Georgia Performance Standards

6th Grade Earth Science

The task

Students designed and constructed a device to collect and measure rainwater. They recorded rainfall amounts and also tested samples of rain with pH paper over a three-month period, and compared their data with regional data collected by the National Weather Service.

Circumstances of performance

This sample of student work was produced in class and for homework, with teacher feedback, in a group, with an opportunity for revision.

What the work shows

Characteristics of Science

SCSm3. Students will be able to use tools and instruments for observing, measuring, and manipulating objects in scientific activities.

a. Use computers to store and retrieve scientific information in topical, alphabetical, numerical, and keyword files, and create simple files.

SCSm5. Students will be able to communicate scientific ideas and activities clearly.

b. Write clear, step-by-step instructions for conducting scientific investigations, operating something, or following a procedure.

c. Understand and describe writing for scientific purposes that incorporates circle charts, bar and line graphs, two-way data tables, diagrams, and symbols.

d. Organize scientific information in simple tables and graphs, and identify relationships they reveal.

SCSm6. Students will be able to question scientific claims and arguments effectively.

a. Identify the flaws of reasoning in arguments in which (1) fact and opinion are intermingled or the conclusions do not follow logically from the evidence given, (2) an analogy is not apt, (3) no mention is made of whether the control groups are very much like the experimental group, or (4) all members of a group (such as teenagers or chemists) are implied to have nearly identical characteristics that differ from those of other groups.

SCSm9. Students will understand important features of the process of scientific inquiry.

b. Investigations are conducted for different reasons, which include exploring new phenomena, checking on previous results, testing how well a theory predicts, and comparing different theories. Scientific investigations usually involve collecting evidence, reasoning, devising hypotheses, and creating explanations to make sense of the collected evidence.

c. When designing investigations and examining data, scientists are aware that their expectations can affect both what they observe and what they miss. To prevent this type of bias, the scientific enterprise uses such strategies as having different investigators conduct independent studies of the same questions.

d. Accurate record keeping, data sharing, and replication of results are essential for maintaining an investigator's credibility with other scientists and society.

e. Computers are valuable scientific instruments because they speed up and extend people's ability to collect, store, compile, and analyze data, prepare research reports, and share data and ideas with investigators all over the world. Science is often stimulated by developments in technology and mathematics to address old questions in new ways.

A B C D E F The students gathered data from classmates and web sites on the Internet. They compared their data and the class data to the experts data to verify their conclusions.

N Students designed a simple device to collect and measure rainfall. They used tools such as a ruler to measure rainfall in inches, and a graduated cylinder to measure sample volume in milliliters.

M O The students used indicators to test samples of rain. They observed that the pH of the samples caused chemical reactions that produced color changes in pH paper, and they correctly concluded that the rain samples were acidic.

A D E M The students utilized the Internet as a data source. In addition, the students utilized the computer for word processing and spreadsheets.

G H N The students built their collecting apparatus and used it for a period of three months to collect data from natural phenomena that occurred outside the classroom.

C D E G H I J K L M N The students produced and compared charts of their own data, the class's data, and data from the Internet.

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C D E G H I J K The students organized and presented data in a series of tables and graphs. They attempted to maintain a degree of uniformity in the style of their graphic presentations.

P In the first paragraph of the conclusion, students argue for their hypothesis from the evidence of their own and others' data. They also correctly note the significance of the geographic difference between their own data and the data they accessed on the Internet.

Content

S6E4. Students will understand the role water in its various phases plays in weather systems.

a. Students will summarize the role of evaporation, condensation, precipitation, and freezing on Georgia's water systems (rivers, ponds, lakes).

S6E7. Students will be familiar with the various sources of energy and with their uses and conservation.

d. Students will observe and compare the positive and negative consequences of human action on the Earth's systems.

Tasks:

A The student shows understanding of the water cycle and principle language associated with it.

A

Background:

From our class discussions, the books that we read, and the information we got from the INTERNET, we learned about acids and bases, the water cycle, and acid rain.

What is the water cycle? It is the way we get our water. It's the way we use and reuse our water. The water cycle has three main stages: evaporation, condensation, and precipitation. Evaporation is when the water changes from a liquid to a gas and goes into the atmosphere. Condensation is when the water droplets form into clouds in the atmosphere. Precipitation is when all the water droplets come down in the forms of rain, hail, sleet, or snow.

An acid is a substance that can burn holes in your clothes. They have a sour taste. Some things that are acidic are vinegar and batteries. A neutral substance is harmless. A base is a substance that can burn the skin. It has a bitter taste. Some things that are basic are ammonia and lye.

A pH scale is a chart with the numbers 1-14 and different colors. It is used to tell us whether something is acidic, neutral, or basic. Hydrion paper is dipped into a substance and matched against the pH scale. A substance that is acidic will have a pH of 1-6. A substance that is neutral will have a pH of 7, which means it is neither an acid nor a base. A substance that is basic will have a pH of 8-14.

