

### What's Included

#### 1. This Teacher Resource

#### 2. Student Handouts

- Activity Fact Sheet\* (p.2-3)
  - What is Light Energy?
  - How Sunlight Turns Into Electricity
- Fact Sheet Questions (p.4)

#### 3. Posters/Slides (p.5-6)

### Curriculum Connections

There are multiple connections to the Alberta curriculum. Here are some of the relevant concepts:

#### Grade 4 - Key Concepts

##### General Learner Expectations

- Investigate the nature of things, demonstrating purposeful action that leads to inferences supported by observations.
- Students will show growth in acquiring and applying respect for living things and environments, and commitment for their care.

##### Light and Shadows

- Demonstrate that light travels outward from a source and continues unless blocked by an opaque material.
- Describing changes in the size and location of Sun shadows throughout the day.
- Recognize that light can be reflected and bent (reflected light contributes to charging a solar panel).

#### Grade 5 – Key Concepts

##### General Learner Expectations

- Design and carry out an investigation, using procedures that provide a fair test of the question being investigated.
- Students will show growth in acquiring and applying respect for living things and environments, and commitment for their care.

##### Mechanisms Using Electricity

- Identify example applications of electrical devices.
- Recognize the importance of switches and other control mechanisms.
- Demonstrate different ways of lighting two lights from a single power source.
- Demonstrate two different ways to light a bulb, and compare the results.
- Given a design task and appropriate materials, invent and construct an electrical device that meets the task requirements.

##### Weather Watch

- Describe the effects of the Sun's energy on daily and

seasonal changes in temperature 24-hour and yearly cycles of change.

- Identify human actions that have been linked to the greenhouse effect.

#### Grade 6 - Key Concepts

##### General Learner Expectations

- Design and carry out an investigation in which variables are identified and controlled, and that provides a fair test of the question being investigated.
- Students will show growth in acquiring and applying respect for living things and environments, and commitment for their care.

##### Sky Science

- Construct and use a device for plotting the apparent movement of the Sun over the course of a day; e.g., construct and use a sundial or shadow stick. (Useful for positioning solar panels.)
- Describe seasonal changes in the length of the day and night and in the angle of the Sun above the horizon. (Useful for solar technology.)

MATH - STATISTICS - 3. Graph collected data, and analyze the graph to solve problems.

All curriculum connections were derived from

<https://education.alberta.ca/media/159711/elemsci.pdf>

\*There is a more comprehensive fact sheet available at the 3NE website that also covers:

- Solar Systems (on & off grid, industrial)
- Benefits of Solar Energy
- Case Study: Fort Chipewyan Solar Farm

<https://www.3ne.ca/wp-content/uploads/2020/09/Solar-Electricity-Fact-Sheet-General-e.pdf>

## Answer Key

### Fact Sheet Questions - (20 points)

#### Fill in the blanks (10 points):

1. straight
2. invisible (to our eyes)
3. energy, food (sugar)
4. thermal (heat) energy
5. sunlight
6. sunshine (sunlight), free
7. harmful gases, waste

#### Matching:

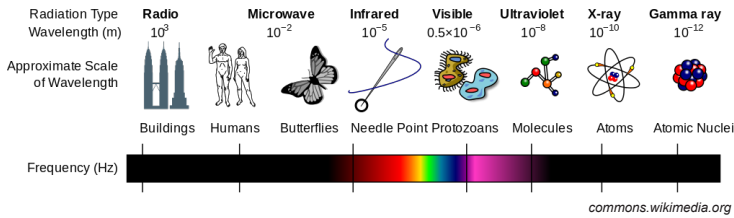
(8 points)

1. b
2. c
3. i
4. e
5. f
6. j
7. g
8. h

#### Short Answer (2 points):

a single solar cell (answers may vary)  
calculator

solar module (answers may vary) an RV



## What is Light Energy?

- Unless disrupted, light travels in a straight line to Earth from our Sun.
- You are most familiar with Visible Light. It is the only type of light energy that you can see. However there are many other types of light including; Radiowaves, Microwaves, Infrared, UltraViolet Light, X-Rays and Gamma Rays. All of these are invisible to our eyes.
- Sunlight supplies plants with energy which they use (through the process of photosynthesis) to make food (sugar).
- Animals then eat the plants to absorb their energy.
- Sunlight delivers thermal (heat) energy that drives ocean currents, wind and on a larger scale, weather and climate systems.
- In fact, nearly all energy on Earth originates from sunlight. Powerful stuff!

