Weather

A teacher training tool for presenting, demonstrating and guiding the hands-on experiences of the OCM BOCES Weather Kit.

In addition to the written overviews and summaries, many of the activities have a link to a video clip. Teacher trainer, **Darlene** Devendorf, will guide you through the activity with demonstrations and tips/hints for classroom implementation.

“Answer Keys” pp. 48 - 59

Activity 1

: **What do I know about weather?**

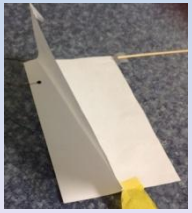
Teacher Guide pp. 1-3
Student Notebook pp.1-4
Blackline Masters pp. 2-7

What Weather Means
Weather is basically the way the atmosphere is behaving, mainly with respect to its effects upon life and human activities. The difference between weather and climate is that weather consists of the short-term (minutes to months) changes in the atmosphere. Most people think of weather in terms of temperature, humidity, precipitation, cloudiness, brightness, visibility, wind, and atmospheric pressure, as in high and low pressure.

In most places, weather can change from minute-to-minute, hour-to-hour, day-to-day, and season-to-season. Climate, however, is the average of weather over time and space. An easy way to remember the difference is that climate is what you expect, like a very hot summer, and weather is what you get, like a hot day with pop-up thunderstorms. (source: www.nasa.gov)

This activity has three goals:

→ Orient students to the new unit
→ Pre-assess student’s knowledge of basic weather terms and concepts
→ Construct a definition of the term “weather”
  → Students experience “weather” using their senses, using weather sources (weather report), through other people’s perspectives (classmates, poetry …)
  → Optional: Make and fly small kites (see Blackline Masters pp. 2-3) – the class would need to provide the simple materials.

Formative Evaluation: Student Notebooks and Blackline Master p. 7.

Activity 2

What do air masses have to do with weather changes across the U.S.?

Teacher Guide pp. 4-12
Student Notebook pp. 5-19
Blackline Masters pp. 8-18

Activity Focus:
Air and air masses can have properties. Air masses take on the properties of their source region.. Air masses move across the Earth's surface powered by prevailing winds and the jet streams.

Air having the property of mass is the basic concept that is built upon to explain that a mass of air is matter . A mass of air can have motion and direction of motion which can be measured.

→ After exploring the properties of air (gases) through Student Activity A, students are treated to Teacher Demo A which is a demonstration of air having the property of mass. (Teacher Guide pp.5 – 6)

Video:
Teacher Demo A
[4:12]

→ A few days are needed for the team of students that are tracking air mass movements (Air Mass-sters) to gather data. This data is needed for the class to work on Student Notebook pp.11 – 13. After working through p.10 students can move on to p.14-16 while awaiting the data for p.11-13.

Activity 2 cont.

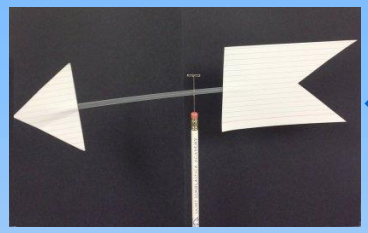
What do air masses have to do with weather changes across the U.S.?

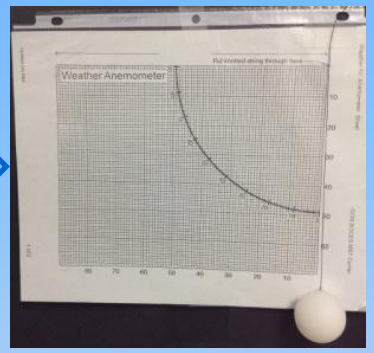
Teacher Guide pp. 11-12
Student Notebook pp. 17-19
Blackline Masters pp. 14 -18

Activity Focus:
Local air movement can be measured. Motion has the properties of direction and speed. Wind direction is measured using a wind vane and wind speed is measured using an anemometer. Local and regional winds can be affected by the topography of the area.