Acid rain is caused by pollution. Chemical pollution from the burning of coal, gasoline, and oil in buildings, cars, buses, factories, homes, and schools goes into the air. It remains in the air until it is washed out of the atmosphere and carried back to where we live, every time it rains. The rainwater comes down as acid rain. Acid rain is water that has been polluted. Acid rain can harm some plants and animals. It can destroy the food we eat. Acid rain can discolor the clothes we wear. Normal rainwater has a pH of about 6. Acid rain has a pH range of 2.5 to 5.7.

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Problem: Do we have an acid rain problem where we live?

Hypothesis: We predict that we do have an acid rain problem where we live.

Materials:

* 100 ML graduated cylinder
* A wooden pole (121 cm)
* Hydrion pH paper
* A composition notebook
* Distilled water
* Masking tape
* Duct tape
* A rain gauge in CM and Inches

Procedure:

1. We had to design and construct a device to collect rainwater at _____. We discussed what we had to make.
2. We discussed how we would attach the pole to the graduated cylinder and place it outside our classroom window.
3. We took a graduated cylinder and attached it to a pole that is 121 cm in length with masking tape. We found out that the masking tape did not work, so we used the duct tape instead to attach the pole to the graduated cylinder.
4. We decided to put the rainwater collecting device outside of a window that had the least blockage in room 307 at _____.
5. We discussed how we would collect and record our rainwater data using our collecting device. We decided to check the rainwater collecting device daily and record the date. If it rained, we would record the amount of rainfall in milliliters and inches.
6. We also decided that each time we collected rainwater, we would test the rainwater p.H. by taking one strip of hydrion paper and dipping it in the water and then taking it out comparing the color of the dipped hydrion paper to the P.H. color chart. We would match the color of the dipped paper to the pH color chart.
7. We would compare our group data with the class data.
8. We would compare the data collected at _____ with INTERNET acid rain data.

Table 1

Title: Amount of Rainwater Collected by our Group During April, May & June 1998

	A	B	C	D	E	F
1	Month	Date	Rainwater in Milliliters	Total Monthly Rainfall in ml	Inches	Total Monthly Rainfall in Inches
2						
3						
4	April	4/2/98	30 m.l.		0.7 in	
5		4/20/98	90 ml.	120 m.l.	2.5 in	3.2 in
6	May	5/4/98	65 m.l.		1.8 in	
7		5/6/98	25 m.l.		0.7 in	
8		5/14/98	26 m.l.	116 m.l.	0.7 in	3.2 in
9	June	6/1/98	31 m.l.		0.8 in	
10		6/15/98	50 m.l.	81	1.3 in	2.1 in
11						

Table 2

Title: Amount of Rainfall Collected at _____ by Class _____ S.A. During April, May & June of 1998

	A	B	C	D	E	F
1	Month	Date	Amount of Rainfall in millimeters	Total Monthly Rainfall in millimeters	Inches	Total Monthly Rainfall in Inches
2						
3						
4	April	4/1	64 ml		1.78 in	
5		4/2	30 ml		.80 in	
6		4/9	60 ml		1.86 in	
7		4/17	26 ml		.77 in	
8		4/20	90 ml		2.50 in	
9		4/23	28 ml	298 ml	.82 in	8.53 in
10	May	5/4	65 ml		1.80 in	
11		5/5	22 ml		.57 in	
12		5/6	25 ml		.60 in	
13		5/11	26.5 ml		.68 in	
14		5/14	26 ml		.70 in	
15		5/25	14 ml	178.5 ml	.42 in	4.77 in
16	June	6/1	31 ml		.80 in	
17		6/12	51 ml		1.29 in	
18		6/15	50 ml		1.30 in	
19		6/17	12 ml		.30 in	
20		6/30	27 ml	171 ml	.79 in	4.48 in

Table 3

Title: Total Monthly Rainfall for New York State During April, May & June 1998

	A	B
1	Month	Total Rainfall in Inches
2		
3	April	7.05 in
4	May	6.94 in
5	June	5.94 in
6		
7	INTERNET Site:	
8	http://www.nwsnoaa.gov/climate/data.html	

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Title:pH Chart

pH 1 - red
pH 2 - brown red
pH 3 - orange brown
pH 4 - dark orange
pH 5 - light orange
pH 6 - yellow orange
pH 7 - greenish yellow
pH 8 - light green
pH 9 - green
pH 10 - dark green
pH 11 - greenish brown
pH 12 - brown
pH 13 - light purple
pH 14 - purple

H Table 4

Title: p.H. of Rainwater Collected by our Group During April, May & June 1998

	A	B	C	D	E	F	G
1	Month	Date	Starting Color of Hydrion Paper	Color of Hydrion Paper After Dipping It in Distilled Water	Color of Hydrion Paper After Dipping In Rainwater	p.H. Scale Reading	Monthly Average p.H. Reading
2							
3							
4							
5							
6	April	4/2	Yellow orange	Greenish Yellow	Yellow orange	6	
7		4/20	Yellow orange	Greenish Yellow	Light orange	5	5.5
8	May	5/4	Yellow orange	Greenish Yellow	Light orange	5	
9		5/6	Yellow orange	Greenish Yellow	Yellow orange	6	
10		5/14	Yellow orange	Greenish Yellow	Light orange	5	5.3
11	June	6/1/98	Yellow orange	Greenish Yellow	Light orange	5	
12		6/15/98	Yellow orange	Greenish Yellow	Light orange	5	5

