Measuring Wind

CONTENT STANDARD: Earth and Space Science

CONTENT TOPIC: Meteorology

CONCEPT: Atmospheric conditions vary.

CONTENT OBJECTIVE: To understand wind and the effect of changing atmospheric conditions

INSTRUCTIONAL OBJECTIVES: The learner will:

- Discover how the wind is created
- Define air masses, how wind speed is measured, how winds move around the Earth.

OUTLINE OF CONTENT:

I. Conditions that change weather
II. Definitions
    A. Wind
    B. Trade winds, Easterlies, Westerlies, Doldrums
    C. Anemometer, Beaufort scale

GOAL: To enable students to acquire scientific knowledge by applying concepts, theories, principles and laws from earth science.

STANDARD(S): The learner will understand that:

Science is based upon suppositions derived from observations of natural phenomena.

BENCHMARK: Unknown or unobserved variables may lead to unanticipated results.

The critical assumptions behind any line of reasoning must be made explicit so that the validity of the position taken can be judged.

BENCHMARK: Prior learning must be accurate and free of incorrect assumptions.

The validity of an investigation cannot be accepted unless the complete investigation can be independently duplicated.

BENCHMARK: Scientific truths must be supported by data in conjunction with logical evaluations.

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CLASSROOM CONNECTORS

TIME REQUIRED: 30 minutes

MATERIALS: Anemometer: 5 three ounce Dixie Cups, 2 soda straws, pin, paper punch, scissors, stapler, sharp pencil with an eraser. Pinwheel: a sharpened pencil, scissors, construction paper, a paper fastener, a plastic drinking straw, crayons, colored pencils or markers.

SET:

Have the students stand up. "Wave your arms in the air. Feel the air and wind? How is the wind outside made?" (response: look for the sun, water, mountains, jungles, deserts, forests, etc) "Wind is air that is moving. It is made by the sun heating the surface of the Earth unevenly. Since the earth is made up of different types of land and water, it absorbs the suns energy unevenly. Two things are needed to identify wind: speed and direction. Today we will build a tool meteorologists use to measure wind called an **anemometer."**

INSTRUCTION:

Kinder and 1st: Emphasis on: The Sun creates all winds. As the sun heats up the air the warm air moves up and cold air moves down. The winds move from the equator to the North and South Poles, cool down and then move back towards the equator.

For older students: The region of Earth receiving the Sun's direct rays is the equator. Remember QUEST last year where we learned that hot air rises and cold air sinks? At the equator, air is heated and rises, leaving low pressure areas behind. As the air moves to about thirty degrees north and south of the equator (show a globe or map), the warm air from the equator begins to cool and sink. Between thirty degrees latitude and the equator, most of the cooling sinking air moves back to the equator. The rest of the air moves toward the poles. The air movements toward the equator are called **trade winds**- warm, steady breezes that blow almost continuously. As the Earth rotates (the Coriolis Effect) makes the trade winds appear to be curving to the west, whether they are traveling to the equator from the south or north.

The trade winds coming from the south and the north meet near the equator. These trade winds meeting produce upward winds as they are heated, so there are no steady surface winds. This area of calm is called the **doldrums**.

Between thirty and sixty degrees latitude (show them a globe or map), the winds that move toward the poles appear to curve to the east. Because winds are named from the direction in which they come from, these winds are called **prevailing westerlies**. Prevailing westerlies in the Northern Hemisphere are responsible for many of the weather movements across the United States and Canada.

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At about sixty degrees latitude in both hemispheres (show them a globe or map), the prevailing westerlies join with **polar easterlies** to reduce upward motion. The polar easterlies form when the atmosphere over the poles cools. This cool air then sinks and spreads over the surface. As the air moves away from the poles, it is turned to the west by the Earths rotation (coriolis effect). Again, because these winds begin in the east, they are called easterlies.

So, how do we measure the speed of the wind? Meteorologists use a tool called an **anemometer.** An **anemometer** is useful because it rotates with the wind.