Wind direction is named by the direction the wind is blowing FROM and tells us from where our weather is coming . Wind speed tells us about the mechanical energy (energy of motion) and force of the air . It is measured in miles or kilometers per hour.

→ Student Activity B: teams of students build two weather tools, a weather vane and an anemometer. Using these tools students explore the wind speed and direction at various locations outside the school building.





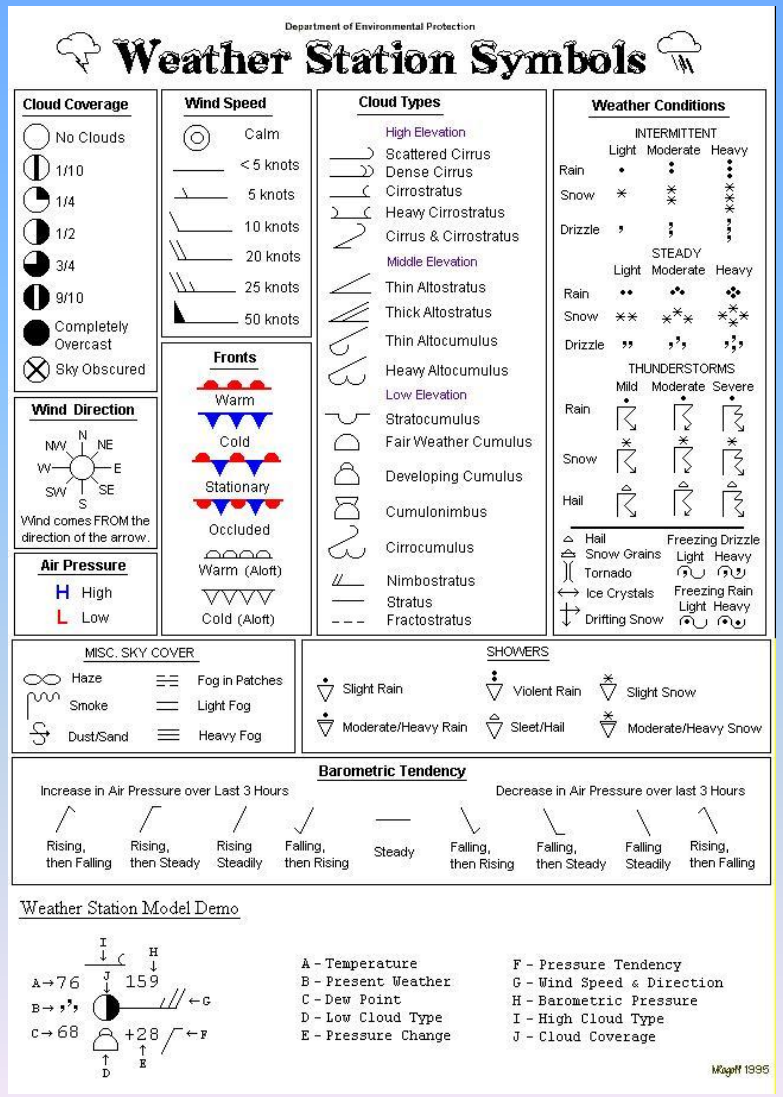
→ A new team of students to track wind speed and wind direction is needed (Air Speed-sters).

