

that 33% of the packaging of products is thrown away in the garbage.

7.1.9 Are you “eco” logical?

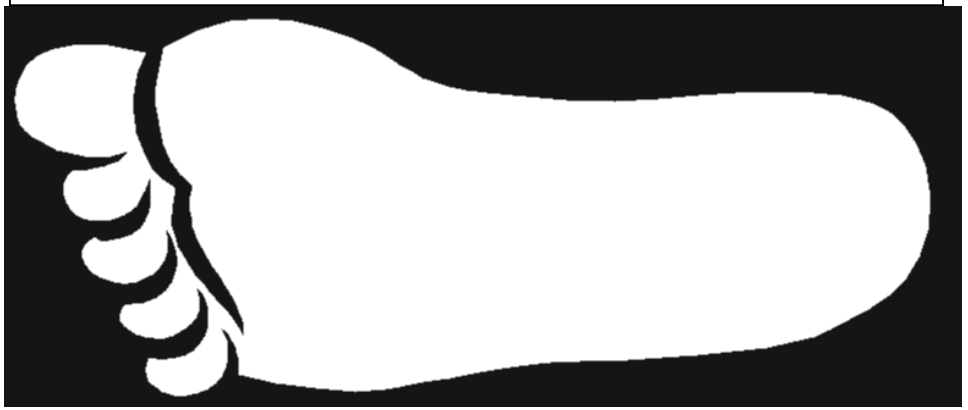


7.1.10: Are you "eco" logical?

What are the 5 most significant factors that affect *your* "Environmental Footprint"?

Brainstorm in your own section.

Through group sharing, select the 5 most significant factors that affect **one's** "Environmental Footprint".



Unit 7: Day 2: Save Your Energy

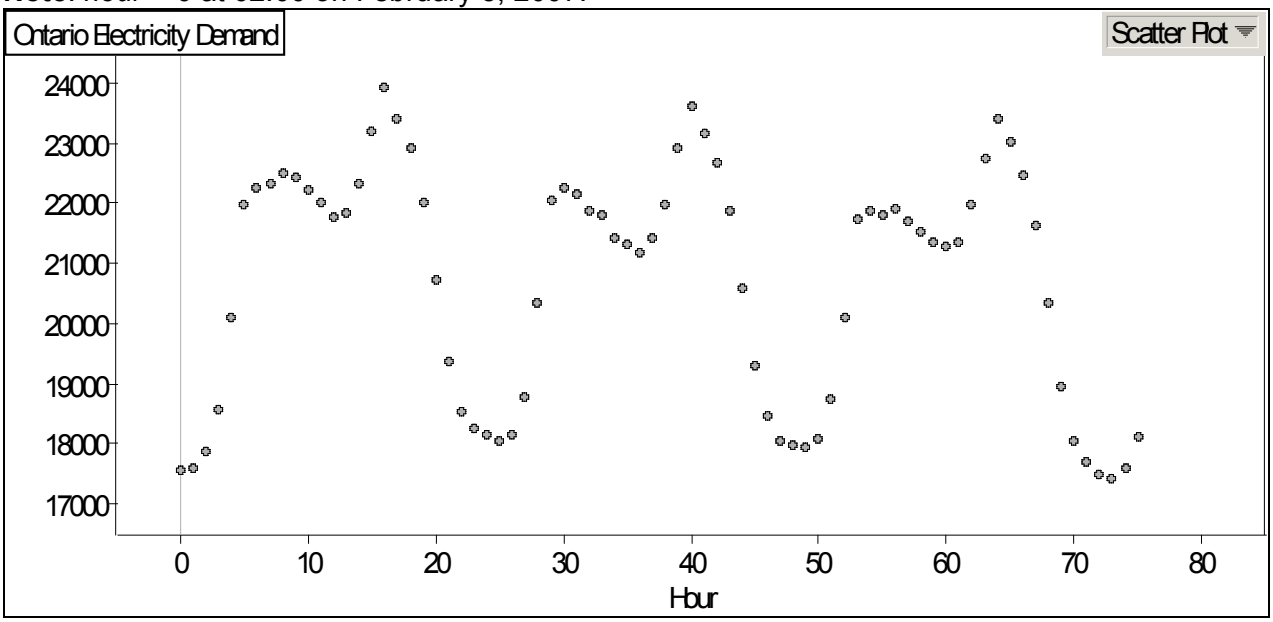
MCT 4C

Minds On: 10 Action: 60 Consolidate:5 Total=75 min	**Learning Goal**: • Represent a sinusoidal function with an equation, given its graph or properties • Collect data (secondary sources) that can be modelled as a sinusoidal function • Identify periodic and sinusoidal functions, including those that arise from real-world applications involving periodic phenomena and explain any restrictions that the context places on the domain and range	**Materials** • BLM 7.2.1-7.2.2 • BLM 7.3.3 • BLM 7.2.3 • Graphing technology (optional)

