How Effective is Perspiration at Cooling?

Task Information

Subject: Biology

Content:

- Biology Syllabus - Unit III
- MST Framework Reference; Standard 4 - Science - The living Environment

Format: Manipulative

Purpose: To collect and analyze data on cooling effect of perspiration/evaporation

Skills:

Primary: Measuring, recording data, graphing
Secondary: Interpreting data, generalizing/inferring

Time: 25-30 minutes

Materials:

- 2 test tubes
- test tube rack - clear container to hold test tubes upright
- newspaper - cut into strips the same length as the test tubes
- hot water - in Styrofoam or insulated cups
- thermometers - to fit in the test tubes
- 4 rubber bands
- eye dropper
- funnel

Preparations:

- 25 - 30 minutes preparation time for teacher to set up required stations and heat H_2O to 32° C.

Safety: Students need to be advised on the use of hot H_2O.

Extensions/Modifications: None

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How Effective is Perspiration at Cooling?

Task: At this station you will collect and analyze data on a model of the perspiration process.

Materials:

- test tubes
- hot water in styrofoam cups
- timer or clock
- eye dropper
- paper towels
- test tube rack
- room temperature water
- thermometer
- 4 rubber bands
- funnel

Background:

You know that when you get hot you perspire. This is your body's way of maintaining normal body temperature. But how effective is perspiring in doing this?

Directions:

1. Examine the apparatus at this station.
2. Place the test tube rack on a paper towel. Prepare your test tubes by wrapping each one with a strip of newspaper. Use two rubber bands to hold the paper on the test tubes.
3. Quickly fill both test tubes with hot water. Taking care not to spill any on the newspaper.
4. Place one thermometer in each test tube. Record the starting temperature for each test tube on the data table. In the next step one (1) test tube will become the wet test tube and one (1) will remain dry.
5. Use the eye dropper to quickly wet the newspaper of one (1) of the test tubes with hot water. The newspaper on the test tube should be completely saturated.
6. Measure and record the water temperature in each test tube at intervals of one minute for the next twelve (12) minutes.
7. Make a line graph of your data and answer questions 3 - 9.

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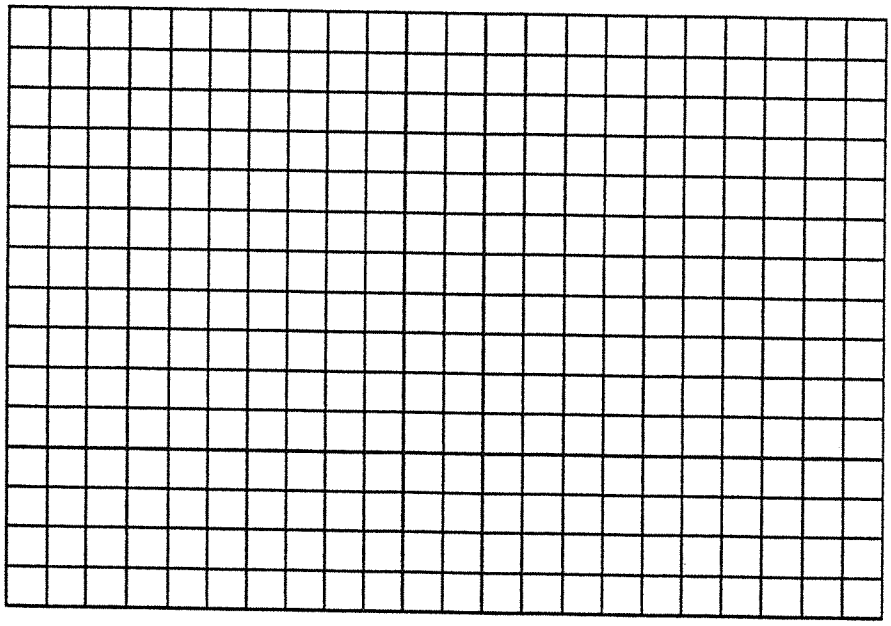
1. Record your data in the data table below.

Cooling Rates of Wet and Dry Tubes

MINUTES	TEMPERATURE °C	
	Wet Tube	Dry Tube
0		
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		

2. Plot your data on the graph below.



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3. From your table, what was the temperature of the water at 6 minutes?

   In the dry tube? _____ In the wet tube? _____

4. From your graph, what was the temperature of the water at 9.5 minutes?

   in the dry tube? _____ In the wet tube? _____

5. Use your graph to predict what the temperature would be in the dry tube after 15 minutes.

   _____

   Using complete sentences, suggest an explanation for your prediction.