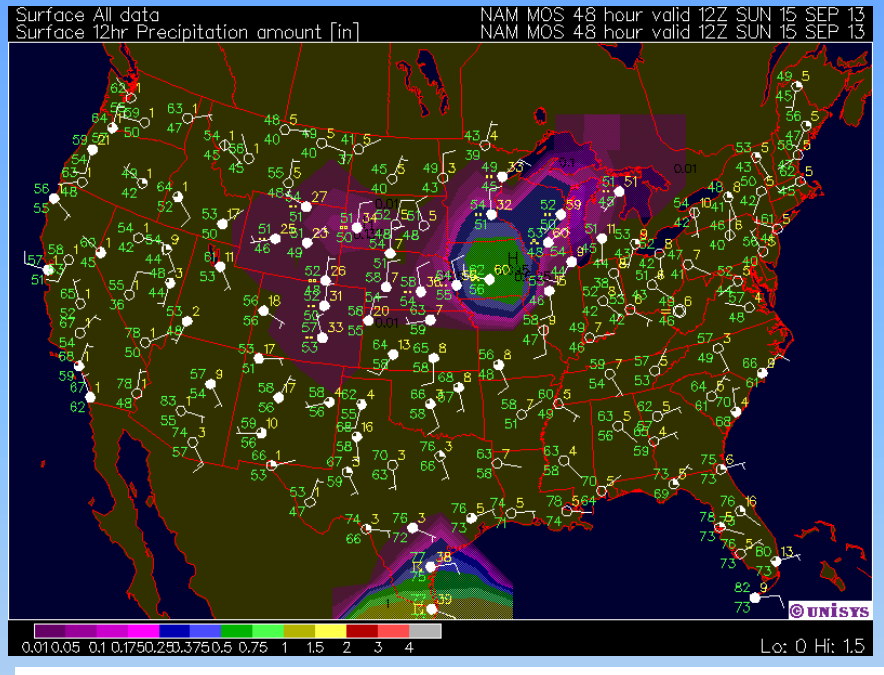
→ Blackline Master p.14: introduces the weather map "Station Model" which is used to place weather data on regional maps. You can choose to use this model to record weather data from the weather teams (see the next two pages).

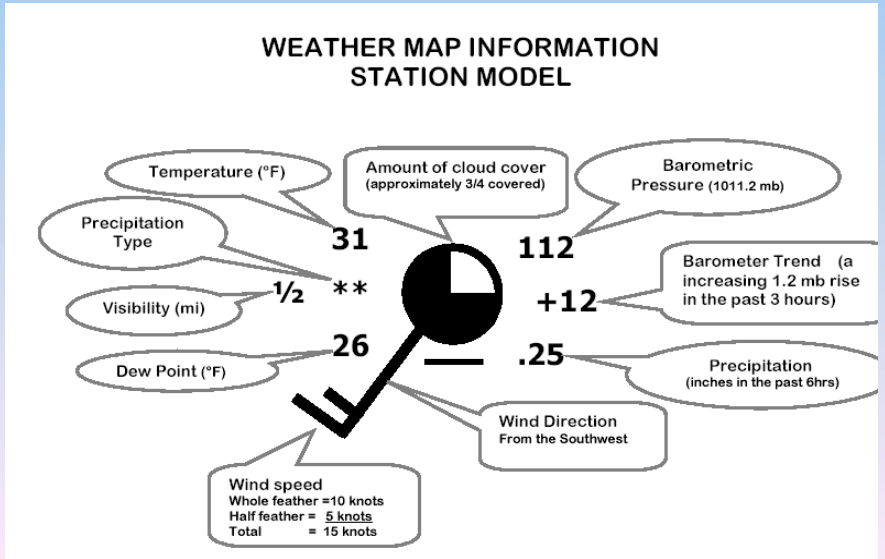
Formative Evaluation: Student Notebooks and Blackline Master pp. 16-17.

Weather Station Model

Used to record data onto weather maps for analysis, station models are not hard to read; you just need to know the symbols and their placement on the model.