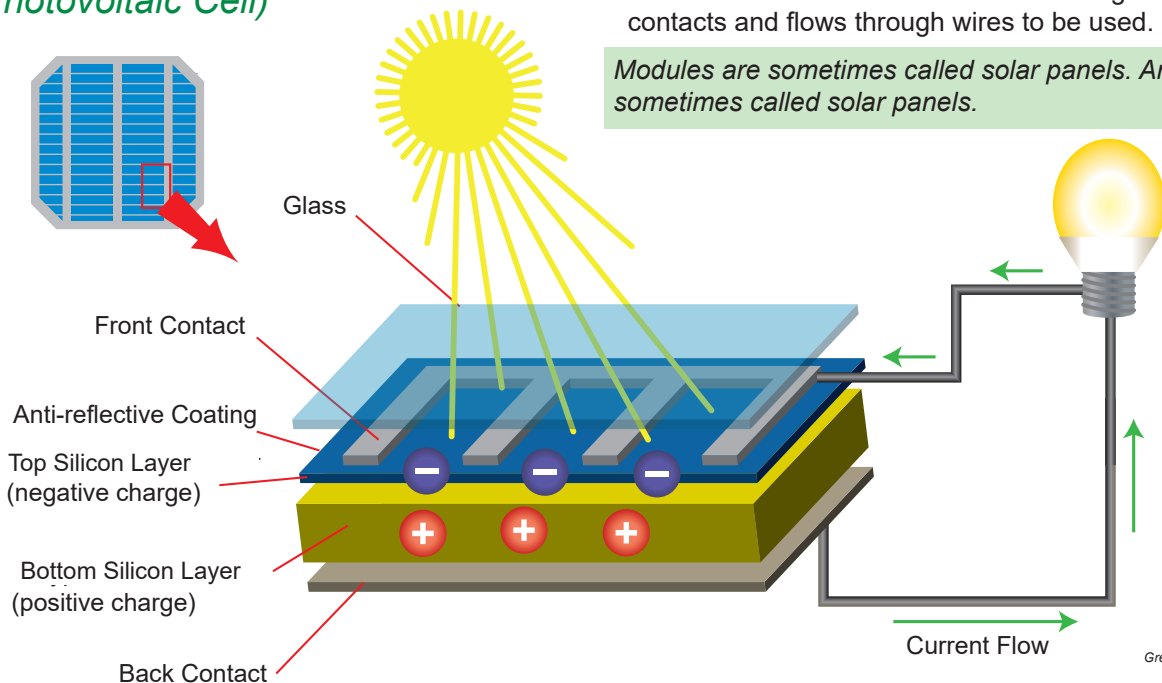
## Why Use Solar Energy?

- Solar panel “fuel” – sunshine – is free. It is a renewable resource that will last nearly forever.
- When they are used, they don’t release harmful gases or waste and are quiet.

## Converting Sunlight Into Electricity

- **Solar cells** (also called photovoltaic cells) come in various sizes. Some are tinier than a stamp. Some are 12 centimeters across.
- The cells are made of a type of material known as a **semiconductor**, usually **silicon**.
- Semiconductors can conduct, or carry, electricity. They don’t do this as well as metals, however. That is why they are called “semi” (which means “half”). Because they only “semi” conduct electricity, they can be used to control electric current.
- A typical simple cell has two layers of silicon. On their top and bottom they typically have metal contacts through which electric current can flow.
- When sunlight shines on the silicon layer, its atoms absorb some light. The light’s energy knocks some electrons out of the silicon atoms. The electrons flow between the two layers of silicon. This flow makes an electric current.
- The current can leave the solar cell through the metal contacts and flows through wires to be used.

## Solar Cell (Photovoltaic Cell)

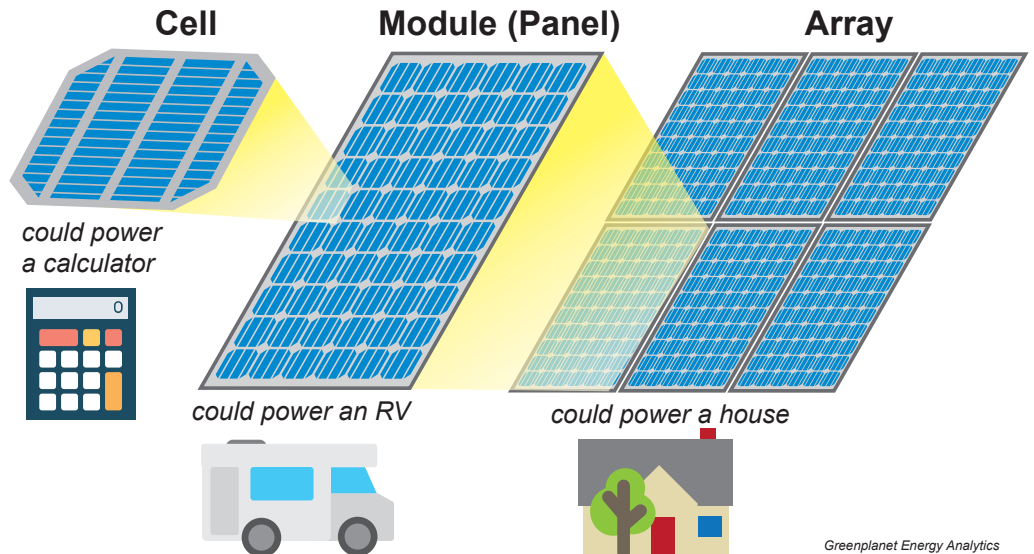


*Modules are sometimes called solar panels. Arrays are also sometimes called solar panels.*

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## Solar Cells, Panels & Arrays

A single simple **solar cell** makes only a little electricity. For this reason, cells are often linked together in groups known as **solar modules**. There are typically 32, 36, 48, 60, 72 or 96 solar cells in a solar module. A solar module has a frame that holds the cells. Some modules are over a metre long. They usually can produce up to a few hundred watts of electricity. If more power is needed, modules can be joined together to form a large **solar array**.



