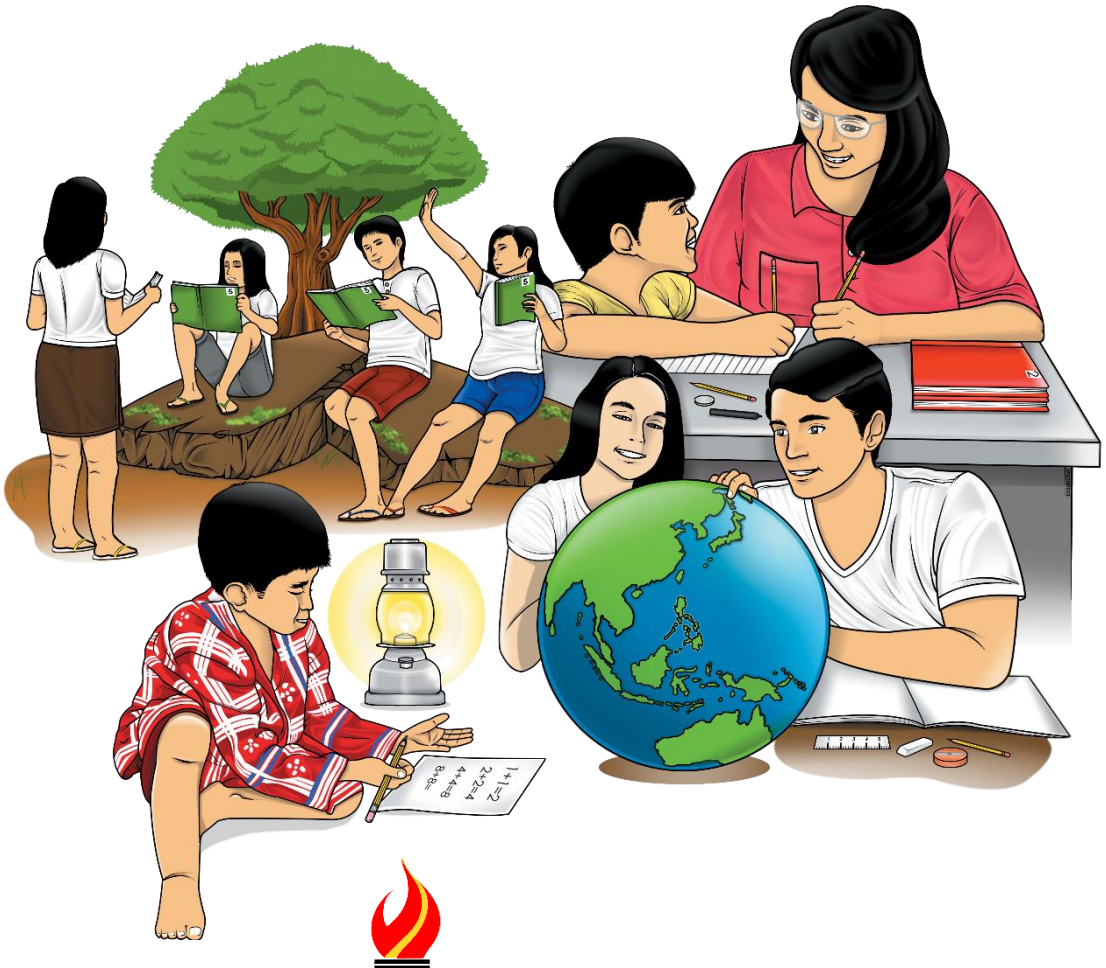
Senior High School

DepED
DEPARTMENT OF EDUCATION

Disaster Readiness and Risk Reduction

Quarter 2 – Module 8: Tools Used for Monitoring Hydrometeorological Hazards



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ADM

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Quarter 2 – Module 8: Tools Used for Monitoring Hydrometeorological Hazards
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Introductory Message

This Self-Learning Module (SLM) is prepared so that you, our dear learners, can continue your studies and learn while at home. Activities, questions, directions, exercises, and discussions are carefully stated for you to understand each lesson.

Each SLM is composed of different parts. Each part shall guide you step-by-step as you discover and understand the lesson prepared for you.

Pre-tests are provided to measure your prior knowledge on lessons in each SLM. This will tell you if you need to proceed on completing this module or if you need to ask your facilitator or your teacher's assistance for better understanding of the lesson. At the end of each module, you need to answer the post-test to self-check your learning. Answer keys are provided for each activity and test. We trust that you will be honest in using these.

In addition to the material in the main text, Notes to the Teacher are also provided to our facilitators and parents for strategies and reminders on how they can best help you on your home-based learning.