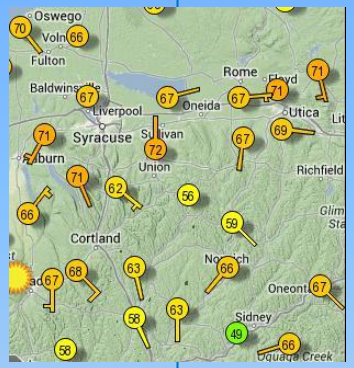




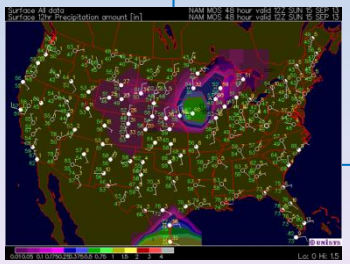
Weather Station Models cont.

Resources - Weather Data using Station Models

- **Weather Underground (www.wunderground.com)**
  - **WunderMap (http://www.wunderground.com/wundermap/)**
    - Uses Station Model *style* symbols to share wind direction and speed data (has modified by placing the local temperature in the center circle)
    - Each symbol represents a weather reporting station. If you hover over the station model it gives the location. If you click on the station model a small window appears with additional atmospheric properties.



- **National Weather Service, UNISYS (http://weather.unisys.com/index.php)**
  - **Surface Data (http://weather.unisys.com/surface/index.php)**
    - Station Model pages, select “Surface Data” or “Upper air Data” from the left menu to view maps



Activity 3

"Answer Keys" pp. 48 - 59

How is air heated and cooled? How does air react to heating and cooling?

Teacher Guide pp. 13 - 19
Student Notebook pp. 20 - 27
Blackline Masters pp. 18 - 24

Activity Focus:
Air and air masses can have properties. Air masses take on the properties of their source region. One such property is temperature. Temperature measures the kinetic energy of matter. This energy is energy of motion of the particles of matter

When matter is heated the particles gain energy of motion which, due to increased particle collisions, causes them to move farther apart. A warmer mass of air would have less particles and therefore would be lighter than a cooler mass of air. As heavier cooler air is pulled downwards by gravity it pushes lighter warmer air of out of the way (upwards).

→ Student Activity C: Teams of students explore the concept of air having the property of temperature which leads to how is air heated and cooled. The answer is "by the surface to which it is near or over. There are two options for this activity, see p. 14, Engage step 2

Option 2:

Video: Student Activity 3-C [4:16]

→ A new team of students to track air temperature is needed (Air Temp-sters). Blackline Master p. 19 shows how to use a Station Model to share temperature data.

Formative Evaluation: Student Notebooks

Activity 3 cont.

How is air heated and cooled? How does air react to heating and cooling?

Teacher Guide pp. 15 - 17
Student Notebook pp. 24 - 26
Blackline Masters p.

Activity Focus:
Air and air masses can have properties. Air masses take on the properties of their source region. One such property is temperature. Temperature measures the kinetic energy of matter. This energy is energy of motion of the particles of matter

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→ Teacher Demo A: What happens to air when it is heated?

Video: Teacher Demo A [4:20]

→ Teacher Demo B or a Student Exploration: How can we show that cooler fluids are denser ("heavier") than warmer fluids? [float and sink]

Video: Teacher Demo or Student Activity [4:20]

Formative Evaluation: Student Notebooks

Activity 3 cont.

How is air heated and cooled? How does air react to heating and cooling?

Teacher Guide pp. 17 - 19
Student Notebook pp. 26 - 27
Blackline Masters pp. 20 - 24

Activity Focus:

Air is composed of particles of matter. Particles of matter (molecules) are very small. We can see them only when there are many, many of them gathered together. An example of this would be viewing a single grain of salt vs viewing a pile of many grains of salt.

A major reason for the particles to be able to gather together or to move apart is the energy of motion of the particles. The greater the energy of the particles the more they push away from other particles.

The particles in a solid have very low energy so they are more locked together. As the energy level increases, as in heating, the particles increase their motion and push away from each other. As the particles become more independent the mass of matter can flow and change shape.

A gas state of matter is the most "free" form. The particles are able to easily increase and decrease their energy levels

→ Student Activity D: Teams of students explore the energy levels of heated and cooled air. They make inferences from changes in the shape of a balloon cover placed upon a flask of air.

