Work Sample & Commentary: *Acid Rain*
Middle School Science

The task[122]

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 under the following conditions:

alone	√ in a group
√ in class	√ as homework
√ with teacher feedback	with peer feedback
timed	√ opportunity for revision

This work sample illustrates a standard-setting performance for the following parts of the standards:[123]

S5c Scientific Thinking: Use evidence from reliable sources.

S5f Scientific Thinking: Work in teams.

S6a Scientific Tools and Technologies: Use technology and tools.

S6d Scientific Tools and Technologies: Acquire information from multiple sources.

S7a Scientific Communication: Represent data and results in multiple ways.

S7b Scientific Communication: Argue from evidence.

S8a Scientific Investigation: A systematic observation, such as a field study.

What the work shows

S5c Scientific Thinking: The student uses evidence from reliable sources to develop explanations.

(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.

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[122] For related work on Acids and Bases, see “Acid/Base”, page 70, and “Buffer Lab”, page 375.
[123] The quotations from the Science performance descriptions in this commentary are excerpted. The complete performance descriptions are shown on pages 152-187.

S5f Scientific Thinking: The student works in teams to collect and share information and ideas.

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

S6a Scientific Tools and Technologies: The student uses technology and tools to observe and measure objects organisms and phenomena directly, indirectly and remotely.

(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.

S6d Scientific Tools and Technologies: The student acquires information from multiple sources such as the Internet and experimentation.

(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.

S7a Scientific Communication: The student represents data and results in multiple ways such as numbers, tables and graphs.

(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.

S7b Scientific Communication: The student argues from evidence; such as data produced through his or her own experimentation by others.

(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.

S8b Scientific Investigation: The student demonstrates scientific competence by completing a controlled experiment, such as a field study.

(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.


ACID
RAIN

Background:

A

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.

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

N

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.

O

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.

B

8. We would compare the data collected at ______ with INTERNET acid rain data.

G

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	Total Monthly	Inches	Total Monthly Rainfall in Inches
2			in Milliliters	Rainfall in ml		
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						

C

Table 2

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

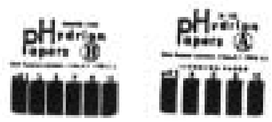
	A	B	C	D	E	F
1	Month	Date	Amount of	Total Monthly	Inches	Total Monthly Rainfall in Inches
2			Rainfall in	Rainfall in		
3			millimeters	millimeters		
4	April	4/1	64 ml		1.78 in	
5		4/2	30 ml		.80 in	
6		4/9	60 ml		1.86 in	
7		4/17	26 ml		.77 in	
8		4/20	90 ml		2.50 in	
9		4/23	28 ml	298 ml	.82 in	8.53 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

D

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.nws.noaa.gov/climate/data.html	



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	Color of Hydrion	Color of Hydrion	p.H. Scale	Monthly
2			Hydrion Paper	Paper After Dipping	Paper After	Reading	Average
3				it in Distilled Water	Dipping		p.H.
4					in Rainwater		Reading
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 ornage	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
1–7	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
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

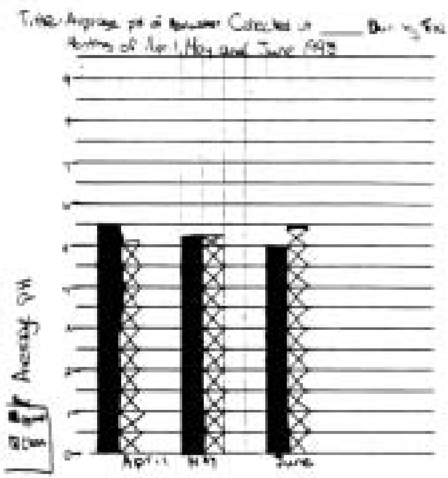
E

Table 6

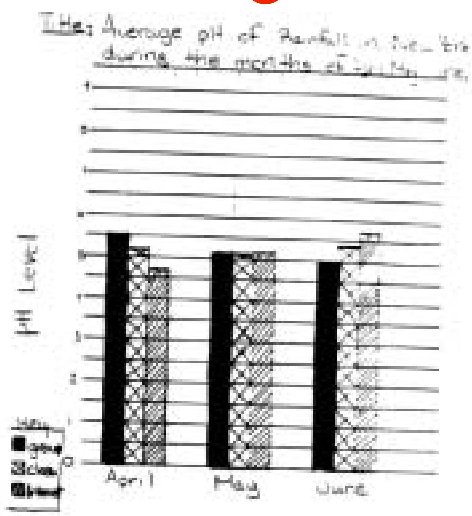
p.H. of Rainfall for NY Region in April, May & June 1998

	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/nwc/NWC/pH/html/NY.html

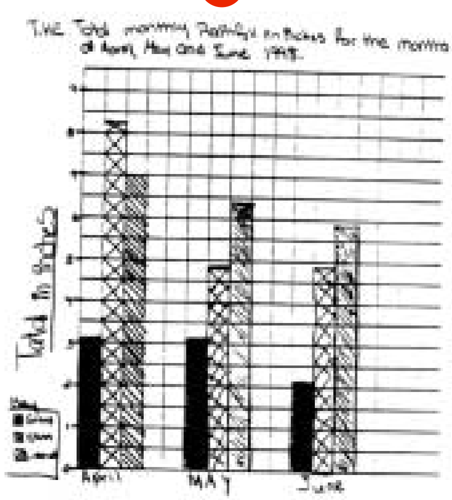
K


Average pH
April
June

L


pH Level
April
May
June

J


Total in Inches
April
MAY
June

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).