				Assessment Opportunities
	Minds On…	**Whole Class → Discussion** Lead a discussion around energy consumption predictions for Ontario. Connect this back to the discussion from the previous day. Suggested questions: • What time(s) of the year is energy consumption the greatest? • Who are the energy consumers each hour? (business and residence) • What shape(s) of function that we've studied would you expect to see with this data over two days? (dependent on the temperatures over those two days)		Possible solutions are also provided for this day in BLM 7.2.2. Background information: The Independent Electricity System Operator (IESO) collects data on Ontario's hourly energy consumption in MegaWatts. Review the concept of military time.Data from www.ieso.ca Hours are provided in military time.
	Action!	**Individual → Investigation** Students will work through day 2 of the summative assessment using BLM 7.2.1. **Mathematical Processes/Performance Task/Rubric**: **Connecting and Reasoning and Proving** Students will **connect** periodic and sinusoidal functions to real-world applications. Students will use **reasoning** skills to make connections between a sinusoidal model and real-world application.		Optional: provide graphing technology to verify sinusoidal equations.
	Consolidate Debrief	**Whole Class → Discussion** Collect BLM 7.2.1. Review the other types of function models that have been examined in the course (i.e., exponential functions and polynomial functions). Inform students that they will be modelling related secondary data with a different model on day 3 of the summative.		
	Reflection	**e Activity or Further Classroom Consolidation** Access the Monthly Market Demand current data at the media desk www.ieso.ca (or use June, 2007 data Monthly Market Demand = 12 693 **G**Wh) and make predictions for **Yearly Market Demand**.		

7.2.1: Save Your Energy

The following data shows Ontario's Energy Demand, in MegaWatts (MW), from February 5, 2007 through February 8, 2007 over a 75-hour period. (source: www.ieso.ca)
Note: *hour* = 0 at 02:00 on February 5, 2007.



1. At what time(s) of the day is Ontario's energy consumption the greatest? Support your answer(s).

2. Is the graph of the data (check one): ❒ periodic OR ❒ sinusoidal
   Provide two reasons for your choice.

3. State the domain and range of this data and explain how this relates to the context.

	Graphical Model	Real – World Meaning
DOMAIN		
RANGE		

4. Create one question that could be answered by examining the graphical data. Answer your question.

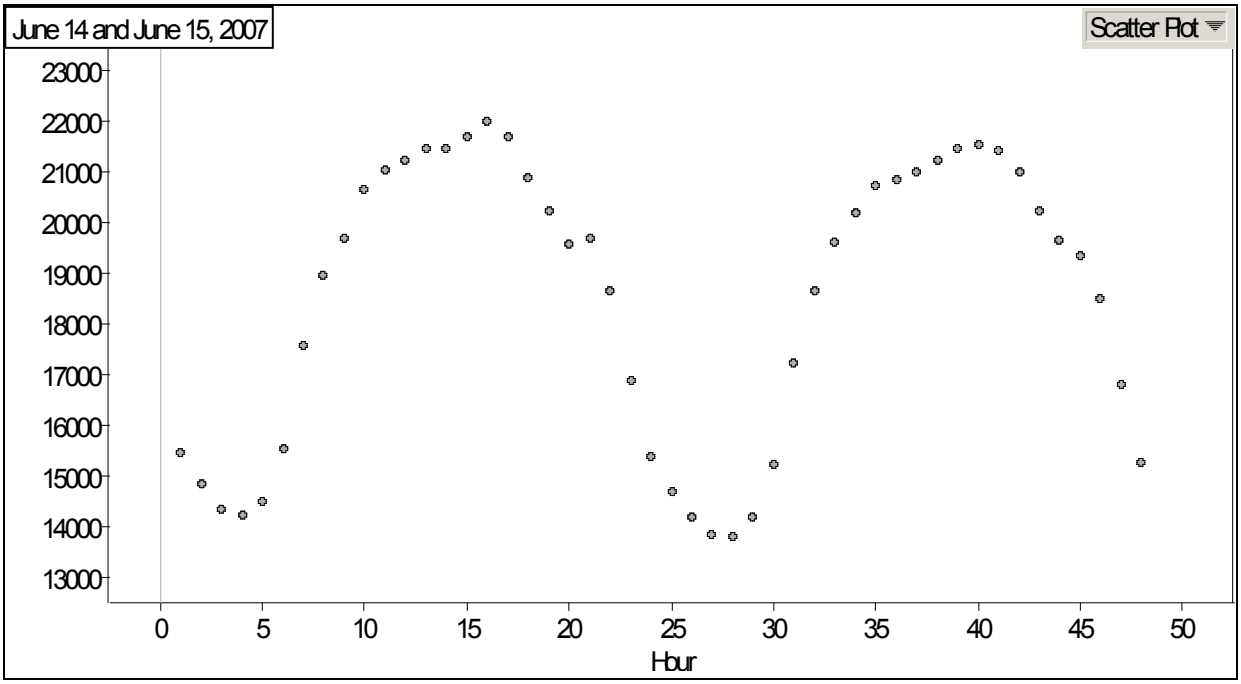
   Question:

   Answer:

7.2.1: Save Your Energy (continued)

The following data shows Ontario's Energy Demand, in MegaWatts (MW) from June 14, 2007 through June 15, 2007 over a 45-hour period. (Source: www.ieso.ca)

Note: *hour* = 0 at 00:00 on June 14, 2007.



5. Using mathematical language, compare the Ontario Energy Demands for February and June.

Similarities	***Differences***

6. The greatest demand occurred June 14 (hour 16) requiring 22 020 MW of electricity. The lowest demand was June 15 (hour 28) at 13 797 MW.
   Create a sinusoidal equation to model the data from June, 2007. Provide work to show how you determined the parameters of your model (e.g., amplitude, period, phase shift).