   _____

   _____

   _____

6. Using complete sentences, describe and compare the cooling patterns in the test tubes.

   _____

   _____

   _____

7. Using complete sentences, explain what causes the difference in water temperature between the water in the two tubes.

   _____

   _____

   _____

8. Using complete sentences, describe what comparison you could make between the effect of perspiration on the skin of the human body and the newspaper on the wet test tube. Relate your answer to body temperature control.

   _____

   _____

   _____

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How Effective Is Perspiration At Cooling? - Scoring Rubric

Maximum score - 23 points

1. Data Table — 2 points total

Allow 1 point for each of the following;

- Table completed
- Data consistent with expectation of results

2. Graph — 5 points total

Allow 1 point for each of the following;

- Appropriate title
- Axes labeled w/ correct variables (units included)
- Appropriate scale
- Points plotted accurately
- Curves are appropriate to data trend

3. Data transfer from table — 2 points total

Allow 1 point for each of the following;

- Correct 6 minute dry tube reading based on data collected
- Correct 6 minute wet tube reading based on data collected

4. Graph Interpretation/Prediction — 2 points total

Allow 1 point for each of the following;

- Corresponds to student's dry tube graph at 9.5 minutes
- Corresponds to student's wet tube graph at 9.5 minutes

5. Extrapolation Prediction — 3 points total

- Allow 1 point for correct temperature prediction based on student's graph/data.
- Allow 2 points if the explanation refers to extrapolation from graph or data and is in complete sentences.
- Allow 1 point if the explanation refers to extrapolation from graph or data and is not in complete sentences.
- Allow 0 points if explanation is not correct even if it is in complete sentences.

6. Data Interpretation/Comparison — 4 points total

Allow 1 point for each of the following;

- States pattern for dry tube readings
- States pattern for wet tube readings
- States relationship/comparison
- Correct statement or statements and all in complete sentences

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7. Data Explanation — 2 points total

Allow 2 points if the explanation is correct and in complete sentences.

Allow 1 point if the explanation is correct, but not in complete sentences.

Allow 0 points if the explanation is incorrect even if it is in complete sentences.

Correct statements may include:

- The wet tube is cooled by evaporation.

OR

- Heat energy is removed more quickly from water in wet tube.

OR

- The dry tube temperature is maintained by better insulation.

8. Comparison — 3 points total

Allow 1 point for each of the following;

- States correct comparison between wet paper towel and perspiration on human skin
- Relates to process/role of evaporation to cooling/heat loss
- Correct statement or statements and all in complete sentences

Allow 0 points if the explanation is incorrect even if it is in complete sentences.

Highest possible score - 23 points

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Student ID _____ **Scoring Form**

Male / Female (circle one) **How Effective is Perspiration At Cooling?**

Circle the student's score for each question. Add the points for each question and write the total score at the bottom of the scoring form.

1. Data table	0	1	2			
2. Graph	0	1	2	3	4	5
3. Data transfer from table	0	1	2			
4. Graph interpretation	0	1	2			
5. Data prediction	0	1				
Data explanation	0	1	2			
6. Data interpretation / comparison	0	1	2	3	4	
7. Data explanation	0	1	2			
8. Comparison	0	1	2	3		

Total Score _____

Total possible score - 23 points

Student ID _____ **Scoring Form**

Male / Female (circle one) **How Effective is Perspiration At Cooling?**

Circle the student's score for each question. Add the points for each question and write the total score at the bottom of the scoring form.

1. Data table	0	1	2			
2. Graph	0	1	2	3	4	5
3. Data transfer from table	0	1	2			
4. Graph interpretation	0	1	2			
5. Data prediction	0	1				
Data explanation	0	1	2			
6. Data interpretation / comparison	0	1	2	3	4	
7. Data explanation	0	1	2			
8. Comparison	0	1	2	3		

Total Score _____

Total possible score - 23 points

Student ID BIO-EP-1 **Scoring Form**

Male / Female (circle one) **How Effective is Perspiration At Cooling?**

Circle the student's score for each question. Add the points for each question and write the total score at the bottom of the scoring form.