F

Bibliography

1. Baines, John. 1939. Acid Rain. Texas: Steck-Vaughn
2. Grolier. 1998. Multimedia Encyclopedia (CD-ROM). California: Grolier Interactive.
3. Multimedia Curriculum Systems. 1998. SciencePlus: Interactive Explorations, Level Red (CD-ROM). U.S.A.: Holt, Rinehart and Winston.
4. http:// www. madison. k12.wl.us/stugeon/overallus.htm
5. http:// www. k12.hi.us./ `cmark/Acid Rain/acid rain7.html
6. http://h20.usqs.gov/nwc/NWC/pH/html/NY.html

The task[124]

Following classroom discussion about the concept of density, students performed an extensive laboratory investigation. In the lab write up the students were asked to:

- **discuss the definition of density;**
- **state a clear purpose for the investigation;**
- **give four clearly stated hypotheses;**
- **list all materials;**
- **clearly organize and label data;**
- **discuss any observed patterns;**
- **clearly explain laboratory procedures;**
- **summarize results;**
- **suggest ideas for future study.**

Circumstances of performance

This sample of student work was produced under the following conditions:

	alone	√	in a group
√	in class		as homework
√	with teacher feedback	√	with peer feedback
	timed	√	opportunity for revision

This work sample illustrates a standard-setting performance for the following parts of the standards: [125]

S1a Physical Sciences Concepts: Properties and changes of properties in matter.

S4a Scientific Connections and Applications: Big ideas and unifying concepts.

S5b Scientific Thinking: Use concepts from Science Standards 1 to 4 to explain observations and phenomena.

S5c Scientific Thinking: Use evidence from reliable sources.

S5e Scientific Thinking: Evaluate the accuracy, design, and outcomes of investigations.

S5f Scientific Thinking: Work individually and in teams.

S6a Scientific Tools and Technologies: Use technology and tools to observe and measure.

S7a Scientific Communication: Represent data and results in multiple ways.

S7e Scientific Communication: Communicate in a form suited to the purpose and the audience.

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[124] For related work on Density, see "Flinkers", page 76, "Density of Sand", page 412, and "Density", page 423.
[125] The quotations from the Science performance descriptions in this commentary are excerpted. The complete performance descriptions are shown on pages 152-187.

Work Sample & Commentary: *Discovering Density*
Middle School Science

What the work shows

S1a Physical Sciences Concepts: The student produces evidence that demonstrates understanding of properties and changes of properties in matter, such as density....

(A) (B) There is clear evidence here and throughout the work that the student understands how volume and mass relate to density.

(C) Although the student has a misconception (air does not have zero mass, and this should be corrected in a revision), the student does describe density in terms of volume and mass.

S4a Scientific Connections and Applications: The student produces evidence that demonstrates understanding of big ideas and unifying concepts, such as order...; change and constancy; and cause and effect.

(D) (E) There are several places in this work where the student acknowledged that volume can remain constant and yet, if mass increases or decreases, the density is changed.

(F) The student provided evidence of understanding that if the density of an object is less than 1.0 g/ml the object will float in water.

S5b Scientific Thinking: The student uses concepts from Science Standards 1 to 4 to explain a variety of observations and phenomena.

(E) The conclusion ties together the concept of density and why objects in the experiment floated and why some sank. This shows that the student was able to use her conceptual understanding of density to predict whether an object would float or sink given information about the density of the medium into which the object is placed and the density of the object.

S5c Scientific Thinking: The student uses evidence from reliable sources to develop descriptions, explanations, and models.

Throughout the work the student used information from reliable sources. One source was direct experimentation. However, the student took information, whether from the teacher or some other source, and explained some sophisticated concepts in her own voice.

S5e Scientific Thinking: The student evaluates the accuracy, design, and outcomes of investigations.

(G) The student identified several reasonable sources of measurement error.

S5f Scientific Thinking: The student works individually and in teams to collect and share information and ideas.

S6a Scientific Tools and Technologies: The student uses technology and tools (such as traditional laboratory equipment...) to...measure objects...indirectly....

The student determined the volume of the balloon by using the formula for a sphere.

(H) (I) The student determined the volume of an irregularly shaped object by using water displacement.

S7a Scientific Communication: The student represents data and results in multiple ways, such as numbers, tables, and technical...writing.

(J) The student presented data in tabular form and analyzed the data in writing.

S7c Scientific Communication: The student communicates in a form suited to the purpose and the audience, such as by writing instructions that others can follow....

(K) (L) (M)

February 17, 1996

Discovering Density

Past History

Density is a measurement of how close atoms and/or molecules are together, or in other words how concentrated they are. For instance, 1,000 lbs. of feathers are less dense than an ounce of gold, because gold molecules are all much closer together than the feather molecules are. We need to know how dense things are, to see if they float or sink, to see if we can break through them, to see how sturdy a substance is, and for many other reasons.

Purpose

The purpose of this laboratory experiment is to examine and determine the relationships between mass, volume, and density.

Hypothesis

I believe that if the mass of an object goes up and the volume stays the same, the density will go up, because that means there are more molecules/atoms in the same amount of space. Accordingly, I think that if the volume of an object goes up and the mass stays the same, than then the density will go down, because there are the same amount of molecules/atoms in a larger amount of space. I think some objects float because there is space for air between molecules, and the molecules trap the are in the object so it floats. If the object is very dense, then there is no room for air in between the molecules, so it sinks. I think that a steel boat floats, because there are molecules that are not very dense, so air can go in the spaces between the molecules, and the sides of the boat add to that ability, because they constantly keep water from being on both the top and bottom of the molecules.

