Learning Goals:

- Learn about temperature, humidity, rainfall and how understanding weather is crucial to our survival
- Explain how humidity and the greenhouse effect are related
- Appreciate indigenous identification of different six different seasons in Northern Parts of Australia and its usefulness in planning for the coming and going of food sources

Directions:

Part 1.1: Temperature

We all know that the Sun warms us during the day and disappears at night. First let's see what the rising and setting of the Sun looks like in the weather data.

Method:

1. Choose a southern location (Melbourne, Adelaide or Perth) and plot the temperature over a 3-day period in summer. For example, Adelaide, February 5 – 7, 2014.
2. Now repeat for the other two capital cities in the south of Australia (Melbourne, Adelaide or Perth).

Questions:

1. Why does the temperature go up and down every day?
2. Estimate the time of day when the temperature is at a *minimum* and a *maximum*.

Now click on the link on the website to see the power generated throughout the day by solar cells mounted on the roof of La Trobe University in Melbourne and Curtin University in Perth.

Question: At what time of the day is the solar cell generating the most power? When is it generating no power?

Extension Question: Plot a 3-day period of solar cell power for the month of April. Estimate the time of dawn and dusk for both La Trobe University (Melbourne) and Curtin University (Perth) – hint: hover your mouse over the charts to show the time. As you go from one day to the next is the day-time getting shorter or longer?

Part 1.2: Temperature

Method:

1. Now choose a far northern location, for example Darwin, and make another plot of temperature for the same 3-day period as you did for Part 1.1.

Questions:

1. Estimate the *minimum* and *maximum* temperature in degrees over the 3-day period. What do you notice about the *difference* between the minimum and maximum temperature in Darwin (when compared with southern locations)?
2. Where is the overnight temperature *drop* the largest? In the north or south of Australia?

Part 2: Humidity

In Part 1 you will have seen that at night the temperature *drop* is less in the far north, even though the maximum temperature during the day is higher. The main reason for this is humidity. Humidity is "water vapour" or steam in the air and is created by *evaporation from the oceans*.

Method:

1. Make a 7-day plot of temperature in the summer for Bundaberg (latitude 24.9 S) and for Alice Springs (latitude 23.8 S).
2. From your plots, estimate the *drop* in temperature at night for Bundaberg and Alice Springs. These two places are at the same latitude (north-south distance) but very different locations.

Questions:

1. Which has the greatest drop in temperature overnight, Bundaberg or Alice Springs?
2. Which is closest to the coast?
3. Why do you think they have a different drop in temperature at night? For a clue, look again at the text above about Humidity.

Humidity plays a very important role in the weather. In general, humidity is greater close to the equator, and close to the sea. Let's look at some humidity data from weather stations at different latitudes.

Method:

1. Make a 7-day plot of humidity for Darwin, Perth and Brisbane in the summer. For example, February 5 – 11, 2014.
2. From your plots, estimate the average humidity over the 7 days for Darwin, Perth and Brisbane.

Questions:

1. Can you order the three capital cities from lowest to highest average humidity?
2. All of these cities are on the coast. Why do you think they are ordered in this way?
3. Does humidity increase or decrease throughout the day?

Part 3: Temperature versus Humidity

Temperature and humidity are very closely related in the atmosphere. When the day begins to heat up, the water vapour in the air at ground level can be "burnt off", rising high into the sky to form clouds.

Did you know? *The most humid time of day is just before dawn.*

Method:

1. Plot humidity and temperature on the same graph for Alice Springs over a 3-day period in summer. For example, February 5 – 7, 2014.
2. Looking at your plot, identify the times of dawn and dusk from the temperature.

Questions:

1. What happens to the humidity when the temperature is high? What happens when it is low?

2. Can you explain why?
3. When is the most humid time of the day?
4. What do you think happens to early morning fog as the day progresses? Watch the first minute of the video "*An early start during construction of the Buckland Park HF Radar*" for a clue!

Part 4: The seasons of Kakadu and far northern Australia

Did you know that in the far north of Australia the seasons are very different to those in the south? In places such as Kakadu National Park in the Northern Territory, the European seasons of Winter, Spring, Summer and Autumn have no meaning at all. The traditional owners of North West Arnhem land and Kakadu National Park identify six distinct seasons: *Gudjewg*, *Banggerreng*, *Yegge*, *Wurrgeng*, *Gurrung*, and *Gunumeleng*. In this section we will explore the differences between these seasons using weather station data.