1. Data table	0	1	(2)			
2. Graph	0	1	2	3	4	(5)
3. Data transfer from table	0	1	(2)			
4. Graph interpretation	0	1	(2)			
5. Data prediction	0	(1)				
Data explanation	0	1	(2)			
6. Data interpretation / comparison	0	1	2	3	(4)	
7. Data explanation	0	1	(2)			
8. Comparison	0	1	2	(3)		

Total Score 23 pts

Total possible score - 23 points

Student ID BIO-EP-2 **Scoring Form**

Male / Female (circle one) **How Effective is Perspiration At Cooling?**

Circle the student's score for each question. Add the points for each question and write the total score at the bottom of the scoring form.

1. Data table	0	1	(2)			
2. Graph	0	1	2	(3)	4	5
3. Data transfer from table	0	1	(2)			
4. Graph interpretation	0	1	(2)			
5. Data prediction	(0)	1				
Data explanation	(0)	1	2			
6. Data interpretation / comparison	0	1	2	3	(4)	
7. Data explanation	0	1	(2)			
8. Comparison	0	1	2	(3)		

Total Score 18 pts

Total possible score - 23 points

Student ID BIO - EP - 3 **Scoring Form**

Male / Female (circle one) **How Effective is Perspiration At Cooling?**

Circle the student's score for each question. Add the points for each question and write the total score at the bottom of the scoring form.

1. Data table	0	(1)	2			
2. Graph	0	1	2	(3)	4	5
3. Data transfer from table	(0)	1	2			
4. Graph interpretation	0	(1)	2			
5. Data prediction	(0)	1				
Data explanation	(0)	1	2			
6. Data interpretation / comparison	0	(1)	2	3	4	
7. Data explanation	(0)	1	2			
8. Comparison	(0)	1	2	3		

Total Score 6 pts

Total possible score - 23 points

Student ID _____ **Scoring Form**

Male / Female (circle one) **How Effective is Perspiration At Cooling?**

Circle the student's score for each question. Add the points for each question and write the total score at the bottom of the scoring form.

1. Data table	0	1	2			
2. Graph	0	1	2	3	4	5
3. Data transfer from table	0	1	2			
4. Graph interpretation	0	1	2			
5. Data prediction	0	1				
Data explanation	0	1	2			
6. Data interpretation / comparison	0	1	2	3	4	
7. Data explanation	0	1	2			
8. Comparison	0	1	2	3		

Total Score _____

Total possible score - 23 points

Bio - EP- 1

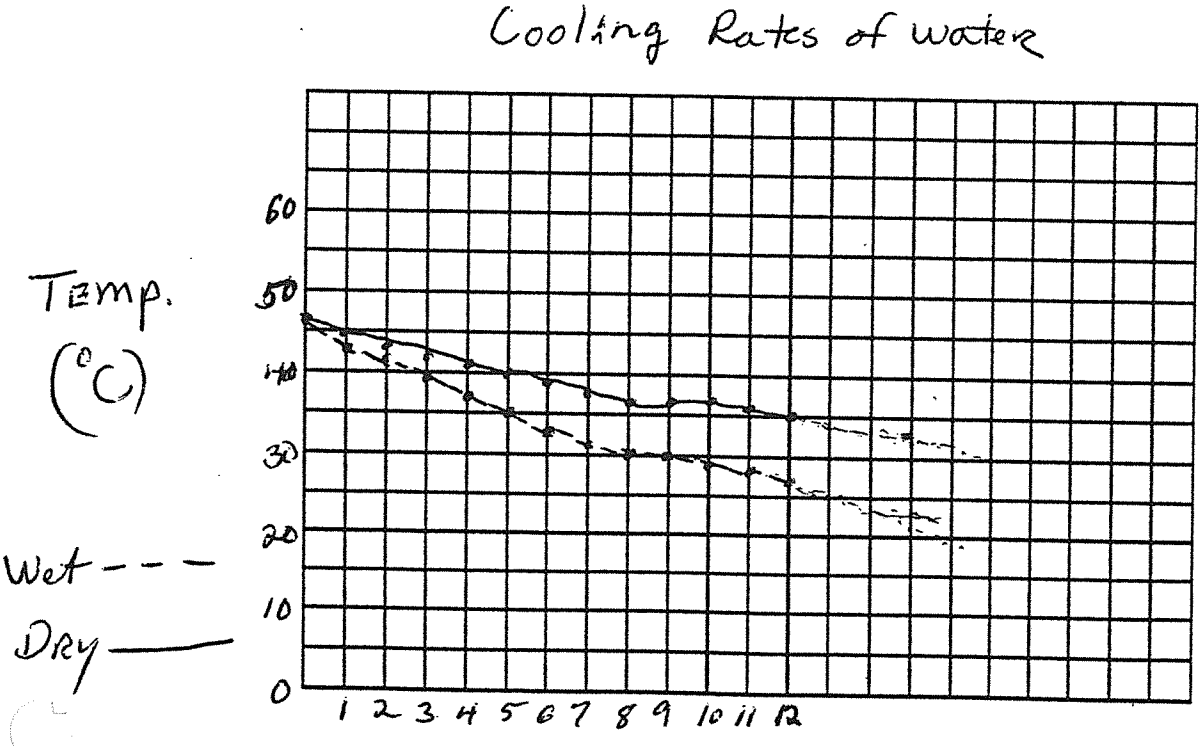
1. Record your data in the data table below.