Materials

big block of wood	balance	square piece of foil	1000 mlbeaker
20 steel BB's	tape measure3	rubber stoppers	balloon
3 unknown liquids	calculator	50 ml graduated cylinder	1 cork stopper
little block of wood	10 ml graduated cylinder	50 ml beaker	100 ml beaker

Processes K

Station 1 SMALL BLOCK / LARGE BLOCK

1. Mass the block of wood.
2. Measure the length, height, and width of the block in centimeters.
3. Calculate the volume using the formula for a rectangular solid.
4. Calculate the density of the block.
5. Fill one of the lange beakers 2/3 of the way with water.
6. Gently place each block of wood into water to determine if it floats.
7. Remove the block from water.
8. Repeat for the other block.

Station 2 STEEL BB'S

1. Fill the graduated cylinder with 5.0 ml of water.
2. Mass the graduated cylinder and water.
3. Gently roll 20 beads into graduated cylinder.
4. Mass the graduates cylinder, water, and beads.
5. Calculate mass of the 20 beads.
6. Record the volume of water and 20 beads.
7. Calculate volume of the 20 beads.
8. Calculate density of the 20 beads.
9. Record whether or not the steel beads float.
10. Pour water back into the beaker and replace the beads into a petri dish.

Station 3 UNKNOWN LIQUIDS

1. Mass the graduated cylinder.
2. Pour approximately 30 ml of Liquid into the graduated cylinder.
3. Mass the graduated cylinder and the Liquid.
4. Record the exact volume of the Liquid that was poured into graduated cylinder.
5. Calculate the density of the Liquid.
6. Repeat for other Liquids.

Station 4 BALLOON L

1. Mass the balloon.
2. Use the tape measure to record the circumference if the balloon.
3. Calculate the radius of the balloon.
4. Using the following formula, calculate the volume of the balloon. v = 4 *pi*r^3/3 H
5. Calculate the density of the balloon.
6. Verify whether or not the balloon floats.

Station 5 RUBBER STOPPERS

1. Mass the rubber stopper.
2. Pour approximately 40 ml into the graduated cylinder.
3. Record exact volume of water in graduated cylinder.
4. Gently place rubber stopper into graduated cylinder.
5. Be sure rubber stopper is completely covered with water and measure the volume of water and stopper.
6. Calculate volume of stopper.
7. Calculate density of stopper.
8. Repeat for other stoppers.

Station 6 CORKS

1. Mass the cork.
2. Pour approximately 40 ml into graduated cylinder.
3. Record exact volume of water in graduated cylinder.
4. Gently place cork into graduated cylinder.
5. Be sure cork is completely covered with water and measure volume of water and cork. I
6. Calculate volume of cork.
7. Calculate density of cork.
8. Repeat for other corks.

Station 7 ALUMINUM FOIL BOAT/ALUMINUM BALL

1. Construct and aluminum boat following your instructor's instructions.
2. Mass the boat.
3. Measure the length, width, and height of the boat.
4. Calculate the volume of the boat.

M

5. Calculate the density of the boat.
6. Determine whether the boat floats or sinks.
7. Squish the boat into a tight "cube" ball.
8. Record the mass of the ball.
9. Measure the length, width, and height of the aluminum ball to determine the volume of the ball.
10. Calculate the volume of the ball.
11. Calculate the density of the ball.
12. Determine if the boat floats or sinks.

Station 8 WATER

1. Mass the graduated cylinder.
2. Pour approximately 30 ml of water into the graduated cylinder.
3. Record the exact volume of the water in the graduated cylinder.
4. Mass the graduated cylinder and water.
5. Calculate the mass of the water in the graduated cylinder.
6. Calculate the density of the water.

Discussion

B

The density of an object is most dependent on mass. This is because there are two factors concerning mass that contribute to the density of an object. At the atomic level each individual atom/molecule could weight a lot, thus effecting the mass which effects the density; or there could be a number of atoms/molecules squished up in a small area, which effects the mass and therefore effecting the volume. This is supported by all of the stations in this laboratory. In all of the stations, the mass and volume were taken, and in each case the individual weight of each atom/molecule and the weight of how ever many atoms/molecules there were affected the mass.

F

Water's density is approximately 1.0 g/ml. You can see this in the Station 8 table of my data. With the data of all of the things that we testing whether they floated or sank it can be determined that things that float, have a density of less then 1.0 g/ml, and all of the things that sink have a density of greater than 1.0.

J

Floats	Density	Sinks	Density
Small Block	0.648 g/ml	Steel Beads	7 g/ml
Large Block	0.616 g/ml	Sm. Stopper	1.1 g/ml
Balloon	0.0052 g/ml	Med. Stopper	1.5 g/ml
Small Cork	0.15 g/ml	Lrg. Stopper	1.2 g/ml
Medium Cork	0.2 g/ml	Almn. Ball	1.2 g/ml
Large Cork	0.17 g/ml		
Almn. Boat	0.012 g/ml		

C

The aluminum boat floated, because it's density was above 1.0 g/ml. Part of the reason, is because the empty space in the middle of the boat (which weighs nothing) is counted in the volume, then when you divide mass by volume the number drops greatly. With the ball you crammed alot of atoms/molecules into a small area, and the volume was so very small, when you divide the number stayed above 1.0 g/ml and it sinks.