Please use this module with care. Do not put unnecessary marks on any part of this SLM. Use a separate sheet of paper in answering the exercises and tests. And read the instructions carefully before performing each task.

If you have any questions in using this SLM or any difficulty in answering the tasks in this module, do not hesitate to consult your teacher or facilitator.

Thank you.

What I Need to Know

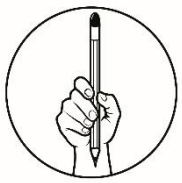
Can you recall the strongest typhoon you have experienced? How will you describe the experience? You have learned in your previous science lessons that the Philippines lies in the Pacific Typhoon Belt making it highly susceptible to hydrometeorological hazards. We have around 20 typhoons in a year, about five of which are considered destructive. Many Filipinos believe that these weather calamities have made them resilient.

Resiliency is one thing, preparedness is another. The crafting of disaster response plans is done by concerned agencies for risk reduction and management purposes. Through careful monitoring and planning, the timely, effective, and coordinated response of the national government and its resources can be achieved. With the use of reliable weather tools, accurate data can be gathered and from there, mitigation measures can easily be mapped. In the ultimate, loss of lives and properties and other damages brought about by a disaster will be kept at a minimum.

The Module is intended to equip you with knowledge concerning tools used for Hydrometeorological Hazards.

After going through this module, you are expected to:

1. Familiarize yourself with the different weather tools;
2. State the function of the weather tools;
3. Formulate plan, develop and invent your own tool which may help country in the future monitoring of hazards; and
4. Appreciate the importance of obtaining accurate data and measurements from the tools for risk reduction and disaster response purposes.



What I Know

Choose the letter of the best answer. Write the chosen letter on a separate sheet of paper.

1. Which of the following is used to measure how hot or cold the surrounding air is?
   a. anemometer
   b. barometer
   c. hydrometer
   d. thermometer

2. What physical quantity is measured or determined by a barometer?
   a. precipitation
   b. pressure
   c. temperature
   d. wind speed

3. The weather forecast tomorrow says there will be a 15 mph northeast wind and a high temperature of 52 degrees. What instruments will a meteorologist use to make this prediction?
   a. barometer, wind vane, hydrometer
   b. hygrometer, anemometer
   c. wind finding radar and thermometer
   d. wind vane and thermometer

4. These weather tools are used for measuring relative humidity.
   a. anemometer and barometer
   b. hygrometer and psychrometer
   c. rain gauge and radar
   d. wind vane and wind-finding radar

5. This type of weather instrument measures wind direction.
   a. anemometer
   b. barometer
   c. rain gauge
   d. wind vane

6. What is determined by a ceiling balloon?
   a. air pressure
   b. height of cloud base
   c. temperature
   d. wind direction

7. Areas with low pressure generally have:
   a. bad Weather
   b. ground Movement
   c. precipitation
   d. sunny Weather

8. This type of instrument measures the amount of precipitation.
   a. anemometer
   b. barometer
   c. rain gauge
   d. wind vane

9. In the Philippines, PAGASA gives the weather report to the Filipinos. What does the second A in the acronym PAGASA stands for?
   a. administration
   b. association
   c. astronomical
   d. atmospheric

10. Which of the following units is used to measure barometric pressure?
   a. millibars
   b. inches of Mercury
   c. both a and b
   d. neither a or b

11. What tool uses narrow beam of light to determine height of cloud base?
   a. barometer
   b. ceiling light projector
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   d. rawinsonde

12. How can computers help humans most with weather data?
   a. by replacing humans altogether
   b. by cutting down on errors made by humans
   c. by compiling information faster than humans can
   d. by automatically correcting erroneous data from other tools

13. All of the following are hydro meteorological hazards except _____.
   a. coronavirus
   b. drought
   c. flood
   d. heatwaves

14. It is the temperature at which the water vapor will condense.
    a. boiling Point
    b. dew Point
    c. melting Point
    d. vaporization Point

15. Which of the following is the ratio of the amount of water vapor actually present in the air to the maximum amount of water vapor the air can hold at a given temperature?
    a. precipitation
    b. moisture
    c. relative Humidity
    d. saturation