Cooling Rates of Wet and Dry Tubes

MINUTES	TEMPERATURE °C	
	Wet Tube	Dry Tube
0	46	46
1	43	45
2	42	43
3	39	42
4	37	41
5	35	40
6	33	39
7	32	38
8	30	37
9	30	37
10	29	37
11	28	36
12	27	35

23/23

2. Plot your data on the graph below.



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Bio - EP- 1

1. Record your data in the data table below.

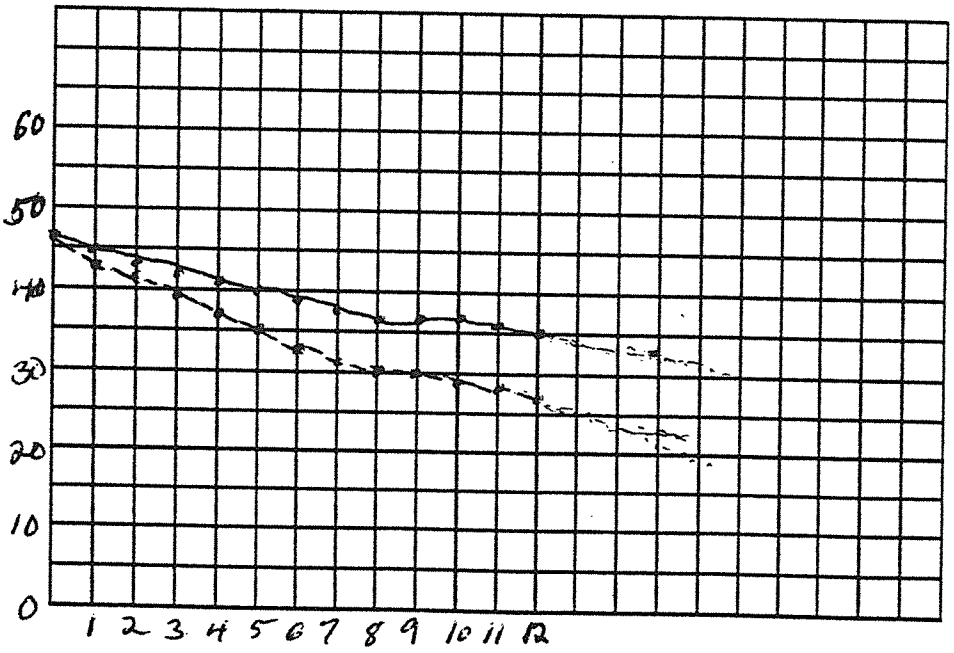
Cooling Rates of Wet and Dry Tubes

MINUTES	TEMPERATURE °C	
	Wet Tube	Dry Tube
0	46	46
1	43	45
2	42	43
3	39	42
4	37	41
5	35	40
6	33	39
7	32	38
8	30	37
9	30	37
10	29	37
11	28	36
12	27	35

23/23

2. Plot your data on the graph below.

Cooling Rates of water



Temp. (°C)

Wet - - -

Dry ——

Time (min)

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BIO - EP - 2

3. From your table, what was the temperature of the water at 6 minutes?

   In the dry tube? 40°C In the wet tube? 35°C

4. From your table, what was the temperature of the water at 9.5 minutes?

   in the dry tube? 39°C In the wet tube? 30.5°C

5. Predict what the temperature would be in the dry tube after 15 minutes.

   32

   Using complete sentences, suggest an explanation for your prediction.

   Since the temperature is going down, it will probably keep on going down.