D

To find if what happens to the density of an object the mass of an object goes up, and the volume stays the same I looked in stations 5 and 6, and 3. If you look at the stoppers and corks that are the same volume, you will see that the mass of the stopper is larger. The density of the more massive object if higher in all three (small, medium, and large) cases. In the liquids station the volume always stayed the same, yet the more massive liquids always had a high density. So it can be concluded that if the mass of an object goes up and the volume stays the same, the density will go up.

To find what happens to the density of an object if the volume goes up and the mass stays the same I looked at station 7 backwards (if we had a aluminum ball first, then built it into a boat). When the aluminum was in a ball, the density was high, and when it was a boat the density was low. This is because the space in the object was counted as part of the object. In conclusion, if the volume of an object goes up and the mass stays the same, the density will go down.

To find out why things float I looked at all of the stations, and the table I made on the previous page, those things with a density lower than the density of the liquid they are in will float, and those things with a density higher than the liquid they are in will sink.

A steel boat floats, because it has sides on it. If it were simply a steel panel, in would sink like a rock. The space in the middle of the boat, counts as part of a boat, therefore making the boat much less dense than the water.

G Some things that might have affected my data, and made it wrong, could have been, water left on the objects, so they had the added mass of the water when they were weighed; how you measured the circumference of the balloon, because it was not a perfect sphere; the holes in the bottom of the stoppers could have filled up with air, and given a false volume reading; the scales might not have always been tared correctly; measurements of water in the graduated cylinders might not have been totally accurate; and when measuring the volume of objects that floated using water displacement, the objects might not have been in the water all of the way, giving and inaccurate reading on the graduated cylinder.

<u>Conclusion</u>

E This lab, has made it very easy to understand the relationships between mass, volume, and density. After completing this lab, it is easy to conclude, that if the mass of an object goes up and the volume stays the same the density will go up; that if the volume of an object goes up and the mass stays the same the density will go down; that objects float because they are less dense then the substance that they are in; and that a steel boat floats because it has side. With this new knowledge and understanding I personally know a little bit more about how this world works. I will also know how to find the density of things if I ever need to know if something floats, like if I ever need to construct a boat, or something like that. Now that I know how to find the density of an object, it would be interesting to go into some physics, and find how much force you would have to apply to break through things with different density's. Knowing how to calculate this, and being able to calculate this might be good for a job in making durable synthetic materials, or finding sturdy materials to make something which must be very strong.

Work Sample & Commentary: *Paper Towels*
Middle School Science

The task

Students in a physical science class were asked to test the effectiveness of one of several different common products. The task required them to perform detailed and accurate testing and report results in a form for public presentation. Further, the students were asked to design and give a presentation promoting the most successful product.

Circumstances of performance

This sample of student work was produced under the following conditions:

	alone	√	in a group
√	in class		as homework
√	with teacher feedback	√	with peer feedback
	timed	√	opportunity for revision

Students had two weeks to complete the task which was part of a unit on scientific methodologies. While students videotaped a portion of their presentation, it is not included here.

Science required by the task

Paper towel testing is a common middle school activity, but many students select variables that are social in nature (e.g., cost, appearance) and are more easily measured than are strength or performance. This project tackled variables that required more imagination and effort to measure.

This work sample illustrates a standard-setting performance for the following parts of the standards: [126]

S4a Scientific Connections and Applications: Big ideas and unifying concepts.

S4b Scientific Connections and Applications: The designed world.

S5a Scientific Thinking: Frame questions to distinguish cause and effect; identify or control variables in experimental or non-experimental research settings

S7a Scientific Communication: Represent data and results in multiple ways.

S8a Scientific Investigation: Controlled experiment.

What the work shows

S4a Scientific Connections and Applications: The student produces evidence that demonstrates understanding of big ideas and unifying concepts, such as…form and function….

(A) The student related the thickness (form) of towels to the characteristic of strength (function).

[126] The quotations from the Science performance descriptions in this commentary are excerpted. The complete performance descriptions are shown on pages 152-187.

S4b Scientific Connections and Applications: The student produces evidence that demonstrates understanding of the designed world, such as…the viability of technological designs.

(A) The student provided evidence of thinking through the design of paper towels and how well they would serve the intended purpose.

S5a Scientific Thinking: The student frames questions to distinguish cause and effect; and identifies or controls variables in experimental and non-experimental research settings.

(B) (C) There is ample evidence of the student's recognition and control of variables.

S7a Scientific Communication: The student represents data and results in multiple ways, such as numbers, tables…drawings, diagrams, and artwork….

(B) (C) The experimental set-up is communicated in both words and drawings.

(D) (E) The results are communicated in tables, graphs, and words. The histogram is more effective than the pie chart. There is a reversal in the table for Test #2 (data for "Job Squad" and "Bounty"), but the multiple representations actually allow the reader to figure that out.

S8a Scientific Investigation: The student demonstrates scientific competence by completing a controlled experiment. A full investigation includes:

- **Questions that can be studied using the resources available.**

(F)

- **Procedures that are safe, humane, and ethical; and respect privacy and property rights.**
- **Data that have been collected and recorded (see also Science Standard 6) in ways that others can verify, and analyzed using skills expected at this grade level (see also Mathematics Standard 4).**

(B) (C) (D) (E)

- **Data and results that have been represented (see also Science Standard 7) in ways that fit the context.**

(D) (E)

- **Recommendations, decisions, and conclusions based on evidence.**

(G)

- **Results that are communicated appropriately to audiences.**

(G)

- **Reflection and defense of conclusions and recommendations from other sources and peer review.**

The student presented the work to others, though evidence of the presentation is not shown here.