Method:

1. Click on the figures above. These show average monthly values for weather data measured at Jabiru in the Northern Territory. Jabiru is a small town in the middle of Kakadu National Park.
2. By looking at the 4 plots of weather data, answer the questions below.

Questions:

1. Describe the period from December to March in terms of rainfall and humidity. Is rainfall high/low? Is humidity high/low? The local aboriginal people call this season "Gudjeuk".
2. April is a time of transition in Kakadu. What happens to the wind during this time? This season is called "Banggerreng" – the "knock em down" season.
3. Look at the period from June to August. How does the temperature and the humidity compare with the rest of the year? This season is called "Wurrgeng". It is the "cold" season in the far north, even though day-time temperatures are still around 30°C degrees, and is also very dry. It is so dry that there is often not a drop of rain at all for 6 months!
4. What happens to the temperature between August and October? What about the rainfall? This season called "Gurrung" is very hot but still dry. It is a time for the hunting of snakes and long-necked turtles as the creeks and waterways dry up.
5. Between October and December what happens to the humidity and the rainfall? This is the season called "Gunumeleng" – which Europeans call the "build up" – and is probably the most uncomfortable of all the seasons in the far north. The rising humidity is accompanied by a gradual build-up of enormous thunderclouds, which signals the coming of the wet season, "Gudjeuk".

Part 5: Weather Fronts

Weather patterns move in particular directions in different parts of Australia and the world. This means that the weather over a particular place (which might include blue skies, rain, heat, cold and everything that makes up the day's weather) can move, as a whole, to another location nearby the next day. In this exercise you will determine which direction the weather moves in the south of Australia. For example, does it move from east to west, west to east, or perhaps north to south?

Large scale weather patterns can be observed from the *pressure* they create. Pressure is a very important quantity measured by weather stations around Australia. It is measured in hectopascals (hPa). "Atmospheric" pressure, which is the average pressure at the surface of the earth, is 1013 hPa. A "low" pressure is when the pressure is less than 1013 hPa, and a "high" pressure is when it is more than 1013 hPa.

Did you know? Low pressure occurs when air is rising *upwards* to a higher altitude. This is usually the case when you see heavy clouds, rain and strong winds.

Method:

1. Make a 7-day plot of pressure for Perth, for the period December 6 – 12, 2013.
2. From your plot, find the time when the pressure is the lowest. What is the value of the pressure at this time?
3. Is this a "high" or a "low" pressure system?
4. Make a 7-day plot of pressure for Adelaide and for Melbourne for the period December 6 – 12, 2013.
5. Find the low point in the pressure plots for Adelaide and Melbourne and estimate the time for each when the pressure is low.

Questions:

1. Which city is furthest to the west, Perth, Adelaide or Melbourne?
2. Weather patterns in the south of Australia move in a particular direction. The same low pressure system often appears in Perth, Adelaide and Melbourne, but at different times. From your results above, does the low pressure system arrive at Perth or Melbourne first?
3. Is the low pressure system moving from west to east or from east to west?
4. By looking at all three pressure plots, how many days does it take for weather to travel from Perth to Melbourne?

Extension: Pressure and Air Temperature

1. Make a 7-day plot of air temperature for Perth, Adelaide and Melbourne for the same period December 6 – 12, 2013.
2. By comparing your pressure plots and temperature plots, what do you notice about the daily maximum air temperature just after the low pressure system arrives?
3. Do you think low pressure systems produce warm weather or cold weather?

Weather Patterns:

The movement of weather patterns from west to east in the south of Australia is very constant. It relies on the rotation of the earth and the heating of the earth's surface by the sun. The movement of weather in the north of Australia is the opposite: with tropical weather patterns often moving from east to west!

Follow the link on the website to see the path followed by Severe Tropical Cyclone Ilsa in March 2009. While tropical cyclones usually travel from east to west, they often have a mind of their own and are very difficult to predict.

Synoptic charts:

Pressure measurements from the very same weather stations you have been using in this remote experiment are all put together to create "synoptic charts". These are the weather maps of Australia you see on the news.

1. Above are the "synoptic" pressure maps made by the Bureau of Meteorology for the time period December 5 – 12, 2013 that you analysed previously. Click on the images and cycle through them. Can you see the low pressure system moving across the south of Australia from west to east?

2. The circles or lines drawn around a low (L) or a high (H) pressure system tell you what the pressure is in hectopascals (hPa). Each circle or line has a particular pressure which is written as a number on the line. Can you find some of these numbers?

3. For the times in your pressure plots when the pressure is lowest for Perth, Adelaide and Melbourne check that the pressure on the synoptic chart agrees with your plots