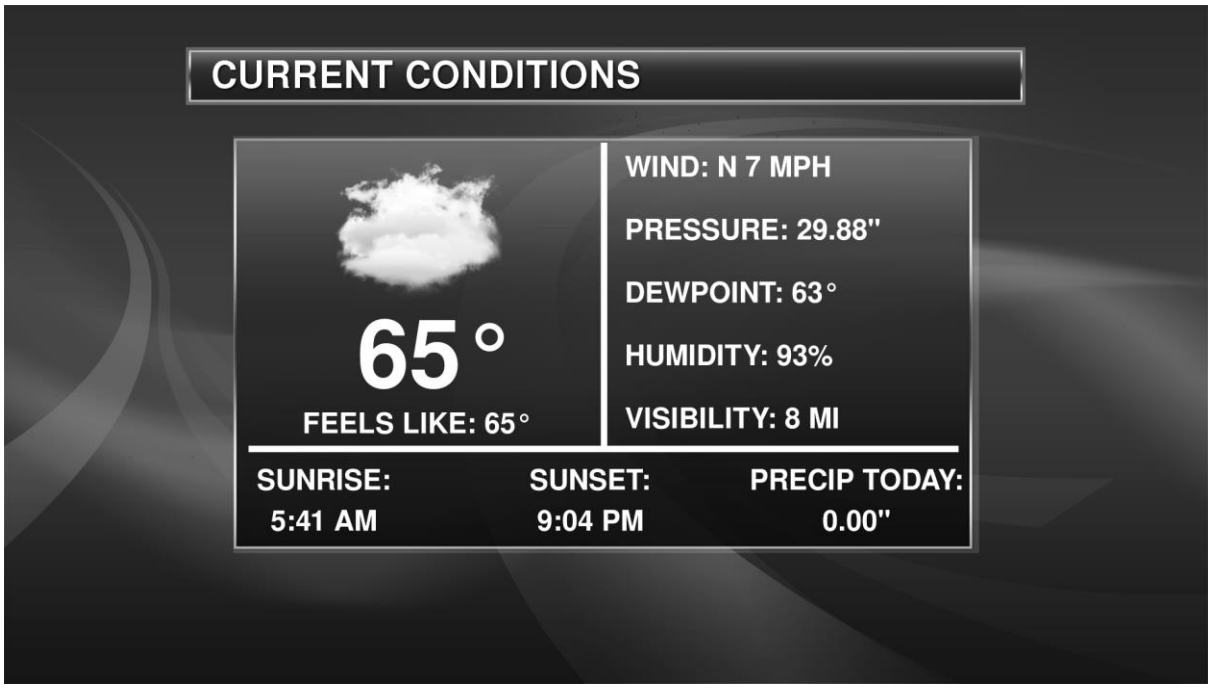
Lesson 1 Tools Used for Monitoring Hydrometeorological Hazards

From your previous science learnings, you have learned basic tools for studying weather. These basic weather tools include wind vane, anemometer, thermometer, rain gauge, etc. These tools are used in making weather forecasts which serve as our guide in planning our daily activities. In a grander scale, accurate weather forecasts when planned ahead of time help in situations of disaster responses and risk reduction.

In this module, you will be familiarized with other more sophisticated tools used for monitoring weather and hydrometeorological hazards.

What's In

Direction: Refer to the weather forecast below. Answer the guide questions that follow?



"Current Weather Conditions Panel", 2020, Praedictix, 1920 x 1080, accessed June 8, 2020 https://praedictix.com/case-studies/spencer/spencer_currents/

Guide Questions:

1. Based from the forecast above, how many grams of moisture is present in a 10-gram sample of air?

   _____

2. To what direction is the wind going? At what speed?

   _____

3. What is the temperature in degrees Fahrenheit?

   _____

4. Is there any chance of raining?

   _____

5. How much force is exerted by air at a given area?

   _____

Notes to the Teacher

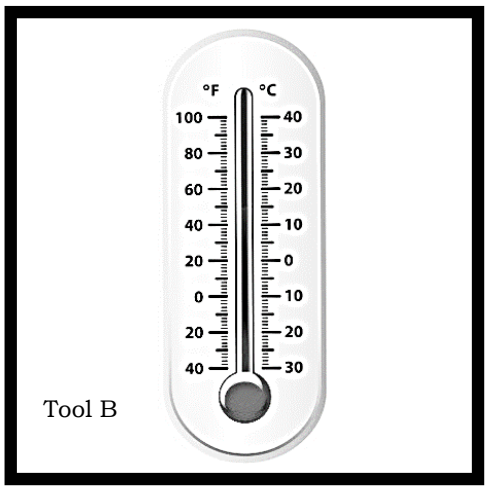
Learner's prior knowledge on basic weather tools and physical quantities usually measured when studying weather is a prerequisite for full understanding of this lesson.

What's New

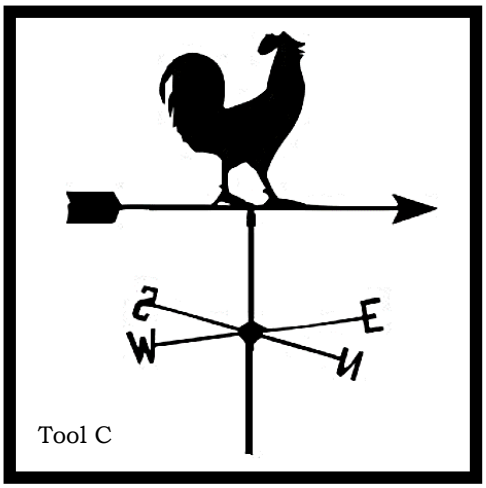
Basic Weather Tools

Direction: The following instruments surely look familiar to you. Identify the name of the following weather instruments and give the corresponding functions.