Test #1

F

Problem: Will the product, Brawny paper towels, be stronger than the other 3 brands of paper towels? Which brand is the strongest brand?

Research: Strength is a major part of this experiment. The word strong or strength doesn't necessarily have to deal with muscles. To be strong you must be powerful and able to resist attack. As well as being powerful, you must be well established, firm, solid, not easily broken, or steadfast. The word steadfast basically comes down to being firmly fixed, steady, and well built. The word strength has a similar meaning. To have strength it means to have the ability to endure, support, or force in numbers.

Paper is a material made by pressing pulp of rags, straw, or wood into thin sheets.

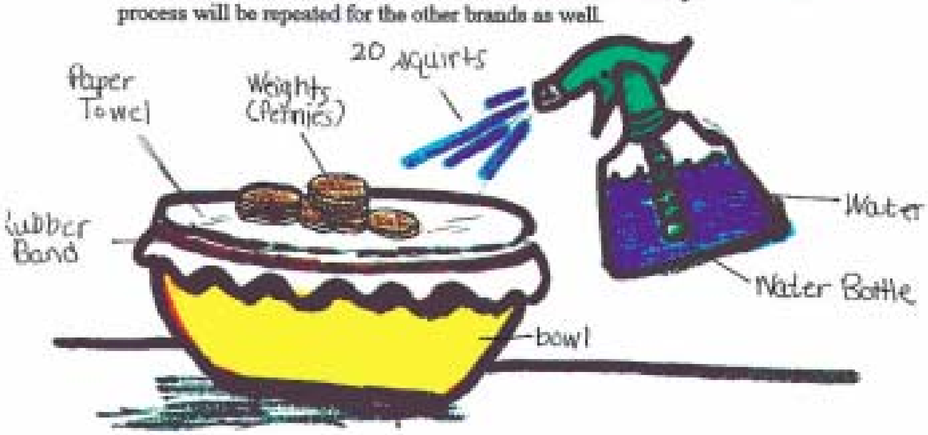
A towel can be cloth or paper. Based upon this experiment the towels being tested are made of paper. Drying is the major purpose for a paper towel, but sometimes they're used for scrubbing surfaces.

A

Hypothesis: Based from the research, I think our product, the Brawny paper towel will be stronger. Being that the towel is made of thin sheets of paper, there is the likely reason that it will rip when wet. But unlike the other brands Brawny is thicker. When we compare the characteristics of strength Brawny fits all the characteristics. Brawny can resist attack. It is well established, firm, solid (thick, in other words), and well built. In our test we will actually find out if it can handle "force in numbers."

B

Set Up: The paper towel will be laid over the rim of a plastic bowl, approximately 4 1/4 of an inch. The paper towel will be secured so that it is tight with a rubber band. The paper towel will be sprayed 20 times with a fine mist from a water bottle. Pennies (the weights) will be put on one at a time until the towel breaks. Then we'll count the pennies and record our data. The process will be repeated for the other brands as well.



Test #2

Problem: Will the product, Brawny paper towels be stronger than the other 3 brands of paper towels? Which brand is the strongest brand?

Research: Strength is a major part of this experiment. The word strong or strength doesn't necessarily have to deal with muscles. To be strong you must be powerful and able to resist attack. As well as being powerful, you must well established, firm, solid, not easily broken, or steadfast. The word steadfast basically comes down to being firmly fixed, steady, and well built. The word strength has a similar meaning. To have strength it means to have the ability to endure, support, or force in numbers.

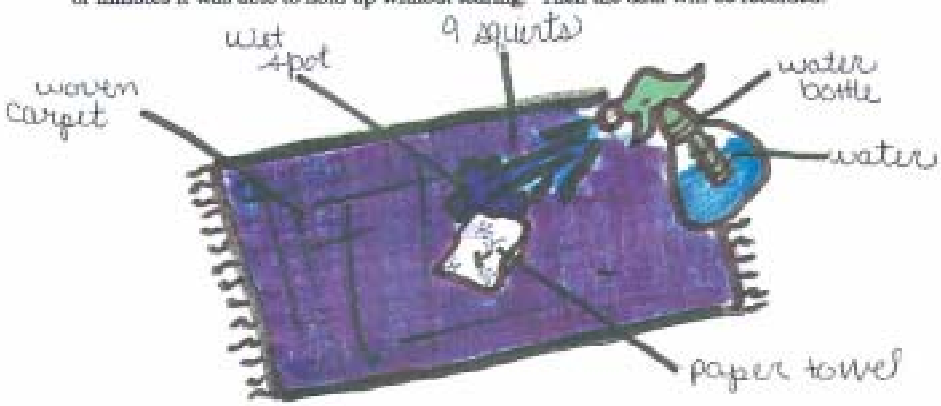
Paper is a material made by pressing pulp of rags, straw, or wood into thin sheets.

A towel can be cloth or paper. Based upon this experiment the towels being tested are made of paper. Drying is the major purpose for a paper towel, but sometimes they're used for scrubbing surfaces.

Carpet is a woven or felted piece of material that covers floors. In many cases carpet must be cleaned. Usually they are cleaned with vacuums but sometimes when there is a spill a cleaning solution and a bundle of paper towels will do the job.

Hypothesis: Based from the research, I think our product, the Brawny paper towel will be stronger. Being that the towel is made of thin sheets of paper, there is the likely reason that it will rip if wet. But unlike the other brands Brawny is thicker. When we compare the characteristics of strength Brawny fits all of them. Brawny can resist attack. It is well establish, firm, solid, (thick in other words), and well built. In our second test we will actually find out if it can handle scrubbing a spill on a rough, woven piece of carpet.

