Teacher Survey

Instructions: Please complete the following evaluation.

1. Did you make any adjustments to the learning module? If so, what did you change or omit?

2. From your observations, are the students more interested in atmospheric science?

3. What part of the lesson was most effective or interesting to them?

4. What concept did the students have most trouble understanding or applying?

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Student Survey

Please distribute this survey to the students before and after completing the module.

Instructions: Circle the answer that best describes your feelings about science.

1. I like science.
    a. I strongly disagree.
    b. I disagree.
    c. I am indifferent or unsure.
    d. I agree.
    e. I strongly agree.

2. How often do you talk to your *family* about what you do in science class?
    a. Never
    b. Rarely (less than once a week)
    c. Once a week
    d. A few times a week
    e. Every day

3. How often do you talk to your *friends* about what you do in science class?
    a. Never
    b. Rarely (less than once a week)
    c. Once a week
    d. A few times a week
    e. Every day

4. I think science will be useful when I am older.
    a. I strongly disagree.
    b. I disagree.
    c. I am indifferent or unsure.
    d. I agree.
    e. I strongly agree.

5. I would like to be a scientist when I am older.
    a. I strongly disagree.
    b. I disagree.
    c. I am indifferent or unsure.
    d. I agree.
    e. I strongly agree.

Effectiveness Assessment

Part 1: Pre and Post Assessment (Student Evaluation)

Instructions: Please distribute and score the **Student Evaluation** for each student before and after completing the module. Each question is worth 1 point.

Student Evaluation

Instructions: After completing the lesson on blizzards, please have the students answer the following questions below.

1. Which of the following is not a condition necessary for the issuing of a blizzard warning?
    a. Visibility ≤ ¼ mile
    b. Wind speeds ≥ 35 mph
    c. Wind chill temperatures ≤ 32°F
    d. Falling or blowing snow
    e. Blizzard conditions lasting at least 3 consecutive hours

2. Why are the Rocky Mountains important for blizzard formation?
    a. The high elevation of the Rockies provides the cold air necessary for snow.
    b. The Rockies help to guide cold air southward from Canada.
    c. The Rockies allow air to rise to get sufficient cloud formation.
    d. The Rockies cause warm, moist air from the Pacific Ocean to rise over the mountain range and form clouds.

3. Which of the following is not true about Canadian air masses?
    a. Canadian air masses are very cold because the ground cools very efficiently.
    b. Canadian air masses are very cold because of the snow cover in place year-round in Canada.
    c. Canadian air masses are very cold in winter because of the low sun angle.
    d. Canadian air masses are very cold because the short daylight hours
    e. Canadian air masses are very cold because of Canada's high latitude.

4. Wind chill is defined as
    a. the temperature when the wind speed exceeds 35 mph.
    b. how cold it feels to a human when the temperature and winds work together to cool your body more efficiently.
    c. the temperature at which frostbite occurs within 30 minutes.
    d. the change in temperature when a blizzard occurs.

5. Which of the following is <u>not</u> true about low pressure systems?
    a. Winds spiral inward and in a clockwise direction around a low pressure.
    b. Low pressure systems contain a wrap around region.
    c. The coldest air is found northwest of the center of the low pressure system.
    d. Wintertime low pressure systems only produce snow, sleet, and freezing rain.

6. Where is the wrap around region located relative to the center of a low-pressure system?
    a. Southwest of the low
    b. South of the low
    c. East of the low
    d. Northwest of the low

7. What is the deadliest part of a blizzard?
    a. Heavy snowfall
    b. Power outages
    c. Frostbite due to extreme wind chill temperatures
    d. Flooding after a blizzard

8. Where is the U.S. are blizzards most frequent?
    a. The Midwest
    b. Colorado, specifically in the Rocky Mountains
    c. North and South Dakota
    d. New England
    e. The Great Plains
    f. Illinois, Wisconsin, and Minnesota

9. As we have learned, the human body loses heat more efficiently as wind speed increases and temperature decreases. This can often cause frostbite or hypothermia to occur. What is the difference between frostbite and hypothermia?

10. The current temperature is 10^{o}F and the wind speed is 25 mph at sunset. Overnight, the temperature drops by 10^{o}F, but the wind speed remains constant. How much did the wind chill temperature change from sunset to sunrise?

    $WC_{sunset} = -11\ ^{o}F$ $WC_{sunset} = -24^{o}F$

    a. $\Delta WC = 4\ ^{o}F$
    b. $\Delta WC = 20\ ^{o}F$
    c. $\Delta WC = 13\ ^{o}F$
    d. $\Delta WC = 35\ ^{o}F$

Part 2: Math & Science Proficiency (Take Home Assignment: Part 1)

Please score **Take Home Assignment**: **Part 1** for each student using the rubric below. This problem is aligned with the following academic standards:

NGSS.MS-PS3-4
MS-PS3-4. Energy: Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles measured by the temperature of the sample.

CCSS.MATH.CONTENT.7.G.B.6
Grade 7: Geometry: Solve real-world and mathematical problems involving area, volume, and surface area of two and three-dimensional objects composed of triangles, quadrilaterals, polygons, *cubes*, and right prisms.

Scoring Rubric

Questions	Score (0 – 3)
Did the student demonstrate knowledge in converting snowfall to liquid water (Q1)?	
Did the student demonstrate knowledge in calculating a volume of water (Q2)?	
Did the student demonstrate knowledge of the potential impacts associated with a blizzard (Q3)?	
Did the student include the correct units in each calculation (Q1 & Q2)?	
Did the student demonstrate understanding of the factors that affect the volume of different phases of water (Q6)?	

0 – Incomplete
1 – Completed with incorrect answer
2 – Complete with small errors
3 – Complete with correct answer

Take Home Assignment: Part 1. Snowfall Measurements

As we learned in the 'Water on Earth' module, liquid water is more dense than ice/snow. The amount of air snowflakes contain directly affects their density and volume (the amount of space it takes up, or how fluffy the snow is). When snow melts, the trapped air is released and thus, the volume of snow is greater than the volume of the liquid water it forms when it is melted. So, how does the volume of snow compare to the volume of liquid water that the melted snow forms?

Instructions: After the Chicago 1967 Blizzard, the National Weather Service confirmed the snowfall accumulation to be 20 inches. For several reasons, the amount of snowfall can be very difficult to figure out how much snow actually fell. A rule of thumb is that every 10 inches of snow is equivalent to approximately 1 inch of liquid water, but this can vary greatly.

1. If all of the snow that fell during the Chicago 1967 Blizzard melted, how much many inches of liquid water (L) would you expect there to be? (Remember the rule of thumb).

2. Using your answer from #1, calculate the total volume of liquid water over the city of Chicago. You may assume the area of the city is 234 miles^2. Assume the volume of a cube for this calculation. (This would be used to determine potential flooding after a large snowstorm, especially in places like Chicago that have a river and lake within close proximity.)

   Step 1: Convert the area of the city from mi^2 to in^2 (1 mile = 63,360 inches).

   Step 2: Calculate the volume (multiply the snow accumulation by the area).

   Step 3: Convert the volume from in^3 to ft^3

3. From your calculation, what potential impacts would this have for the city of Chicago?

4. Using an online search engine, determine how the National Weather Service measures snowfall. Make a list of steps that they use to ensure accuracy.

5. What are some uncertainties associated with this method? Think about the environmental factors and what the snow does when it piles up on the ground.

6. Explain one major factor that might affect the 10:1 ratio of snow to liquid water?