Wind Anemometer Activity: Teacher Worksheet

Target Age: Junior and Senior Secondary School (Ages 12-18)

Subject: Geography and Mathematics

Duration: 1 hour

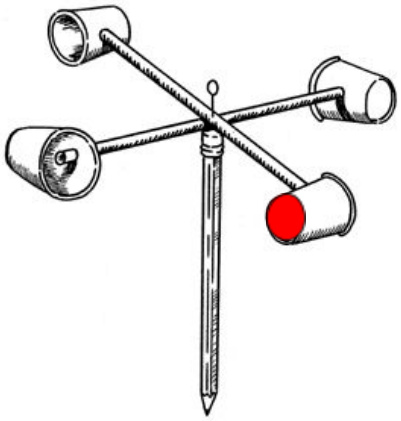
Learning Goals:

- Define an anemometer as an instrument used to measure wind speed
- Calculate the wind speed outside using the cup anemometer
- Compare the calculated wind speed to wind speed from the TAHMO station

Materials:

Each group will need

- pencil with eraser (1)
- push pin (1)
- Flexible straws (2)
- tape or stapler
- Small paper or plastic cups (4)
- Timer or clock (1)



Methods:

1. Working in teams of two, build a cup anemometer. Be sure that all of the cups face the same direction when assembled. You may need to tape or staple the straws together to keep them fixed at right angles. Fix the straws to the pencil eraser using the push pin, but make sure the straws can still rotate when the pencil is held still.
2. Mark one cup with a red dot or other mark, you can use this cup as a reference point when counting the rotations in the next step.
3. Go outside in a clear spot, preferably close to the TAHMO weather station. Holding your anemometer in the air, start the timer and count the number of revolutions. Record the time and number of anemometer rotations.
4. Perform the calculations below to compare the velocity from the anemometer to the velocity from the weather station

Calculations:

We measured the number of revolutions of our anemometer. To calculate the angular velocity, we divide the number of rotations by the time. The angular velocity describes the speed at which a circle is spinning.

# Rotations	/	Time (seconds)	=	Angular velocity (rotations/second)
_____	/	_____	=	_____

Now that we have angular velocity, we want to convert it into linear velocities. The speed we drive our cars or walk are both linear velocities. To convert from angular velocity (revolutions per second) to linear velocity (radians per second) we need to use to conversion 1 revolution = $2*\pi$ radian ≈ 6.28 radians. A revolution is when the cup completes a circle, traveling 360 degrees, or 2π radians. We now have the angular velocity in rad/sec, to calculate linear velocity we multiply the radius of the wind anemometer by the angular velocity.

Angular velocity (rotations/second)	*	Conversion from (rev/s) to (rad/s)	*	Anemometer radius (meters)	=	Linear velocity (meters/second)
_____	*	$2 * \pi$	*	_____	=	_____

To find the average linear velocity of the wind using the cup anemometer, simply add the three calculated linear velocities and divide by 3.

Results:

Trial #	Time (s)	Revolutions	Linear velocity (m/s)
1			
2			
3			
Average	----------	----------	

Discussion:

In a weather station, which meteorological variable does an anemometer measure?

What is the recorded wind speed from the TAHMO weather station from the same time that the cup anemometers were tested outside?

How does this value compare to the calculated linear velocity from the wind anemometer? What is the percent error between the two values? Hint: % error= (TAHMO wind speed - average linear velocity from the table above)/(TAHMO wind speed).

What errors are involved with measuring velocity with an anemometer?