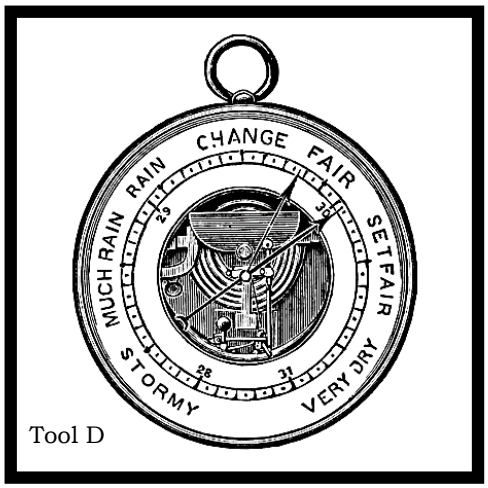

Tool A



Tool B



Tool C



Tool D

Images accessed from the following (clockwise from top left)
https://en.wikipedia.org/wiki/File:Wea00920.jpg ; http://clipart-library.com/free/thermometer-clipart-png.html ; https://www.pinterest.ph/pin/229331806000629704/; http://clipart-library.com/clipart/246560.htm

Name of Tool A: _____ Function: _____ _____ _____	Name of Tool B: _____ Function: _____ _____ _____
Name of Tool C: _____ Function: _____ _____ _____	Name of Tool D: _____ Function: _____ _____ _____

What is It

Hydrometeorological hazards are hazards caused by extreme meteorological and climate events which can lead to loss of life, injury or other health impacts, property damage, loss of livelihood, social and economic disruption, or environmental damage.

In the Philippines, examples of hydrometeorological hazards we encounter are cyclones, typhoons, flashfloods, storm surge, lightning storms/ thunderstorms, El Niño, and La Niña. In other countries, they experience snow fall, avalanches, blizzards, heatwaves, cold spells, etc. Do you think tsunami is an example of a meteorological hazard? Why do you say so?

The government agency which is tasked to monitor and give forecasts and warnings about atmospheric conditions is *PAGASA*, or Philippine Atmospheric, Geophysical and Astronomical Services Administration.

Unlike an earthquake, forecasts pertaining to hydrometeorological hazards are easier to predict with the help of some important tools which can monitor atmospheric conditions.

Below are the tools used for monitoring atmospheric conditions.

(Source: http://bagong.pagasa.dost.gov.ph/learning-tools/weather-instruments)

For measuring temperature

1. **Thermometer**

   A thermometer measures the extent of a given substance's hotness or coldness. Mercury is one of the liquids which is overly sensitive to temperature changes. The mercury expands and rises in the capillary tube when the substance to be measured is warm. Instead, mercury contracts. That is, principle of thermal expansion.

Indoor / Outdoor Classroom Thermometer, *Classroom Outlet*, Accessed June 15, 2020. https://www.dkclassroomoutlet.com/indoor-outdoor-classroom-thermometer

Usage tips: Place the thermometer about 5-ft above the ground, under the shade, ensuring good air flow. Then the temperature is directly read from the instrument.

2. **Thermograph**

   This tool records air temperature continuously on graphing paper during a period in a given area. It uses digital infrared imaging to record slight changes in temperature.

Sigma II Remote One Point Thermograph. Sato, Accessed on June 15, 2020. https://www.sksato.co.jp/modules/shop/product_info.php?cPath=24_34&products_id=308&language=english

Usage tips: A record of temperatures over a period is recorded in the generated graph. By examining the graph, fluctuations in atmospheric temperature can be detected.

For measuring atmospheric pressure

Barometers can tell if a good or bad weather is on the way. Low pressure reading is indicative of a foul weather while high pressure reading is a sign that the weather will be fair.

1. **Mercurial Barometer**
   In a mercurial barometer, the atmospheric pressure balances the mercury column, the height of which can be measured precisely. Corrections and adjustments are made for temperature expansion of the instrument, gravity and latitude in order to obtain accurate measurements. Millibars, millimeters, or inches of mercury are the units of measurements of pressure readings.

Muller, Alfred. Mercurial Barometer, Meteorologische Instrumente KG., Accessed June 15, 2020. http://www.rfuess-mueller.de/111-0E.pdf

Usage tips: Read the pressure from the height of the mercury. Mercury is used, and not water because mercury is denser than water. This tool is calibrated upon receipt to make it appropriate for use in a given altitude of a place.