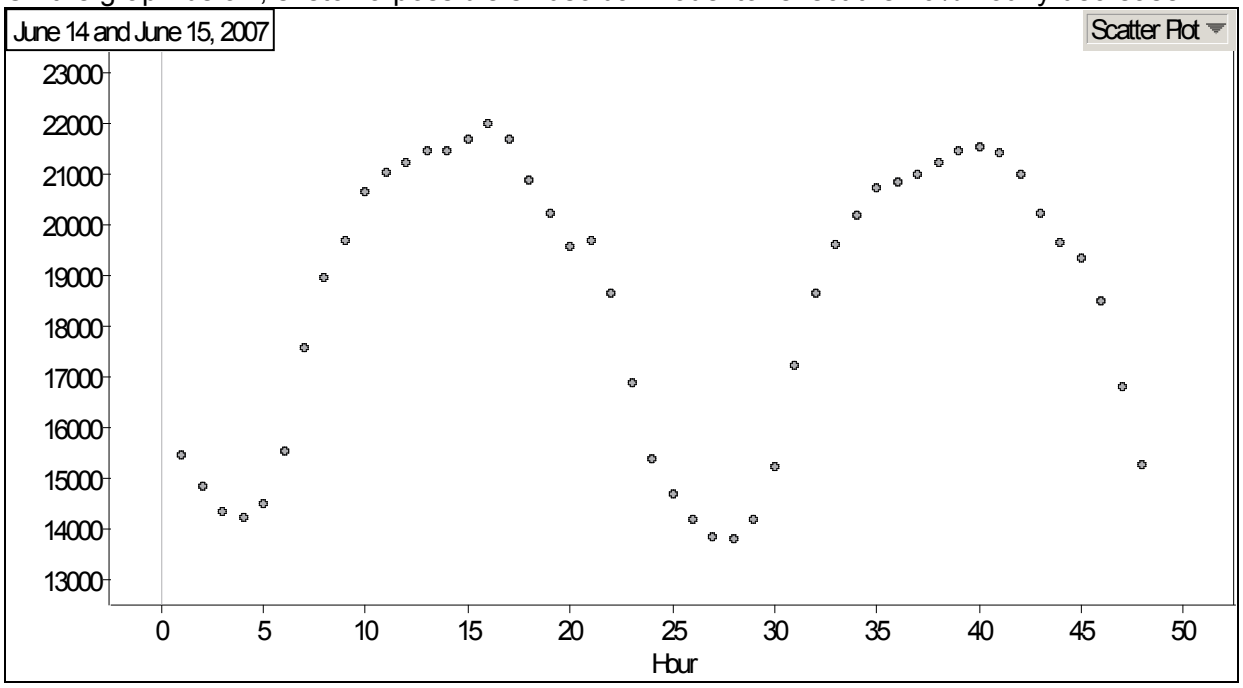
7. Explain how each of the parameters in your sinusoidal equation relate to the real-world context.

7.2.1: Save Your Energy (continued)

8. If Ontario were to have decreased its energy demand by 10% for each hour during June 14 and June 15, 2007:

a) Identify which feature(s) of the graph would change and which feature(s) of the graph would remain the same.

b) On the graph below, sketch a possible sinusoidal model to reflect the 10% hourly decrease.



c) Using your sinusoidal equation from #6, identify which value(s) of the equation would change and which value(s) of the equation would remain the same.

7.2.1: Save Your Energy (continued)

9. The Government of Ontario recommends that Ontarians reduce their energy consumption during peak hours. Typically, demand peaks between 4 p.m. and 7 p.m.

a) List three things that you could do to meet this goal.

i) _____

ii) _____

iii) _____

b) Identify which feature(s) of the graph for June 14 and June 15, 2007 would change and which feature(s) of the graph would remain the same.