Set Up: In this experiment the first step is to wet one area of the carpet by squirting it 9 times with the water bottle. The area will be squirted 9 times in the exact area for a single test. Then when the second brand is tested we'll move to a different area and squirt nine times (and so on). C The wet surface will be scrubbed with one sheet of the paper towel. The carpet will be scrubbed over and over with the paper towel until the paper towel begins wearing away. With the first notice of "wear and tear" we'll stop rubbing. Each brand will be timed for the number of second or minutes it was able to hold up without tearing. Then the data will be recorded.



D

Test #1 Graph

Towels & Pennies

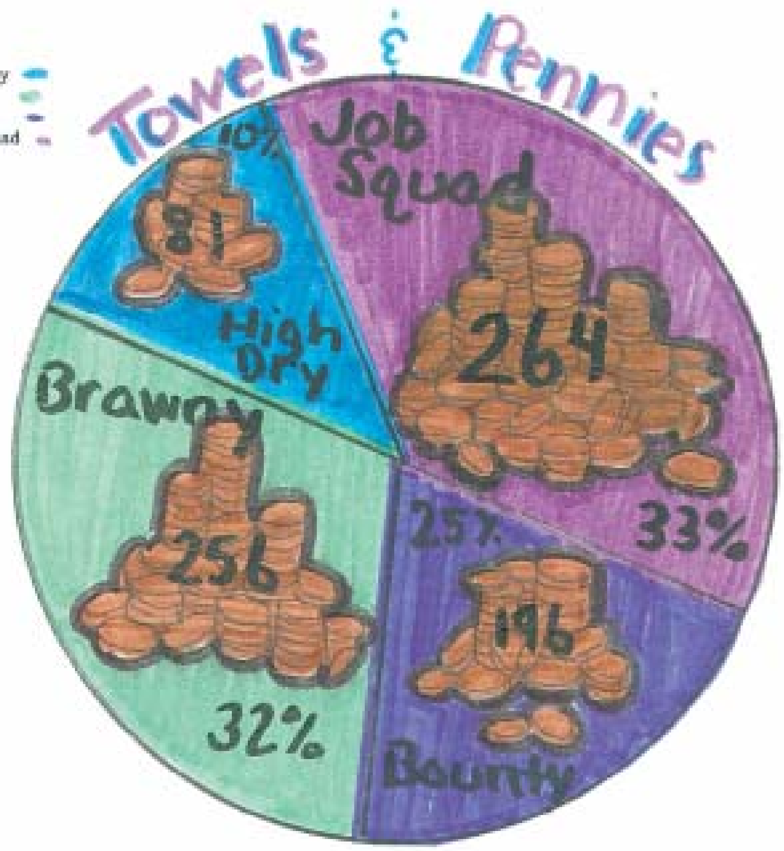
Brand of Paper Towel	# of Pennies (weights) it held
Bounty	196
High Dry	81
Job Squad	264
Brawny	256

Towels & Pennies

This graph gives you an idea of how much pennies filled the plastic bowl in our tests. The number of pennies the towel brand was able to hold is written across the pennies. In addition it tells out of the 797 pennies what percent of a certain brand was able to hold. In Brawny's case it held 32% of the pennies.

Key:

High Dry
Brawny
Bounty
Job Squad



Based by this pie graph you can see Job Squad held the most pennies. Following that Brawny held 256. Then Bounty held the third greatest amount of pennies. And last, High Dry held 10% of the pennies.

E

Test #2

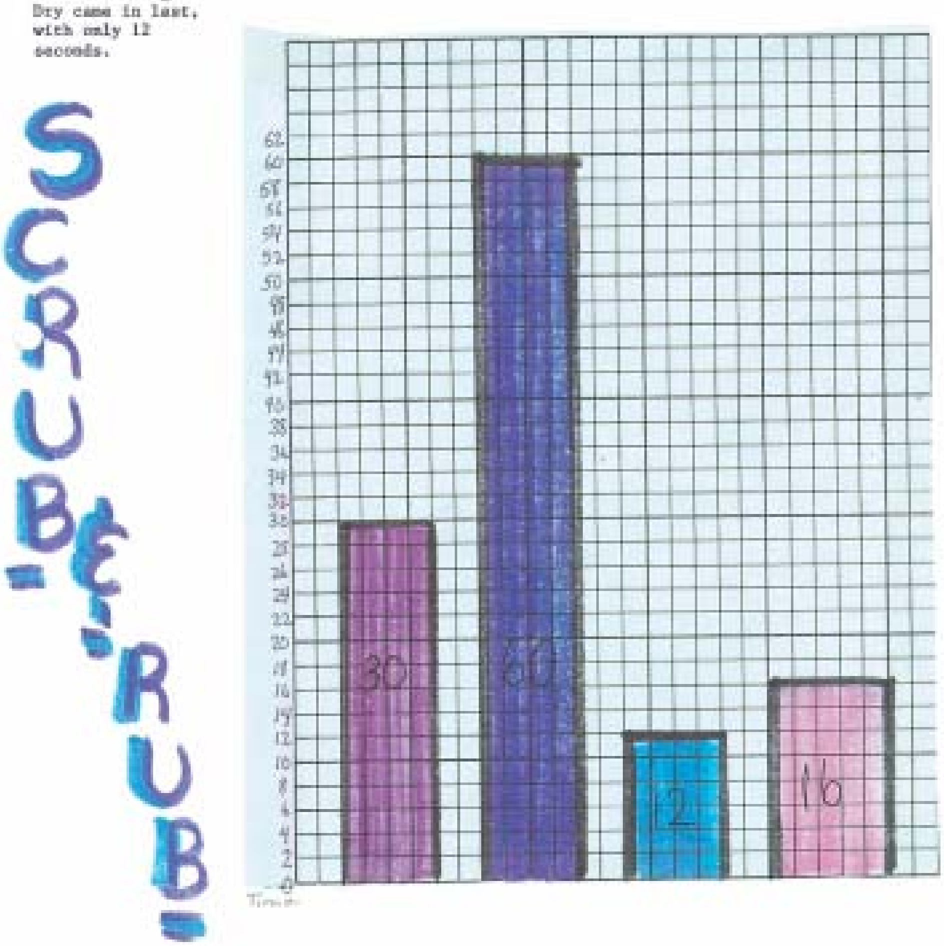
Brand of Towel	Amount of Time before Wear & Tear
Brawny	30 seconds
Bounty	60 seconds (1 minute)
High Dry	12 seconds
Job Squad	16 seconds