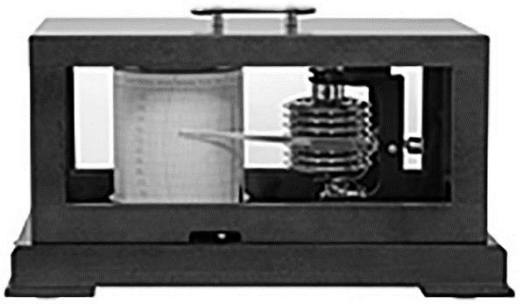
2. **Aneroid Barometer**
   A sealed box (blue, sometimes called an aneroid cell) is built around an aneroid barometer, which expands or contracts with increasing pressure. As it moves, it pulls or pushes a spring and a system of levers, moving a pointer up or down the dial yellow.

Barometer - Barometer Atmospheric Pressure Measurement Atmosphere Of Earth. FAVPNG, Accessed June 15, 2020. https://favpng.com/png_view/barometer-barometer-atmospheric-pressure-measurement-atmosphere-of-earth-png/yGZ71JM9

Usage tips: Prior to reading, tap first the glass lightly, but firmly, to ensure that the linkage mechanism is not sticking. Your barometer will most likely be marked in tens of hectopascals (990, 1000, 1010 etc.) with further graduations given for each hectopascal, which enable it to be read reasonably easily to the nearest half hectopascal. (1000 hectopascals= 750.1 mm).

3. **Barograph**

A barograph is a recording barometer. A barograph is a barometer that records the barometric pressure over time in the form of a graph. The pen point which traces the pressure curve on the paper is made to move up or down by a series of levers attached in tandem to aneroid cells (metallic boxes).



Meteoclima Barograph. Boat Books Australia, Accessed June 15, 2020. https://www.boatbooks-aust.com.au/product/meteoclima-barograph/

Usage tips: Rotate the knob so that the barograph arm moves up and down against the drum until the tip of your barograph pen rests on your chart at the correct pressure reading.

For measuring atmospheric relative humidity

1. **Sling Psychometer**

A dry and wet-bulb thermometer is made of the sling psychrometer. The term bulb refers to the portion of the glass tube that contains mercury. In building the dry and the wet bulbs are exactly the same.

Dew point is the temperature at which the water vapor condenses while the relative humidity is the ratio of the amount of water vapor actually present in the air to the maximum amount of water vapor that the air at a given temperature can hold.

General Tools SP100FM Sling Psychrometer, 20/120F Pocket Sling Mercury Filled. John Morris Group, Accessed June 15, 2020. https://www.johnmorrisgroup.com/AU/Product/133924/General-Tools-SP100FM-Sling-Psychrometer,-20120F-Pocket-Sling-Mercury-Filled

Usage tips: The weather observer first wets the cloth cladding the wet-bulb, whirls the psychrometer a few times, then reads the wet-bulb. He reads the dry-bulb last. Normally, the wet-bulb's reading will be lower than the dry-bulb. The dry-bulb reading is the air temperature. The difference between the dry and the wet-bulb readings will give, with the aid of a psychrometric table, the dew point temperature and the relative humidity.

2. **Hygrometer**
   This system uses an organic material (normally human hair) that expands and contracts as a result of the humidity around. This change can be made to move an indicator needle that moves across a scale, with graduations ranging from 0 to 100%.

Wood, David. What does a hygrometer measure. Sciencing. Updated April 24, 2017, Accessed June 15, 2020. https://sciencing.com/what-does-hygrometer-measure-4909583.html

Usage tips: The mechanical sensors inside the hygrometer move the needle along the gauge, so it points at the proper level of relative humidity.

For measuring precipitation

1. **8-inch Rain Gauge**
   An 8-inch rain gauge, so-called because the collector's inner diameter is exactly 8 inches above a funnel which leads rain into a cylindrical measuring tube or receiver. The collector's volume is 10 times that of the measuring tube. As a result, the actual precipitation depth is increased ten times when collected in a smaller measuring tube.

8-inch Rain Gauge. Pierce College Weather Station, Accessed June 15, 2020. http://piercecollegeweather.com/instruments/8-inch-rain-gauge/

Usage tips: To measure the amount of rainfall accumulated in the measuring tube, a thin measuring stick with the magnified scale printed on its face is used. The precisely dimensioned measuring tube has a capacity representative of only 2 inches (50.8 millimeters) on flat level ground. Rainfall beyond this amount spills into the overflow can but can be easily measured by pouring it into the measuring tube for total rainfall.