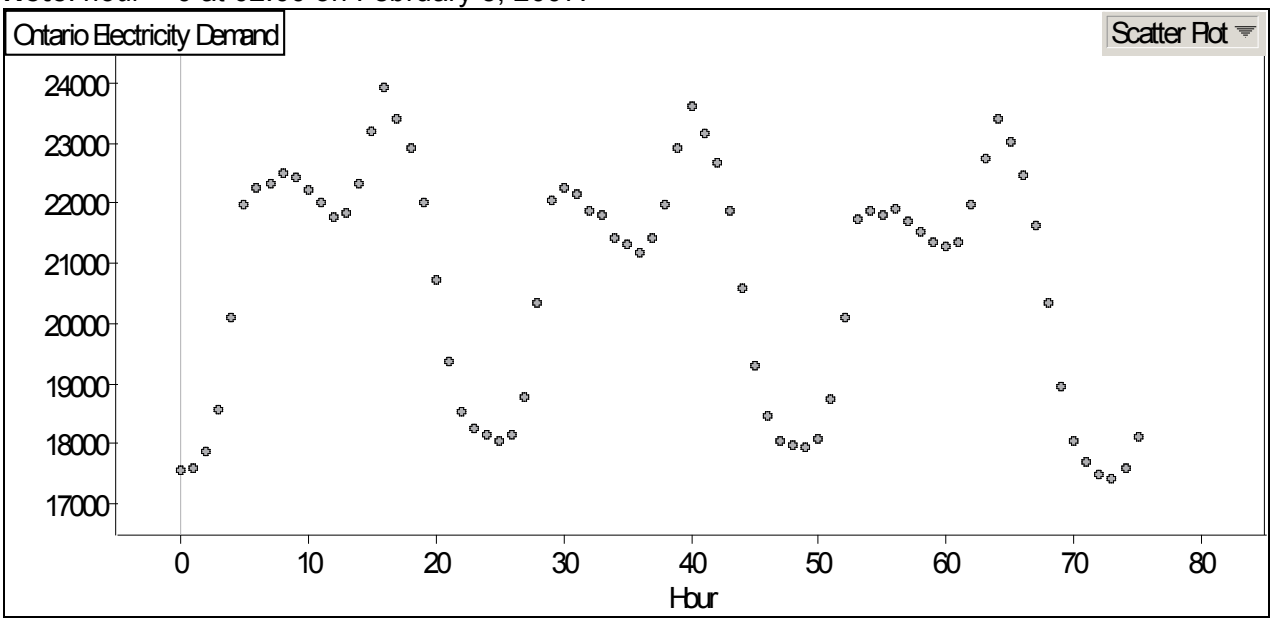
10. Would the sinusoidal equation you created in question #6 be an appropriate model for Ontario's Energy Demand over the entire year (check one)?

❒ yes OR ❒ no

Justify your response.

7.2.2: Save Your Energy: Solutions (Teacher)

The following data shows Ontario's Energy Demand, in MegaWatts (MW), from February 5, 2007 through February 8, 2007 over a 75-hour period. (source: www.ieso.ca)
Note: *hour* = 0 at 02:00 on February 5, 2007.



1. At what time(s) of the day is Ontario's energy consumption the greatest? Support your answer(s).

   t = 16, 40 and 64 (may refer to first peak only)

   times are: 18:00 on Feb. 5, 2007, 18:00 on Feb. 6, 2007 and 18:00 on Feb. 7, 2007

2. Is the graph of the data (check one): ☑ periodic OR ❒ sinusoidal
   Provide two reasons for your choice.
   - Periodic – repeats at regular cycles
   - Not sinusoidal – does not have smooth curves like y = sinx
   - Other appropriate support

3. State the domain and range of this data and explain how this relates to the context.

	Graphical Model	Real – World Meaning
DOMAIN	$x \in [0,75]$	Time for data from 02:00 on Feb. 5 through 05:00 on Feb. 8
RANGE	$y \in [17\,430\ ,\ 23\,913]$ reasonable estimates should be expected	The lowest and highest values for Ontario's energy demand in MW

4. Create one question that could be answered by examining the graphical data. Answer your question.

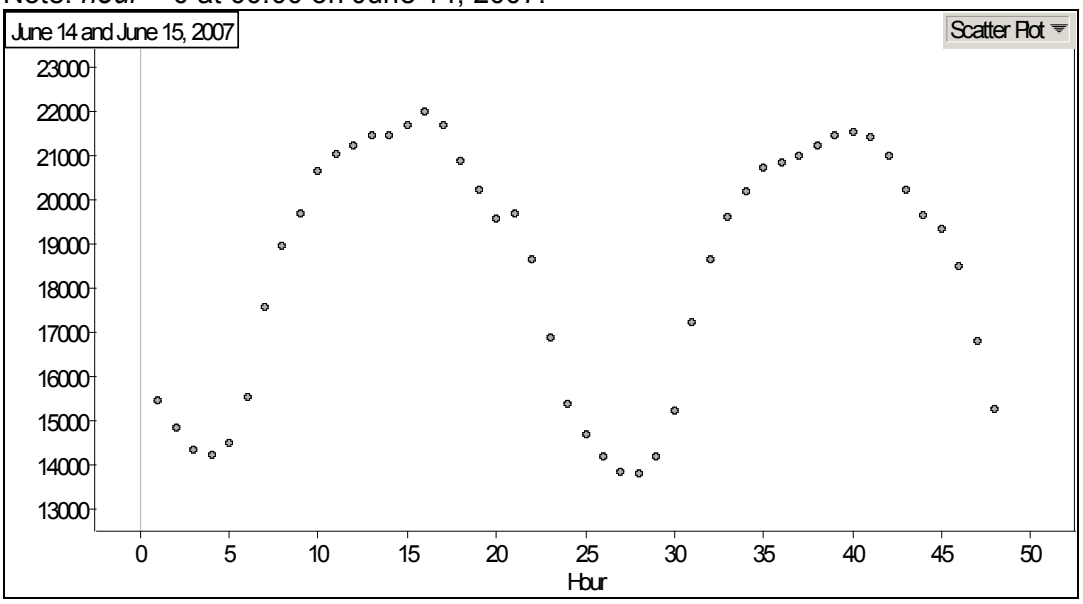
   Question: Questions will vary

   Answer: Answers should be consistent with question.

7.2.2: Save Your Energy: Solutions (continued)

The following data shows Ontario's Energy Demand, in MegaWatts (MW) from June 14, 2007 through June 15, 2007 over a 45-hour period. (Source: www.ieso.ca)

Note: *hour* = 0 at 00:00 on June 14, 2007.



