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 tornadoes, please have the students answer the following questions below.

1. Which type of tornado is most frequent?
    a. Weak
    b. Strong
    c. Violent

2. What is the average warning time once a tornado has been spotted?
    a. 1 minute
    b. 5 minutes
    c. 13 minutes
    d. 30 minutes
    e. 2 hours

3. What is the number one killer associated with tornadoes?
    a. Fast winds
    b. Hail
    c. Flying debris
    d. Insufficient warning time

4. What is the name of the scale that characterizes tornado intensity?
    a. Saffir-Simpson Scale
    b. Rotation Scale
    c. Destruction Scale
    d. Barometer Scale
    e. Enhanced Fujita Scale

5. Where is Tornado Alley located?
    a. Coastal regions
    b. The Great Plains
    c. Texas
    d. Southwest U.S.

6. Wind shear is
    a. a change in wind speed with altitude.
    b. a change in wind direction with altitude.
    c. the most crucial ingredient for tornado formation.
    d. the most crucial ingredient for supercell thunderstorm formation.
    e. all of the above

7. What instrument is used to detect potential tornadoes?
    a. Satellite
    b. Barometer
    c. Doppler radar
    d. Anemometer
    e. Thermometer

8. On average, approximately how many tornadoes are reported in the U.S. each year?
    a. 50
    b. 100
    c. 250
    d. 1,000
    e. 2,500

9. Tornadoes form most often in rotating supercell thunderstorms. Briefly explain how they begin rotating. Draw a picture to help describe the process.

10. A tornado that is 2.1 miles wide remains on the ground for 12 minutes. The path of destruction, such as the one in the picture below, lasted 4.8 miles. What is the <u>area</u> of destruction for this particular tornado?

    a. 2.1 sq. miles
    b. 2.3 sq. miles
    c. 4.8 sq. miles
    d. 10.1 sq. miles

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

Please score **Take Home Assignment**: **Part 2** for each student using the rubric below. This problem is aligned with the following academic standard:

NGSS.MS-PS1-5
MS-PS1-5. Chemical Reactions (Crosscutting Concept: Energy and Matter): Matter is conserved because atoms are conserved in physical and chemical processes.

CCSS.MATH.CONTENT.7.RP.A.1
Grade 7: Ratios and Proportional Relationships: Analyze proportional relationships and use them to solve real-world and mathematical problems.

Scoring Rubric

Questions	Score (0 – 3)
Did the student demonstrate knowledge in calculating average speed (Q1)?	
Did the student demonstrate understanding of what it means for a property to be conserved (Q2)?	
Did the student properly calculate the velocity at the surface (Q2)?	
Did the student include the correct units in each step (Q1 & Q2)?	
Did the student demonstrate knowledge of relating the wind speed to the intensity of a tornado using the Enhanced Fujita scale (Q3)?	
Was the student able to properly identify features on a radar image and determine the location of a tornado (Q4)?	

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

Take Home Activity: Part 2. El Reno and Moore Tornadoes (2013)

The infamous Moore and El Reno tornadoes occurred in Oklahoma less than 2 weeks apart in May 2013. Using information about these two devastating events, answer the following questions.

The Moore tornado was estimated to be 1.1 miles wide at the ground and remained in contact with the ground for 14 miles (approximately 39 minutes).

The El Reno tornado was 2.6 miles wide and touched down for 16 miles (approximately 44 minutes). Maximum wind speeds exceeded 200 mph.

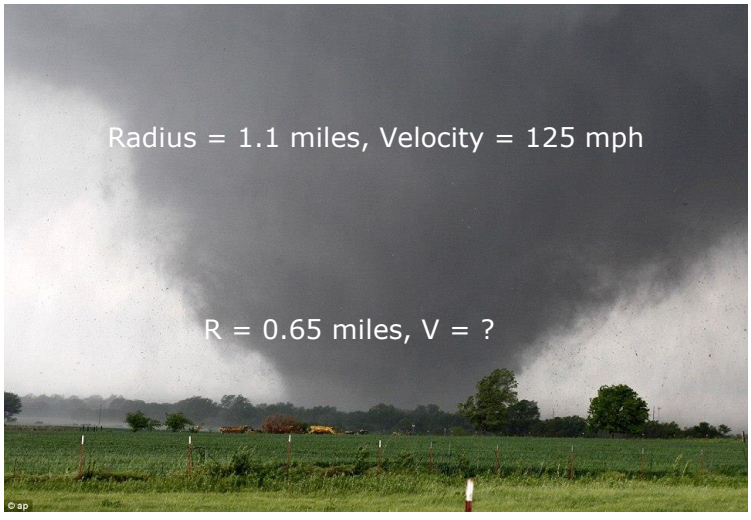
1. From the information given above, calculate the average speed of these two tornadoes in miles per hour.

Moore _____ El Reno _____

Recall, rotating objects and specifically tornadoes follow a principle called "conservation of momentum." The conservation of momentum is defined as

$$(M \times R_1 \times V_1) = (M \times R_2 \times V_2)$$

where M is the angular momentum (conserved, or constant), V is the rotational speed, and R is the radius of the tornado.



2. Using the conservation of angular momentum equation, estimate the wind speed at the surface (V_1) in the Moore tornado.

   At the surface, R_1 = 0.65 miles
   At some height above the surface, R_2 = 1.1 miles and V_2 = 125 mph

   V_1 = _____

3. Solely based on wind speed, which category (EF-Scale) would the Moore and El Reno tornadoes fall into?

   Moore _____

   El Reno _____

4. What two features do you notice in the Doppler radar image below? Which of those two indicate a tornado?