I Table 5

Title: p. H. of Rainwater Collected at _____ by Class _____ S.A During April, May & June 1998

	A	B	C	D	E	F	G
1	Month	Date	Starting Color of Hydrion Paper	Color of Hydrion Paper After Dipping In Distilled Water	Color of Hydrion Paper After Dipping in Rainwater	p.H. Reading on p.H. Scale	Monthly Average p.H. Reading
2							
3							
4							
5							
6							
7							
8	April	4/1	Yellow orange	Greenish yellow	Light orange	5	
9		4/2	Yellow orange	Greenish yellow	Yellow orange	6	
10		4/9	Yellow orange	Greenish yellow	Light orange	5	
11		4/17	Yellow orange	Greenish yellow	Dark orange	4	
12		4/20	Yellow orange	Greenish yellow	Light orange	5	
13		4/23	Yellow orange	Greenish yellow	Yellow orange	6	5.2
14	May	5/4	Yellow orange	Greenish yellow	Light orange	5	
15		5/5	Yellow orange	Greenish yellow	Light orange	5	
16		5/6	Yellow orange	Greenish yellow	Yellow orange	6	
17		5/11	Yellow orange	Greenish yellow	Light orange	5	
18		5/14	Yellow orange	Greenish yellow	Light orange	5	
19		5/25	Yellow orange	Greenish yellow	Yellow orange	6	5.3
20	June	6/1	Yellow orange	Greenish yellow	Light orange	5	
21		6/12	Yellow orange	Greenish yellow	Light orange	5	
22		6/15	Yellow orange	Greenish yellow	Light orange	5	
23		6/17	Yellow orange	Greenish yellow	Yellow orange	6	
24		6/30	Yellow orange	Greenish yellow	Yellow orange	6	5.4

E Table 6

p.H. of Rainfall for NY Region in April, May & June 1998

	A	B
1	Month	Average Precipiation p.H
2	April	4.7
3	May	5.3
4	June	5.7
5		
6		WEb Sites:
7		http://www.madison.K12.wi.us/stugeon/overallus.html
8		http://www.K12.hi.us/~cmark/AcidRain/acidrain7.html
9		http://h20.usgs.gov/nwo/NWC/prishtml/NY.html

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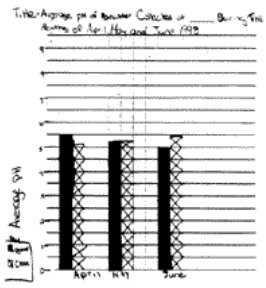
K



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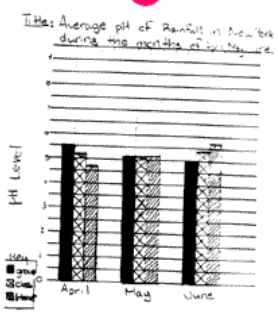

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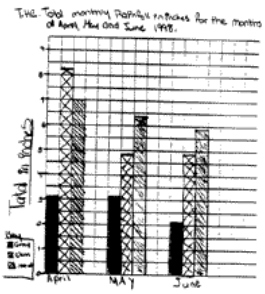

M

Conclusion:

P

In conclusion, our hypothesis is correct. We have an acid rain problem at _____. We looked at our group and class pH data that we collected during the months of April, May and June 1998, and found that we had pH readings of 5.5 and 5.2 for April, for May 5.3 and 5.3 and for June 5 and 5.4. We compared our group and class pH information to the average pH data for the New York State region on the INTERNET. We found out that our group data, class data and regional data were the same for the month of May with pH readings of 5.3, 5.3, and 5.3 but different in April (5.5, 5.2, 4.7) and in June (5, 5.4, 5.7). Because all group, class and INTERNET rainwater pH information collected was in the acid rain range of pH 2.5 - 5.7, we conclude that we have an acid rain problem at _____. Because the pH data on the INTERNET is for all of New York State and not just for New York City where we go to school, we think that our group and class pH data is better for _____ than the pH data on the INTERNET.

In April our group collected 3.2 inches of rain, the class collected 8.5, and the scientists collected a total of 7 inches of rain. Then in May our group collected 3.2 inches of rain , the class collected 4.7 inches and the scientists collected 6.9 inches. In June, our group collected 2.1 inches of rain, the class collected 4.4 and the scientists collected 5.9 inches. We found that our group, class and INTERNET data were very different. We think this is because in April the group only collected rainwater twice, the class collected 6 times. In May our group collected rainwater 3 times the class collected 7 times. In June our group collected rainwater two times the class collected five times. In April, May, and June scientists collected rainwater every time it rained. So we think that the scientists had the best rainfall data. So looking at their data we found out that there was less rain for the month of June (5.9 inches) than in April (7.0 inches) and May (6.9 inches).

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