→Top of the warmed flask moves upward (outward): the inferential conclusion is that the air inside the flash has more energy, more energy of motion than the outside air, which results in movement of the balloon top.

Video: Student Act. D

→Top of the cooled flask moves downward (inward): the inferential conclusion is that the air inside the flash has less energy, less energy of motion than the outside air, which results in movement of the balloon top.

→ This activity is the bridge to Activity 4 and air pressure.

Note: be careful to limit the discussion here to "energy levels" and not force or pressure. Later, when we visit the topic of pressure, we will find that warming a mass of air in an open environment leads to the air mass having less particles and thereby less force than a cooler mass of air.

Formative Evaluation: Student Notebooks and Blackline Master pp. 23-24.

Activity 4

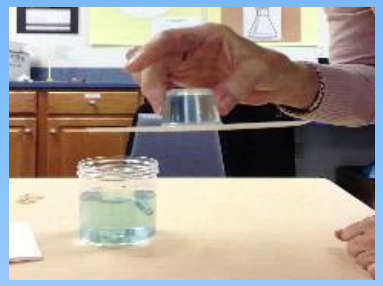
What is air pressure? What happens when air has force? How does a change in air temperature affect air pressure?

Teacher Guide pp. 20 - 29
Student Notebook pp. 28 – 42
Blackline Masters pp. 25 - 28

Activity Focus:
Many of the previously experienced concepts come together in this activity.

Air masses are heated and cooled by the surface they are over. Due to this heating and cooling, some air masses are lighter (less dense) and others are heavier (more dense). The heavier air masses sink towards the Earth's surface (gravity). The lighter air masses are pushed upwards by the sinking heavier air masses.
Lighter, less dense air masses have less pressure (force) and form low pressure areas. Heavier, more dense air masses have greater pressure (force) and form high pressure areas. (Note that lighter and heavier, less and more are relative terms.)

→ Teacher Demo A: Air has pressure. At sea level air exerts a pressure on all objects of 15 pounds per square inch of surface area.



Video: Teacher Demo A

→ Student Activity E: How can I detect the pushing force of air? (another example – wind! Fly a kite)

Video: Student Act. E

Formative Evaluation: Student Notebooks

Activity 4 cont.

What is air pressure? What happens when air has force? How does a change in air temperature affect air pressure?

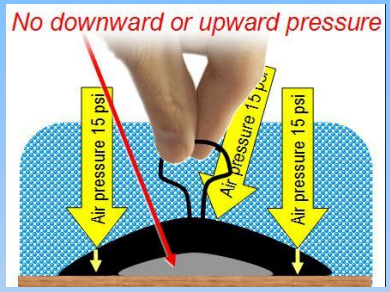
Teacher Guide pp. 23 - 24
Student Notebook pp. 30 – 35
Blackline Masters pp. 25 - 26

Activity Focus:
Air pressure differences can affect the motion of air.

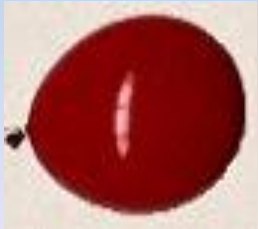
Air pressure can change by changing the number of air particles - changing the mass.
This can be done by adding air, as in blowing up a balloon.
This can be done by removing air, as in pushing down on a suction cup..

An air pressure difference between two air masses (ie. inside the balloon and outside the balloon) creates unequal pushing. This unequal pushing can lead to motion in the direction of the greater force.

→ Student Activity F: How can you explain why a suction cup sticks to a surface?
This can be related to the previous student exploration with the jar and the plastic bag. If you Increase the space "behind" the object without letting very much air into that space – the air around the object has greater pushing force.



→ Teacher Demo 4-B: Air has pressure. Air pressure differences can affect air motion.