2. **Tipping Bucket Rain Gauge**
   By capturing a small volume of water in one of two small buckets, the tipping bucket gauges act. Once the rain is caught, the tips of the bucket are empty. This tip is recorded and precipitation volumes and rates are transmitted as the number of tips and the rate at which they occurred.

Tipping Bucket Rain Gauge. Darrera, Accessed June 15, 2020. https://www.darrera.com/wp/en/product/hd2013-tipping-bucket-rain-gauge/

Usage tips: Rainfall character is decided by the total amount of rain that has fallen in a set period (usually 1 hour) and by counting the number of pulses clicks in a 10-minute period the observer can decide the character of the rain. Algorithms may be applied to the data as a method of correcting the data for high-intensity rainfall.

For monitoring clouds:

1. **Ceiling Light Projector**
   A projector with ceiling light project a small beam of light vertically onto a cloud foundation. The cloud base height is determined by using a clinometer positioned at a known distance from the projector to calculate the elevation angle contained on the cloud by the illuminated spot, the measurement, and the projector.

Ceiling Light Projector. Weather Instruments, Accessed June 15, 2020. http://bagong.pagasa.dost.gov.ph/learning-tools/weather-instruments

2. **Ceiling Balloon**
   This is another way of finding the height of the cloud base. A ceiling balloon is a meteorological balloon whose rate of rise has been predetermined. It is lighter filled with gas than air, usually hydrogen, and released. The release time is recorded, and the time the balloon disappears into the cloud.

   The time difference multiplied by the rate of ascent will give the height of the cloud base, that is speed=d/t, hence distance or height=t x s) where s=speed, d= distance and t is time.

Weather balloon. New World Climate. Published May 7, 2015. Accessed June 15, 2020. http://www.nwclimate.org/guides/meteorological-instrumentation/

Special Instruments

1. **Pilot Balloon/ Theodolite**
   A Pilot Balloon is a weather balloon lighter than air filled with gas. When used in conjunction with a theodolite the pilot balloon is used to determine wind speed and direction at different atmospheric levels.
   Theodolite is similar to a transit made by an engineer. It consists of a sighting telescope mounted in such a way that it is free to rotate around a horizontal and vertical axis and has graduated scales so that the rotation angles may be measured while tracking the pilot balloon.

Douglas, Michael, et. al. *Underutilized observations for studying tropical climate variations: the historical pilot balloon database*. National Severe Storms Laboratory/NOAA, Cooperative Institute for MesoscaleMeteorological Studies, Weather Decision Technologies.

2. **Radiosonde**

The radiosonde is an airborne instrument used in the upper air for measuring sound, temperature, and relative humidity. A meteorological balloon inflated with hydrogen takes the instrument up aloft.

Vaisala Radiosonde RS92-SGP. Vaisala, Published 2015, Accessed June 15, 2020. https://www.vaisala.com/sites/default/files/documents/Vaisala%20Radiosonde%20RS92%20Users%20Guide_M210295EN-J.pdf

3. **Rawindsonde**

The rawindsonde is an electronic tool used aloft to determine wind speed, strain, temperature, and humidity. It is also attached to a balloon and, as it rises through the atmosphere, it measures the required.

4. **Wind Finding Radar**

Through radar echoes it determines the speed and direction of winds aloft. A radar target is attached to a balloon and it is this target that the ground radar tracks. A receiver measures the bearing and the interval time of the echoes.

WF2 Wind Finding Radar. Australian Government, Bureau of Meteorology, Accessed June 15, 2020. http://www.bom.gov.au/qld/longreach/images/LR6.jpg

5. **Wind Surveillance Radar**

A Weather Surveillance Radar is of the long range type that detects and tracks typhoons and cloud masses 400 kilometers or less away. This radar has a rotating antenna disk preferably mounted from any physical obstruction on top of a building. The radar is a useful instrument for monitoring and tracking tropical cyclones.