Scrub & Rub

This bar graph shows which paper towel could stand up, and last the longest by rubbing it on a wet piece of carpet until it had a tear.

The x-axis names the brands of the 4 paper towels. The y-axis numbers by 5, with a range of 0 to 62 seconds. This axis is the time axis. By looking at the graph you can see that Job Squad lasted for 60 seconds until ripping. None of the other towels were close to Job Squad's time.

Brawny took 30 seconds until it wore away. Bounty took 16 seconds before wear and tear. High Dry came in last, with only 12 seconds.



C

Conclusion:

Based from both tests and graphs, I compared my results and found that my hypothesis was incorrect. Job Squad turned out to be the stronger brand in both tests. Job Squad was able to hold 264 pennies before breaking, and was able to last 60 seconds without wear or tear. In the hypothesis I predicted that Brawny would be the strongest, but found that it was 8 pennies short of being tied with Job Squad. In the Scrub and Rub test their was a great difference in the results: Job Squad lasted for 60 seconds, while Brawny was only able to last for 30 seconds-a difference of 30 seconds.

When making my hypothesis I had trouble decided on which brand would be the strongest. Two of the four paper towels were rather thick, but Bounty seemed to be a bigger sheet. In my hypothesis I was partly right, Bounty was strong-but not the strongest.

Job Squad is the better and stronger brand. It can handle force in numbers, and obviously it was built very well, firm, steady, and it was not easily broken.

The task[127]

After a study of the interactions that occur within ecosystems, students were asked to design a bio-box showing a pond ecosystem. Using pictures and models made from construction paper or clay, students were asked to depict both the living organisms and the non-living physical factors in a pond ecosystem. Students in groups of two to three met in a planning session to discuss a design for the ecosystem, using the diagram "Needs and Activities of Living Things" as a guide. Students gathered materials (e.g., glue, scissors, construction paper, tape, markers, colored pencils and a ruler) and made items to contribute to the bio-box which could be constructed in a shoe box, milk carton, or a 2L soda bottle cut lengthwise. In the second session, students constructed the bio-box. In the third session, students used the bio-box and their knowledge of interdependence to answer questions on the worksheet. Though the questions were answered by the entire group, the last section of the written component asked each student to list his or her individual contribution to the project, and the conclusions they drew about interactions in a pond ecosystem.

The task calls for the student to explore the range of available floating and sinking objects. In order to accomplish the task, it is necessary to combine floating and sinking objects to construct one of the correct density.

Circumstances of performance

This sample of student work was produced under the following conditions:

√ alone	√ in a group
√ in class	√ as homework
√ with teacher feedback	with peer feedback
timed	√ opportunity for revision

This work sample illustrates a standard-setting performance for the following parts of the standards:[128]

S2d Life Sciences Concepts: Populations and ecosystems.

S4a Scientific Connections and Applications: Big ideas and unifying concepts.

S5b Scientific Thinking: Use concepts from Science Standards 1–4.

S5f Scientific Thinking: Work individually and in teams.

[127] For related work on Interdependence, see "Biomes", page 104, "Owl Pellets", page 234, "Eagles", page 456, and "The Invincible Cockroach", page 460.

[128] The quotations from the Science performance descriptions in this commentary are excerpted. The complete performance descriptions are shown on pages 152-187.

Work Sample & Commentary: *Bio Box*
Middle School Science

What the work shows

S2d Life Sciences Concepts: The student produces evidence that demonstrates understanding of populations and ecosystems, such as the roles of producers, consumers, and decomposers in a food web; and the effects of resources and energy transfer on populations.

(A) The students demonstrate knowledge of the role of producer when they state "…carbon dioxide & water taken in [and] used by plants to make food."

(B) The students explain flow of resources within a system by explaining the dynamics of a food chain. Although their use of the term "food web" is erroneous, it is clear that they have a basic understanding of the functions of trophic levels.

S4a Scientific Connections and Applications: The student produces evidence that demonstrates understanding of big ideas and unifying concepts, such as order and organization;…change and constancy; and cause and effect.

(B) The students demonstrate understanding of order and organization.

(C) (D) Evidence of basic understanding of change and constancy is indicated in the students' statement concerning ecological balance.

(E) (F) The graphs showing the effect resources have on population size indicate an understanding of cause and effect.

S5b Scientific Thinking: The student uses concepts from Science Standards 1–4 to explain a variety of explorations and phenomena.