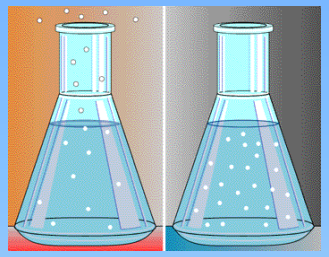
Formative Evaluation: Student Notebooks

Activity 4 cont.

What is air pressure? What happens when air has force? How does a change in air temperature affect air pressure?

Teacher Guide pp. 24 - 28
Student Notebook pp. 36 – 37
Blackline Masters pp.

→ Teacher Demo 4-C: How can air pressure be increased or decreased?



Video:
Teacher Demo 4-C

Activity Focus:
Changes in air pressure can be caused by changes in energy levels, as in heating and cooling.

Air pressure differences between two masses of air causes unequal pushing. Unequal pushing leads to horizontal and vertical air motion.

The two masses of air can be named using the terms “Low pressure area “ and “High pressure area”.

Changes in air pressure can be measured using a tool called a barometer.

→ Student Activity G: How can we measure changes in air pressure? (barometer) p. 36 – an easy “build it”

√ Weather Team: Air Press-sters

√ Make note of the barometric pressure on the day that the class builds the barometers.

Possible Evaluation question:
How does your barometer “work” to show air pressure changes?

Formative Evaluation: Student Notebooks

Activity 4 cont.

What is air pressure? What happens when air has force? How does a change in air temperature affect air pressure?

Teacher Guide pp. 28 - 29
Student Notebook pp. 38 – 42
Blackline Masters pp. 27 - 28

Activity Focus:
Reviewing that air has pressure. The air around us pushes on all surfaces.

Reviewing that pressure differences can be caused by heating and cooling of the air.

→ Revisiting Teacher Demo 4-A: How do the index card keep the water in the cup?

→ Gravity is pulling down. We know from our personal experiences that water is pulled to the ground by gravity, therefore, an opposing force must be pushing up on the index card. It must be a force strong enough o oppose the pounds per square inch force of the water.. Deduction: Air exerts force on all surfaces. At sea level, the column of air above us exerts a pressure of 15. PSI. Therefore, it must be the force of the air around us pushing on the card. What else can it be?

→ FYI: An inch high column of water exerts a pressure of .036 PSI. You would need a 34 foot tall column of water to equal atmospheric pressure. Of 15 PSI. (WOW!!)

→ Teacher Demo 4-D: Air pressure at work (milk jug and hot water)

Formative Evaluation: Student Notebooks and Blackline Master p.27 and 28.

Activity 5

How do meteorologists use air pressure measurements? What are the differences between high and low pressure systems? What are weather fronts?

Teacher Guide pp. 30 - 31
Student Notebook pp. 43 – 48
Blackline Masters pp. 29 - 30

Activity Focus:
High and low pressure systems , generally, move from west to east across the U.S.

High-pressure systems generally bring fair weather.
Low-pressure systems usually bring cloudy, unstable conditions.

Fronts are the boundaries between air masses.

Eureka! You have made it to the "cruising" phase.

→ Students are:
- → Watching weather maps (high and low pressure systems)
- → Making local weather measurement or recording local weather measurements obtained from resources.
- → Looking for trends in changes in: air pressure, wind speed and direction, temperature and. Perhaps, noticing changes in clouds and precipitation.

→ You are facilitating:
- → Class charting of the weather changes that seem to occur with the tracking of the air masses, H and Ls, on the weather map. Perhaps looking at previously collected data to support current data or to make observations about these trends.
- → Class forming hypothesis or drawing conclusion about the weather associated with these air masses.
- → Student Notebook pages 43 and 44

→ You are introducing
- → Weather fronts
- → Student Notebook pp. 45 - 48

Formative Evaluation: Student Notebooks and Blackline Master p. 29 - 30

Activity 6

What factors affect the formation of clouds? Why do clouds form around low pressure systems and along weather fronts? What role do clouds play in weather?