5. Using mathematical language, compare the Ontario Energy Demands for February and June.

Similarities	***Differences***
Answers will vary…examples include: ▪ periodic (repeating cycles) ▪ periods are approximately 24 hours ▪ model Ontario's energy demand ▪ peaks, valleys, increasing and decreasing intervals	Answers will vary…examples include: ▪ June is sinusoidal ▪ Actual values for peaks and valleys differ ▪ Number of days of data

6. The greatest demand occurred June 14 (hour 16) requiring 22 020 MW of electricity. The lowest demand was June 15 (hour 28) at 13 797 MW. Create a sinusoidal equation to model the data from June, 2007. Provide work to show how you determined the parameters of your model (e.g., amplitude, period, phase shift).

$$period = \frac{360}{k}$$

$$24 = \frac{360}{k}$$

$$k = 15$$

Vertical displacement = (22020 + 13797)÷2 = 17908.5.
Phase shift approximately hour 7 (for sine function).
Amplitude (based on day 7) is 22 020 - 17908.5 = 4 111.5

y = 4 111.5 sin (15(x – 7)) + 17908.5 OR
y = 4 111.5 cos (15(x – 13)) + 17908.5 (based on matching above model – peak is not equidistant from vertical displacement at x = 16) may choose to accept
y = 4 111.5 cos (15(x – 16) + 17908.5 based on peak at x = 16

7. Explain how each of the parameters in your sinusoidal equation relate to the real-world context.

Period is the cycle where energy consumption is the same for subsequent days (24 hours apart)
Vertical displacement is the average energy consumption over the given time
Amplitude is the optimal demand based on the average energy consumption over the given time

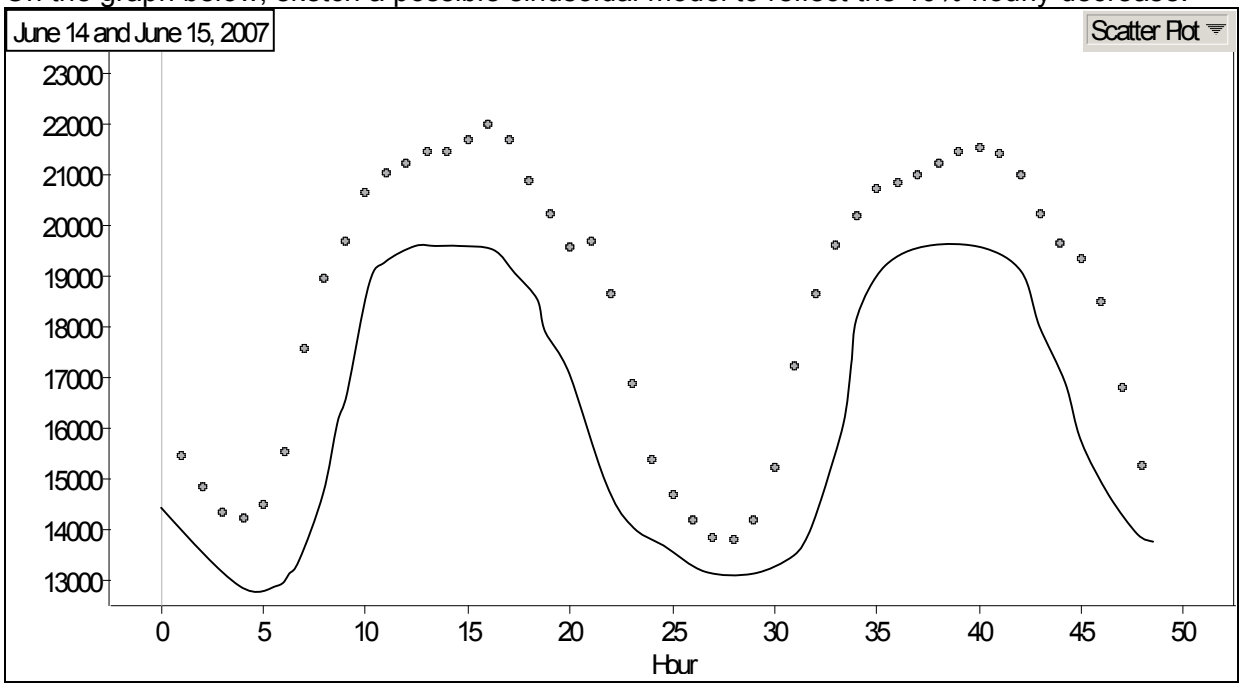
7.2.2: Save Your Energy: Solutions (continued)

8. If Ontario were to have decreased its energy demand by 10% for each hour during June 14 and June 15, 2007:

a) Identify which feature(s) of the graph would change and which feature(s) of the graph would remain the same.

Values for each hour would be 10% less – maximum value 10% lower, minimum value 10% lower, vertical displacement 10% lower
Vertical displacement changes to = (19818 + 12417.3)÷2 = 16 117.65
Amplitude (based on day 7) is 19818 - 16 117.65 = 3 700.35
Period and phase shift would remain the same

b) On the graph below, sketch a possible sinusoidal model to reflect the 10% hourly decrease.



c) Using your sinusoidal equation from #6, identify which value(s) of the equation would change and which value(s) of the equation would remain the same.

y = 4 111.5 sin (15(x – 7)) + 17908.5 OR y = 4 111.5 cos (15(x – 13)) + 17908.5

CHANGES WOULD BE:

y = **3 700.35** sin (15(x – 7) + **16 117.65** OR y = **3 700.35** cos (15(x – 13) + **16 117.65**

7.2.2: Save Your Energy: Solutions (continued)

9. The Government of Ontario recommends that Ontarians reduce their energy consumption during peak hours. Typically, demand peaks between 4 p.m. and 7 p.m.

a) List three things that you could do to meet this goal.