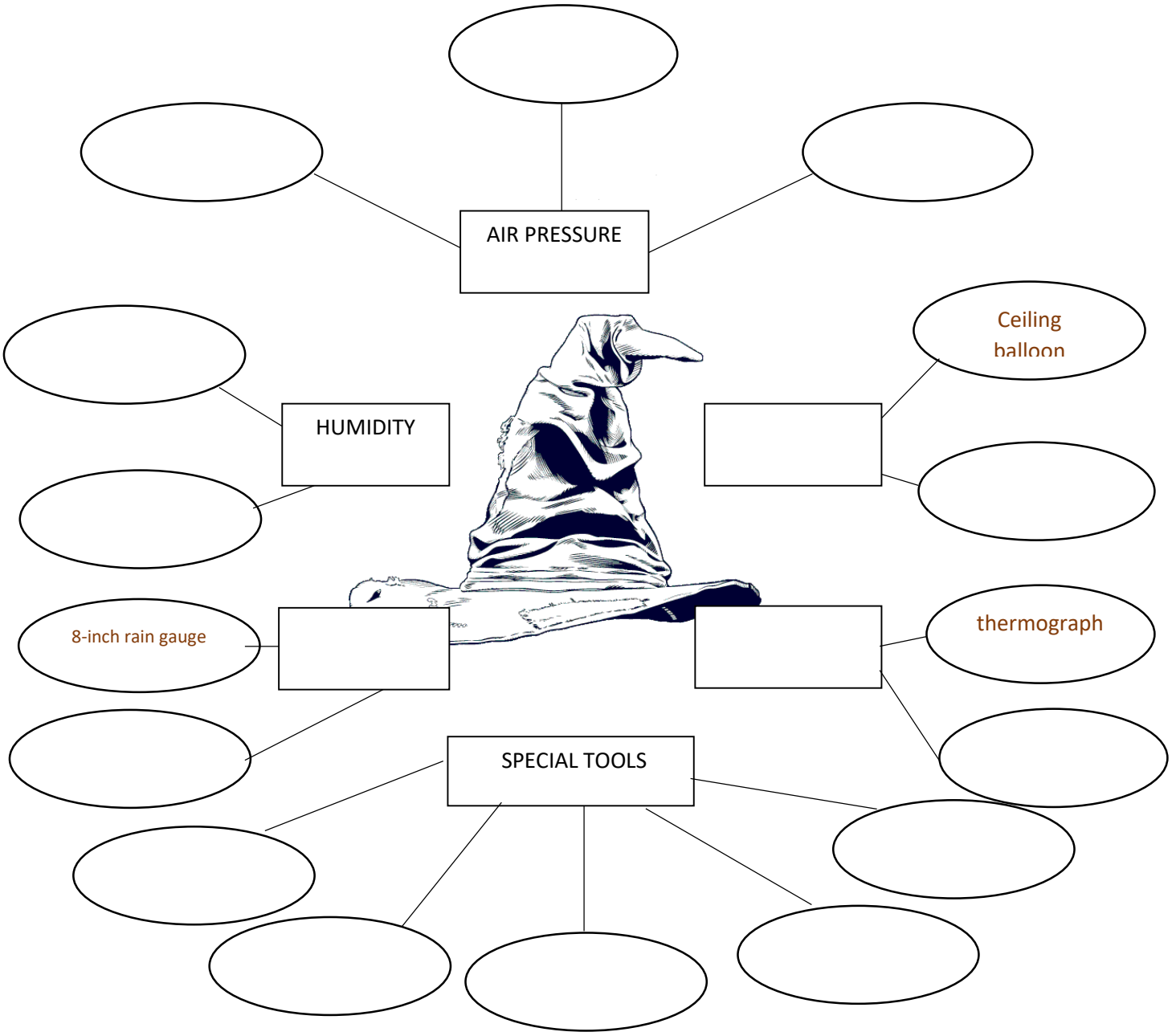
De Guzman, Rodolfo P. Doppler Radar and Synoptic Station in Iloilo. *DOST.gov.ph*, Published February 26, 2016, Accessed June 15, 2020. http://www.dost.gov.ph/knowledge-resources/news/45-2016-news/920-doppler-radar-and-synoptic-station-in-iloilo.html

What's More

Activity 1.1 TOOL SORTING HAT

Direction: Group the weather tools you have learned from this module by writing them inside this figure ⬭ and the physical quantities being measured by the tools inside this figure ▭

(Sorting Hat image accessed on June 15, 2020 at http://www.geocities.ws/harry0_0potter/quiz)



Activity 1.2 Mix-and-Match

Direction: Reveal the weather tools from the jumbled letters under column A. Write the formed words on the first space of column B. On the second space of column B, write the letter of the corresponding function of the tools from column C.

A	B	C
1. RYOHERMGET	_____ ___	a. describes wind speed only
2. RHOTEMEERT	_____ ___	b. determines wind speed and direction
3. NIAR UEGAG	_____ ___	c. determines height of cloud base
4. ROPHEMSCERYT	_____ ___	d. measures humidity (has human hair)
5. RAVELILCENUS DAARR	_____ ___	e. tracks and monitors typhoons
6. ECILIGN BOLLANO	_____ ___	f. measures temperature
7. DWIN FDIGNIN DAARR	_____ ___	g. determines precipitation
8. WDIN NEVA	_____ ___	h. measures air pressure
9. RERABOTEM	_____ ___	i. measures humidity (has bulbs)
10. MOTEMANER	_____ ___	j. tells wind direction only

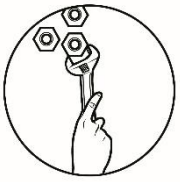
What I Have Learned

Direction: Fill in the blanks with the correct word/s to complete the statements.