6. Using complete sentences, describe and compare the cooling patterns in the test tubes.

   The wet tube cooled faster than the dry tube. The difference between them was about 5 degrees. Both go down faster at the start.

7. Using complete sentences, explain what causes the difference in water temperature between the water in the two tubes.

   The difference is caused by the wet paper. This acted as a cooling agent.

8. Using complete sentences, describe what comparison you could make between the effect of perspiration on the skin of the human body and the newspaper on the wet test tube. Relate your answer to body temperature control.

   The wet newspaper acts as perspiration on the skin. The wetnewspaper cools the tube just like perspiration cools the skin

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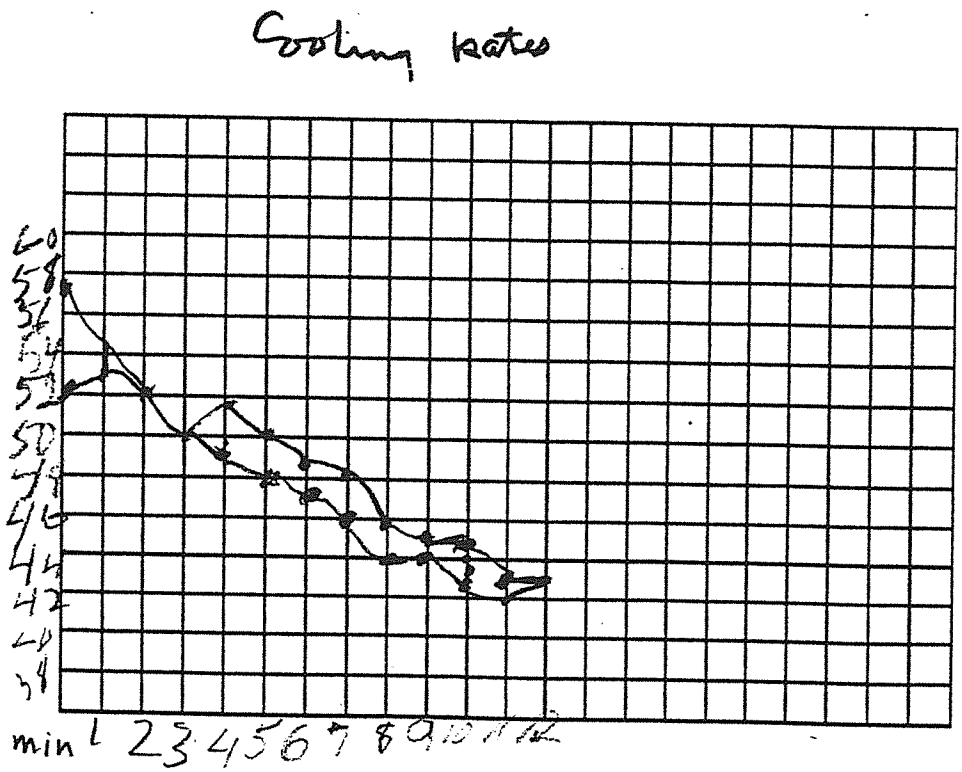
1. Record your data in the data table below.

Cooling Rates of Wet and Dry Tubes

MINUTES	TEMPERATURE °C	
	Wet Tube	Dry Tube
0	52	57
1	53	54
2	52	52
3	50	50
4	49	52
5	48	50
6	47	49
7	46	48
8	44	47
9	44	46
10	43	45
11	42	43
12	43	43

2. Plot your data on the graph below.



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BIO-EP-3

3. From your table, what was the temperature of the water at 6 minutes?

   In the dry tube? 47 In the wet tube? 49

4. From your table, what was the temperature of the water at 9.5 minutes?

   in the dry tube? 46.5 In the wet tube? 43.5

5. Predict what the temperature would be in the dry tube after 15 minutes.

   About 35

   Using complete sentences, suggest an explanation for your prediction.

   It has to go down

6. Using complete sentences, describe and compare the cooling patterns in the test tubes.

   As the tubes sits the temperatures will keep going slowly down Like they are doing now till they hit room Temperature.

7. Using complete sentences, explain what causes the difference in water temperature between the water in the two tubes.

   It is because one of them is wet.

8. Using complete sentences, describe what comparison you could make between the effect of perspiration on the skin of the human body and the newspaper on the wet test tube. Relate your answer to body temperature control.

   As the cooler the Temperature gets the cooler the wet or Testtube gets and as the hotter or warmer the the Temperature is the warmer the Testtube or body gets.

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