Electricity demand is primarily influenced by weather, hours of daylight, business hours, school holidays and consumption patterns as people arrive home from work.

b) Identify which feature(s) of the graph for June 14 and June 15, 2007 would change and which feature(s) of the graph would remain the same.

Vertical displacement would be lower due to the fact that the maximum values (reduction during peak hours) will be lower
Amplitude would be less

Period would be the same
Phase shift would be the same
Minimum values would be the same (as only peak hours are changing)

10. Would the sinusoidal equation in #6 be an appropriate model for Ontario's Energy Demand over the entire year (check one)?

❒ yes OR ☑ no

Justify your response.

Answers will vary…

- The temperature variations throughout the year would require different energy demands.
- Reference to the shapes of the graphs of Feb and June as NOT the same

7.2.3: Save Your Energy (Teacher Resources - data files)

The following files contain the data for the graphs in this activity in various formats.

Data from 2002 to present
MCT_FE2XL1_V1_tb

February data:
MCT_FE2XL2_V1_tb
MCT_FE2FTH1_V1_tb

June data
MCT_FE2FTH2_V1_tb

Unit 7: Day 3: Save Your Energy

MCT 4C

Minds On: 5 Action: 50 Consolidate:20 Total=75 min	**Learning Goal**: • Pose problems on real-world applications that can be modelled with exponential equations and solve these using a table of values or from its equation • Pose problems based on real-world applications that can be modelled with exponential equations and solve these by rewriting them in logarithmic form	**Materials** • BLM 7.3.1 • BLM 7.3.2 • BLM 7.3.3 • Graphing technology (optional)

				Assessment Opportunities
Minds On…	**Whole Class → Discussion** Revisit yesterday's homework question referring to the Monthly Market Demand current **data.** Discuss the fact that total annual Ontario energy demand is measured in TerraWatt hours (TWh), where 1 TWh = 1 billion KWh. Discuss class predictions and accuracy.		Data collected from www.ieso.ca
Action!	**Individual → Investigation** Students will work through Day 3 of the summative assessment using BLM 7.3.1. **Mathematical Process/Observation/Rubric** Circulate as students work and assess them using BLM 7.3.3		
Consolidate Debrief	**Whole Class → Collection of materials** Collection of BLM 7.3.1.		
Application *Concept Practice* *Skill Drill*	**e Activity or Further Classroom Consolidation** Prepare for a pencil and paper summative that addresses the expectations that were not covered in the final summative task.		

7.3.1: Energy Required

The data below shows the total annual Ontario energy demand, measured in TerraWatt hours (TWh), where 1 TWh = 1 billion KWh

Time, *t* (Years)	Energy Demand, *D* (TWh)	Percentage Increase Over Previous Year
2005	157	2.3%
2004	153	1.1%
2003	152	-0.7%
2002	153	4.1%
2001	147	0%
2000	147	2.1%
1999	144	2.9%
1998	140	1.4%
1997	138	

Source: http://www.ieso.ca/imoweb/media/md_demand.asp

1. For the data provided, determine the average of the percentage increases over the previous year. Show your work.

2. Using this average rate of increase, determine an exponential equation that relates time, *t*, in years, and Energy Demand, D, in TWh. Assume *t* = 0 is 1997.

3. Why was an exponential model selected to model this situation?

4. Complete the table using your equation from #2. Round answers to two decimal places.

Years	Time, *t*	Energy Demand, *D* (TWh)
2005		
2004		
2003		
2002		
2001		
2000		
1999		
1998		
1997	0	138

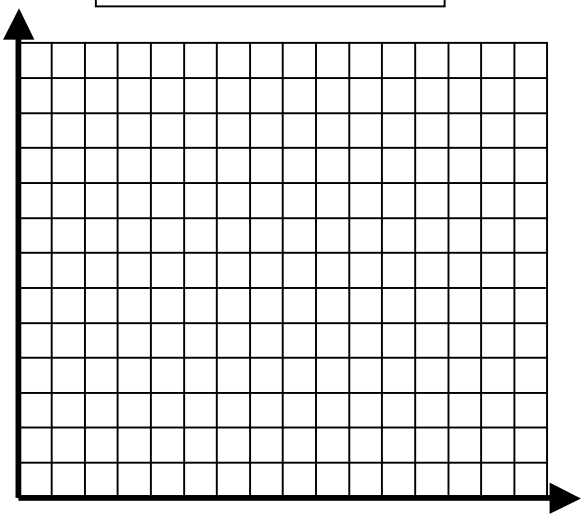
7.3.1: Energy Required (continued)