1. _____ are hazards caused by extreme meteorological and climate events which can lead to loss of life, injury or other health impacts, property damage, loss of livelihood, social and economic disruption or environmental damage.
2. Tools used for measuring hydrometeorological hazards can be grouped according to their use.
   For measuring _____- thermometer, thermograph
   For measuring atmospheric pressure- _____, _____and _____.
   For measuring relative humidity- _____ and _____
   For determining _____- 8-inch rain gauge and tipping bucket rain gauge
   For determining height of cloud base-_____ and _____

Special tools- _____, _____, _____, _____ and _____

3. Weather tools are important for _____ of hydrometeorological risks.



What I Can Do

Hey, young scientist! If you were to invent a sophisticated weather tool, what would it be?

Realistic or a bit fictional, it is your choice!

Draw it on a piece of paper. Then, give its descriptions, purposes and features. Lastly, give it a name.

Assessment

Choose the letter of the best answer.

1. These weather tools are used for measuring relative humidity.
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   b. hygrometer and psychrometer
   c. rain gauge and radar
   d. wind vane and wind-finding radar

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    a. precipitation
    b. moisture
    c. relative Humidity
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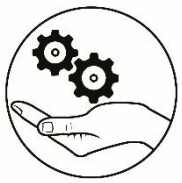
    c. wind finding radar and thermometer
    d. wind vane and thermometer



Additional Activities

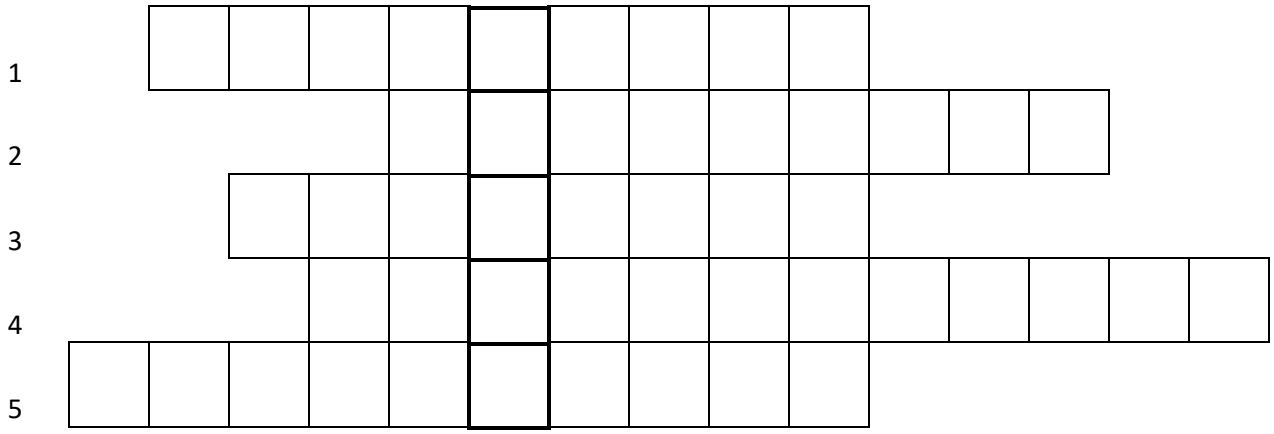
In life, we cannot always control what situation we will be in, but we can always choose how to respond.

Direction: Write your answers to questions 1 to 5 on the puzzle. Unveil the mystery word that will complete the quotation. Explain briefly the formed quotation.

"I cannot change the direction of the wind, but I can always adjust my _____ to reach my destination." -Jimmy Dean

Questions:

1. What term refers to how fast the wind is moving?
2. What instrument measures air pressure?
3. What term refers to the amount of moisture present in air?
4. What tool is used in conjunction with theodolite?
5. What special tool can determine pressure, temperature and relative humidity in the upper air?



Mystery word: _____

Brief explanation of the quotation:

_____
_____
_____
_____

Answer Key

What I Know

1. D
2. B
3. C
4. B
5. D
6. B
7. A
8. C
9. D
10. C
11. B
12. A
13. A
14. B
15. C

What's More

Activity 1.1

-Refer to **What's It**

Activity 1.2

1. Hygrometer D
2. Thermometer F
3. Rain gauge G
4. Psychrometer I
5. Surveillance radar E
6. Ceiling balloon C
7. Wind finding radar B
8. Wind vane J
9. Barometer H
10. Anemometer A

Assessment

1. B
2. A
3. A
4. D
5. D
6. B
7. C
8. D
9. C
10. B
11. A
12. B
13. C
14. B
15. C

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