For the older students: To calculate the speed (velocity) at which your anemometer spins, determine the number of revolutions per minute (RPM). Next, calculate the circumference (in feet) of the circle made by the rotating paper cups. Multiply your RPM value by the circumference of the circle and you will have an approximation of the velocity of at which your anemometer spins (in feet per minute). Your anemometer doesn't need to be pointed in the wind for use.

ACTIVE PARTICIPATION:

2nd thru 5th grades:

Let's build an anemometer!

1. Take four of the Dixie Cups and use the paper punch to **punch one hole** in each, about a half inch below the rim.
2. Take the fifth cup and **punch four** equally spaced holes about a quarter inch below the rim. Then punch a hole in the center of the bottom of the cup.
3. Take one of the four cups and push a soda straw through the hole. Fold the end of the straw and staple it to the side of the cup across from the hole. Repeat this procedure for another one-hole cup and the second straw.
4. Slide one cup and straw assembly through two opposite holes in the cup with four holes. Push another one-hole cup onto the end of the straw just pushed through the four-hole cup.
5. Bend the straw and staple it to the one-hole cup, making certain that the cup faces the opposite direction from the first cup. Repeat this procedure using the other cup and straw assembly and the remaining one-hole cup.
6. Align the four cups so that their open ends face in the same direction either clockwise or counter-clockwise around the center cup.
7. Push the straight pin through the two straws where they intersect.
8. Push the eraser end of the pencil through the bottom hole in the center cup. Push the pin into the end of the pencil eraser as far as it will go.
9. Now your anemometer is ready for use!

Kinder and 1st grades:

Make a pinwheel:

1. Decorate both sides of the construction paper pinwheel.
2. Cut the dotted lines from the four corners to the center circle. Try not to cut into the center circle.
3. Use the sharpened pencil to poke a hole through the four tiny dark circles. The pencil point also works well to poke a hole into the straw. Carefully push the pencil point through the straw about 1/2 inch from the top.
4. Make the tiny holes on the four points meet at the center circle.
5. Push the ends of the paper fastener through the holes on the pinwheel. Then push the fastener through the center circle.
6. Place the straw on the back side of your pinwheel and push the ends of the fastener through the hole in the straw. Open-up the fastener by flattening the ends in opposite directions.

CLOSURE:

- Can you name 5 things that the wind can make move?
- How does a hot air balloon work? (Air is heated by a gas flame below the balloon. The hot air inside is lighter or less dense than the cooler air outside the balloon. As the hot air rises, it carries the balloon upward. When the gas flame is turned down, the air cools and the balloon sinks back to the ground.) Have the students draw a picture of a hot air balloon in their journal.
- What other examples can students think of that demonstrate the concept of heating of air and the wind? Have students note additional examples in journals.

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Beaufort Scale

The Beaufort scale is a measure for the intensity of the weather based on wind power. The scale uses the numbers 1 through 12, with 12 being the strongest winds. The scale was created by the British naval commander Sir Francis Beaufort around 1806.

Beaufort number	Wind speed MPH	Wind Speed Knots	Description	Sea conditions	Land conditions
0	<1	<1	Calm	Flat	Calm
1	1-3	1-3	Light air	Ripples without crests	Wind motion visible in smoke
2	4-7	4-6	Light breeze	Small wavelets	Leaves rustle
3	8-12	7-10	Gentle breeze	Large wavelets	Smaller twigs in constant motion
4	13-18	11-16	Moderate breeze	Small waves	Small branches begin to move
5	19-24	17-21	Fresh breeze	Moderate longer waves	Smaller trees sway
6	25-31	22-27	Strong breeze	Large waves with foam crests	Large branches in motion
7	32-38	28-33	Near gale	Sea heaps up and foam begins to streak	Whole trees in motion
8	39-46	34-40	Gale	Moderately high waves with breaking crests	Twigs broken from trees
9	47-54	41-47	Severe gale	High waves with dense foam	Light structure damage
10	55-63	48-55	Storm	Very high waves. The sea surface is white	Trees uprooted. Considerable structural damage
11	64-72	56-63	Violent storm	Exceptionally high waves	Widespread structural damage
12	73-82	64-71	Hurricane	Sea completely white with driving spray.	Massive and widespread damage to structure