1. Use your exponential equation from #2 to determine the Energy Demand, D, for the year 2014. Show your work.

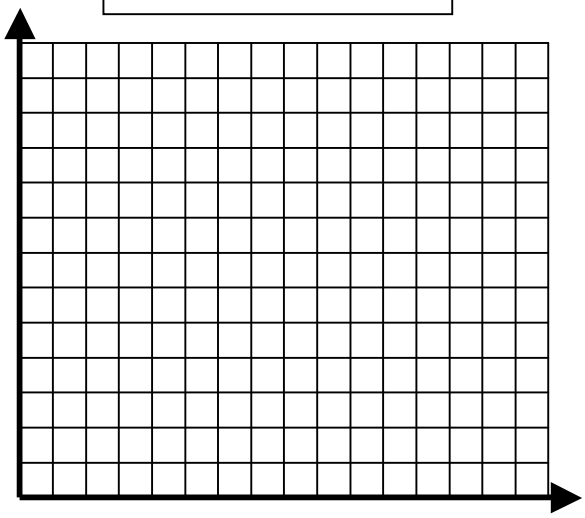
2. Use your exponential equation to determine the year in which the energy demand will be 180 TWh. Show your work.

3. Create scatter plots of Time, t, versus Energy Demand, D for both sets of data.

Actual Data



Modelled Data



4. Comment on the appropriateness of your model.

7.3.1: Energy Required (continued)

5. The table below includes data for 2006.

Time, *t* (Years)	Energy Demand, *D* (TWh)	Percentage Increase Over Previous Year
2006	151	-3.8%
2005	157	2.3%
2004	153	1.1%
2003	152	-0.7%
2002	153	4.1%
2001	147	0%
2000	147	2.1%
1999	144	2.9%
1998	140	1.4%
1997	138	

The average of the increases over previous years changes to approximately 1.44% if 2006 is included in the calculation.

The following statement can be found on the Independent Electricity System Operator website: "…energy consumption in Ontario is forecast to grow to roughly 169 TWh in 2014." (source: http://www.ieso.ca/imoweb/media/md_demand.asp)

Is this an accurate prediction? ❒ yes OR ❒ no

Provide mathematical support for your choice.

7.3.2: Energy Required (Teacher Notes)

The data below shows the total annual Ontario energy demand, measured in TerraWatt hours (TWh), where 1 TWh = 1 billion KWh

Time, *t* (Years)	Energy Demand, *D* (TWh)	Increase Over Previous Year
2005	157	2.3%
2004	153	1.1%
2003	152	-0.7%
2002	153	4.1%
2001	147	0%
2000	147	2.1%
1999	144	2.9%
1998	140	1.4%
1997	138	

Source: http://www.ieso.ca/imoweb/media/md_demand.asp

1. For the data provided, determine the average of the increases over the previous year. Show your work.

$$average\ of\ increases = \frac{23 + 1.1 - 0.7 + 41 + 0 + 2.1 + 29 + 1.4}{8}$$

$$= 1.65$$

$\therefore$ the average is 1.65%

2. Using this average rate of increase, determine an exponential equation that relates time, *t*, in years, and Energy Demand, D, in TWh. Assume *t* = 0 is 1997.

$$D(t) = 138(1.0165)^t$$

3. Answers will vary. Students may comment on the fact that the data looks linear and support the decision to use an exponential model.

4. Complete the table using your equation from #2.

Time, *t* (Years)	Energy Demand, *D* (TWh)
2005	$138(1.0165)^8 \approx 157.30$
2004	$138(1.0165)^7 \approx 154.75$
2003	$138(1.0165)^6 \approx 152.24$
2002	$138(1.0165)^5 \approx 149.77$
2001	$138(1.0165)^4 \approx 147.34$
2000	$138(1.0165)^3 \approx 144.94$
1999	$138(1.0165)^2 \approx 142.59$
1998	$138(1.0165)^1 \approx 140.28$
1997	138

7.3.2: Energy Required (Teacher Notes) (continued)

5. Use your exponential equation from #2 to determine the Energy Demand, D, for the year 2014. Show your work.

$D(17) = 138(1.0165)^{17}$
$D(17) = 171.70$
$\therefore$ The demand for the year 2014 would be 171.70 TWh.

6. Use your exponential equation to determine the year in which the energy demand will be 180 TWh. Show your work.

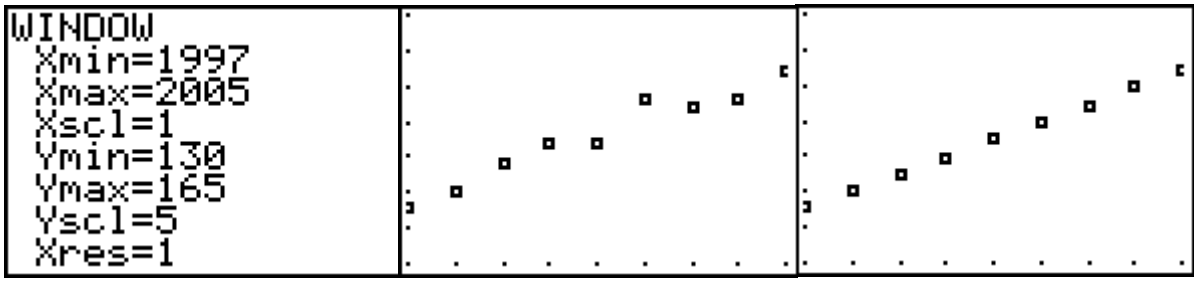
$$180 = 138(1.0165)^t$$
$$\log (180/138) = t \log (1.0165)$$
$$\log (180/138) \div \log (1.0165) = t$$
$$16.2 \approx t$$

$\therefore$ The demand for 180 TWh would occur in 2013.