Teacher Guide pp. 32- 41
Student Notebook pp. 48 – 59
Blackline Masters pp. 29 - 30

In Activity 6 students focus on clouds and cloud formation. The .major factors needed for clouds to form are water vapor, cooling and surfaces on which the water can condense.

Activity Focus:

1. Condensation on a surface occurs when air containing water vapor is cooled

The cooling or decreased energy level of water vapor, water in the gas state, causes water particles to move closer together and collect on surfaces. Depending of the amount of reduction of the energy level, amount of cooling, the mass of water particles collecting together will either enter a liquid state or a solid state. They will either become liquid water droplets or solid ice crystals. When this happens near the Earth's surface we experience wet or icy surfaces, such as wet chairs, wet cars, icy car windows, wet grass (dew), icy grass (frost).

2. Water vapor in the atmosphere is cooled by the surface it is near, or when it is pushed upwards (rises) to areas of lower pressure.

Video: Teacher Demo

→ Teacher Demo 6-A
  → This is a bridging demo from previously introduced concepts.
  → The goal is to re-focus on the concept that warmed air is pushed upwards.

Video: Student Activity

→ Student Activity H
  → You are facilitating the student exploration into factors needed for cloud formation.

→ Student Activity I and J: Cloud Types and Cloud Cover (form Weather Team: Cloud-sters):

Formative Evaluation: Student Notebooks

Activity 6 cont.

What factors affect the formation of clouds? Why do clouds form around low pressure systems and along weather fronts? What role do clouds play in weather?

Teacher Guide pp. 37 - 41
Student Notebook pp. 55-61
Blackline Masters pp. 34 - 36

Activity Focus:

1. Clouds and pressure systems
   Clouds form over low pressure systems because the lower pressure, lighter air is being pushed upwards by the higher pressure air surrounding it.
2. Clouds form along weather fronts.
   Weather fronts are boundaries between warmer and cooler air masses. Here air is being pushed upwards due to the temperature differences of air masses. Warmer lighter air is being pushed upwards by the cooler heavier air
3. Clouds form near/over geographic features such as mountains.
   As air masses are moved towards mountains the air is uplifted.

→ Student Activity K: The focus is condensation and the temperature at which it occurs (gas to liquid or solid) pp. 53-54. Students should look for "clouding" of the surface not large droplets.

You introduce: Dew Point Temperature

- → Dew Point Temperature: the temperature, at which condensation will occur (condensation = cloud formation, dew or frost forming on surfaces, fog formation)
- → Student Notebook pp.55 - 59

→ Teaching Moment (TG pp.38 – 40)

- → Students listen and take notes related to where clouds form and why..
- → Where: low pressure areas, along weather fronts, over geographic areas, Why: air is pushed upwards and cools

→ Elaborate: How do we measure precipitation? p. 41

→ Extension: S'Cool – Students' Cloud Observations On-Line (NASA)

→ Extension: Relative Humidity

Formative Evaluation: Student Notebooks and Blackline Master p. 34 - 36

Activity 7

What do I know about weather? What do I need to know to predict the weather? What does a weather report tell me about the weather? Why is it important to have weather advisories?

Teacher Guide pp. 42 - 45
Student Notebook pp. 60 – 63
Blackline Masters pp. 37 - 45

Activity Focus:
Students examine and report on extreme weather conditions. In doing so they will re-visit the weather factors and concepts studied through out this unit.

In addition, students will research appropriate responses to these extreme weather conditions as it relates to human safety.

→ Weather Report Puzzler and Weather Data – Fact or Fiction p. 45 - 46

→ Weather Predictions p. 46

→ Severe Weather Systems p. 47

→ Extension: Weather Related Careers

Formative Evaluation: Student Notebooks, Student Activities, Student Reports
Summative Evaluation: Blackline Masters p. 40 - 45