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- Solar panels for buildings are no different from other panels. They must be able to receive enough sun-light to be useful. Often, they are put on a roof that faces the Sun and is not shaded. Sometimes they are simply built on the ground.
- What happens to solar energy when it is night or cloudy? Special batteries are used to store the electricity while its sunny and then this power is available when it is too dark for the solar panels to work.
- Even on a cloudy day or when they have some snow on them, solar panels can produce some energy.
- The more cells you link together, the more electricity you make. With enough modules, huge amounts of power are possible. A good example is the Three Nations Energy solar farm in Fort Chipewyan, Alberta. It has 6,500 solar modules that produces 2.2 megawatts of electricity that replaces 25 per cent of diesel generated electricity. This will help save money and the environment.



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Three Nations Energy solar farm in Fort Chipewyan, Alberta

## Further Information

Photovoltaic System - University of Calgary

[https://energyeducation.ca/encyclopedia/Photovoltaic\\_system](https://energyeducation.ca/encyclopedia/Photovoltaic_system)

How Do Photovoltaics Work? - NASA

<https://science.nasa.gov/science-news/science-at-nasa/2002/solarcells#:~:text=Photovoltaics%20is%20the%20direct%20conversion,of%20light%20and%20release%20electrons.&text=The%20diagram%20above%20illustrates%20the,also%20called%20a%20solar%20cell.>

How Solar Panels Work - Popular Mechanics

<https://www.popularmechanics.com/technology/infrastructure/a28186403/how-solar-panels-work/>

Follow the Sun: How Solar Panels Are Evolving - CBC

<https://www.cbc.ca/news/technology/what-on-earth-solar-panels-bifacial-dual-axis-1.5643798>

Micro-generation - Alberta Government

<https://www.alberta.ca/micro-generation.aspx>

## Videos

Solar Energy - Bill Nye's How Stuff Works

<https://www.youtube.com/watch?v=av24fEMhDoU>

Shining A Light On Solar Energy Myths #135 - Green Energy Futures

<https://www.greenenergyfutures.ca/episode/solar-myths>

How Do Solar Panels Work? - Richard Kom/TED Talk

<https://ed.ted.com/lessons/how-do-solar-panels-work-richard-komp>



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Solar array being installed at remote cabin near Fort Chipewyan, AB

### Fill in the blanks: (10 points)

1. Light travels in a \_\_\_\_\_ line to Earth from our Sun.
2. There are many other types of light including; Radiowaves, Microwaves, Infrared, UltraViolet Light, X-Rays and Gamma Rays. All of these are \_\_\_\_\_.
3. Sunlight supplies plants with \_\_\_\_\_ which they use to make \_\_\_\_\_. Animals then eat the plants.
4. Ocean currents, wind, weather and climate are driven by \_\_\_\_\_ from sunlight.
5. Nearly all energy on Earth comes from \_\_\_\_\_.
6. \_\_\_\_\_ is the solar panel "fuel". It makes the best fuel because it is \_\_\_\_\_.
7. Solar panels do not release \_\_\_\_\_ or \_\_\_\_\_ and are quiet.

### Matching: (Not all letters will be used.) (8 points)

- |   |                      |
|---|----------------------|
| ___ 1. Also called photovoltaic cells.  | a. solar modules     |
| ___ 2. Conduct, or carry, electricity but not very well so they are used to control electric current. | b. solar cells       |
| ___ 3. A typical solar cell has two layers of this.   | c. semiconductors    |
| ___ 4. The sun's energy knocks some of these out of the silicon atoms and makes electricity flow.     | d. no electricity    |
| ___ 5. Modules and arrays are sometimes called this.  | e. electrons         |
| ___ 6. Solar panels for buildings are often put on a roof and sometimes they are built where?         | f. solar panels      |
| ___ 7. What are used to store the electricity while its sunny?  | g. special batteries |
| ___ 8. On a cloudy day, solar panels produce _____.   | h. some energy       |
|   | i. silicon           |
|   | j. on the ground     |

### Short Answer: (2 points)

Give an example of what each of these could power:

a single solar cell \_\_\_\_\_

solar module \_\_\_\_\_

### BONUS - The sun provides energy for many things.

- Color the picture below **OR**
- Draw your own picture to show how the sun provides energy for us.



# Solar Cell

(Photovoltaic Cell)