A solution by systematic trial and error is possible as well.

7. Create scatter plots of Time, *t*, versus Energy Demand, D, for both sets of data.

Actual Data Modelled Data



8. Comment on the appropriateness of your model.

Answers will vary

Fairly accurate in general shape, initial and final values
Both show growth

Demand factors will not be equivalent from year to year, accounting for some of the differences

7.3.2: Energy Required (Teacher Notes) (continued)

9. The table includes data for 2006.

Time, *t* (Years)	Energy Demand, *D* (TWh)	Increase Over Previous Year
2006	151	-3.8%
2005	157	2.3%
2004	153	1.1%
2003	152	-0.7%
2002	153	4.1%
2001	147	0%
2000	147	2.1%
1999	144	2.9%
1998	140	1.4%
1997	138	

The average of the increases over previous years changes to approximately 1.44%.

"…energy consumption in Ontario is forecast to grow to roughly 169 TWh in 2014." (source: http://www.ieso.ca/imoweb/media/md_demand.asp)

Is this an accurate prediction? ❒ yes OR ❒ no

Provide mathematical support for your choice. Does support reflect mathematical understanding of exponential growth?

If we consider 138 as the initial value:

$D(t) = 138(1.0144)^t$

$D(17) \approx 175.97$

This value is not close to the prediction (169 TWh)

If we consider 151 as the initial value and modify the growth rate from this point to 1.44%.

$D(t) = 151(1.0144)^t$

$D(8) = 151(1.0144)^8$

$D(8) \approx 169.30$

This value is very close to the prediction (169 TWh)

7.3.3: Energy Required Assessment Rubric

Name:_____

Reasoning and Proving				
Criteria	**Level 1**	**Level 2**	**Level 3**	**Level 4**
Degree of clarity in explanations and justifications in reporting **Day 1 #5 and #9**	Explanations and justifications are partially understandable	Explanations and justifications are understandable by me, but would likely be unclear to others	Explanations and justifications are clear for a range of audiences	Explanations and justifications are particularly clear and detailed
Making inferences, conclusions and justifications **Day 1 #8** **Day 2 #7 and #8**	Justification of the answer presented has a limited connection to the problem solving process and models presented	Justification of the answer presented has some connection to the problem solving process and models presented	Justification of the answer presented has a direct connection to the problem solving process and models presented	Justification of the answer has a direct connection to the problem solving process and models presented, with evidence of reflection
Exploring and Reflecting				
** Ability to apply the processes of inquiry and problem solving i.e., reflecting, and revising and revisiting **Day 1 #10**	Applies the processes to the assigned task with significant prompts	Applies the processes to the assigned task with minor prompts	Applies the processes to the assigned task without prompts	Applies the processes to the assigned task with a broader view of the task without prompts
Selecting Tools and Computational Strategies				
Select and use tools and strategies to solve a problem **Day 1 #4** **Day 2 #1, #3, #4 and #5**	Selects and applies appropriate tools, with major errors, omissions, or mis-sequencing	Selects and applies appropriate tools, with minor errors, omissions or mis-sequencing	Selects and applies appropriate tools, accurately, and logically sequenced	Selects and applies the most appropriate tools, accurately and logically sequenced
Connecting				
Relate mathematical ideas to situations drawn from other contexts **Day 1 #1, #2, #3 and #7**	Makes weak connections	Makes simple connections	Makes appropriate connections	Makes strong connections

7.3.3: Energy Required Assessment Rubric (continued)

Representing				
Criteria	**Level 1**	**Level 2**	**Level 3**	**Level 4**
Creation of a model to represent the data [e.g., numerical, algebraic, graphical, physical, or scale model, by hand or using technology] **Day 1 #6** **Day 2 #2 and #6**	Creates a model that represents little of the range of data	Creates a model that represents some of the range of data	Creates a model that represents most of the range of data	Creates a model that represents the full range of data
Communicating				
Ability to read and interpret mathematical language, charts, and graphs **Day 1 #1, #4 and #5** **Day 2 #1, #2 and #5**	Misinterprets a major part of the information, but carries on to make some otherwise reasonable statements	Misinterprets part of the information, but carries on to make some otherwise reasonable statements	Correctly interprets the information, and makes reasonable statements	Correctly interprets the information, and makes subtle or insightful statements
Correct use of mathematical symbols, labels, units and conventions **Throughout Day 1 and Day 2**	Sometimes uses mathematical symbols, labels and conventions correctly	Usually uses mathematical symbols, labels and conventions correctly	Consistently uses mathematical symbols, labels and conventions correctly	Consistently and meticulously uses mathematical symbols, labels and conventions, recognizing novel opportunities for their use
Appropriate use of mathematical vocabulary **Throughout Day 1 and Day 2**	Sometimes uses mathematical vocabulary correctly when expected	Usually uses mathematical vocabulary correctly when expected	Consistently uses mathematical vocabulary correctly when expected	Consistently uses mathematical vocabulary correctly, recognizing novel opportunities for its use