(C) (D) The students draw conclusions based on their knowledge of the roles of producers and consumers, and application of Science Standard S2d.

S5f Scientific Thinking: The student works individually and in teams to collect and share information and ideas.

(H) (G) The use of the plural "we" indicates that each student participated as a member of a team and contributed to the collective results.

THE LESSON

BUILD A BIO-BOX

"INTERDEPENDENCE IN A POND ECOSYSTEM"

Directions: Design a bio-box with items made from construction paper and clay, and magazine or drawn pictures of organisms that are found in a pond ecosystem. The box may be constructed from a shoe box, milk carton or a soda bottle (two-liter) cut lengthwise. Use the picture "Needs and Activities of Living Things" as a guide. Use the bio-box to answer the questions below about interdependence in a pond ecosystem.

1A. Look at the pond ecosystem and make a list of the living organisms.

LIVING ORGANISMS

The living organisms are: butterflies, spiders, lizard, frog, turtle, dragonfly, pond snake, tree, lilypads, insects and land strips, protozoas.

1B. Make a list of the nonliving, physical factors in the pond ecosystem.

NONLIVING PHYSICAL FACTORS

The non-living things are: air, water, sunlight, rocks, and earth.

2A. Using the bio-box as your guide, complete the chart below indicating which organisms are the producers, consumers and decomposers.

PRODUCERS	CONSUMERS	DECOMPOSERS
• plants	• frog	• bacteria
• trees	• turtle	• fungi
• pond lily	• snake	
	• lizard	
	• spider	
	• butterflies	

(2)

2B. Define these words using your knowledge of pond life:

Producer: To bring about; create. To make a special process For example: a plant making its own food.

Consumer: One that consumes. That eats the producer. For example: a frog

Decomposer: A fungus or a bacteria which grows and eats dead animals and plants.

3A. Sunlight is the major source of energy in the pond ecosystem.

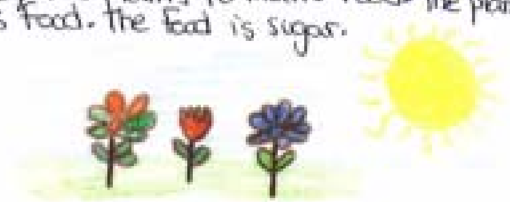
Draw a diagram and write an explanation for each sentence below, which describes how the living organisms use the sun 's energy. Use the words photosynthesis and food web in the diagram in which it is appropriately used.

A PLANT GROWS IN THE SUNLIGHT

Photosynthesis

A

The process by which food can be produced by plants is called photosynthesis. The plants chlorophill attracts the energy from the sun. Then carbon dioxide and water taken in. Those are used by the plants to make food. The plants give us back oxygen and keeps its food. The food is sugar.



AN INSECT EATS A PLANT, AND THE FROG EATS THE INSECT.

Food Web

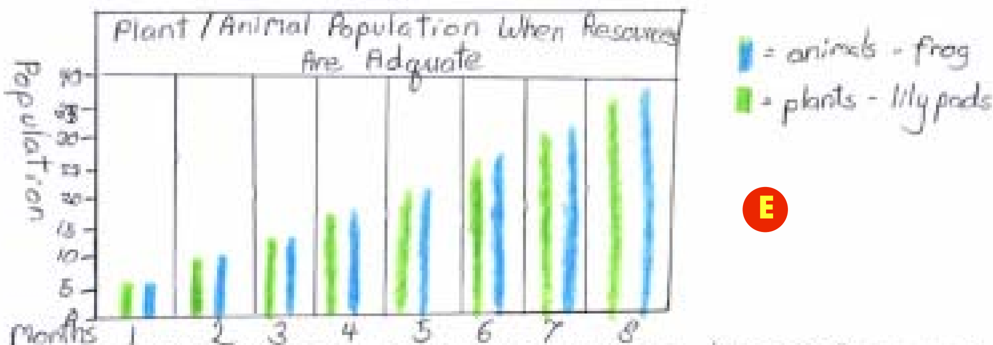
B

This picture shows a part of a food web. It all starts with the cattail attracting the sunlight to make energy. The cattail is the producer. Then, a grasshopper comes along and eats the plants. This is the consumer. On top of the web, is the frog. It is a consumer. It is a carnavore. The frog eats the grasshopper. This is how a food web works.

(3)

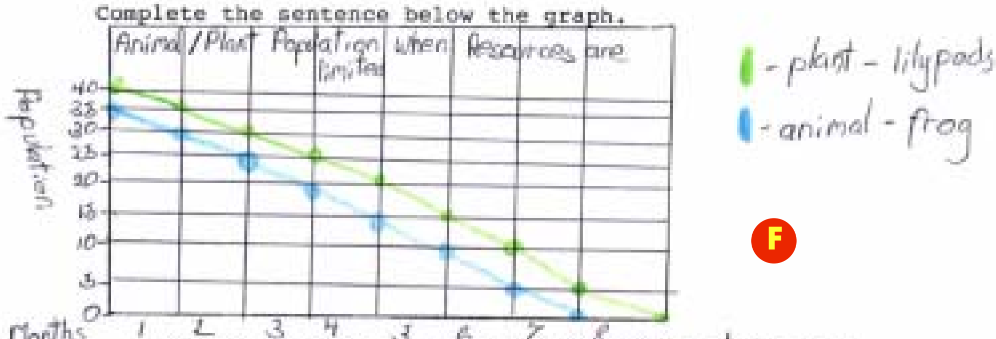
MAKE A PREDICTION

4A. Draw a graph showing what you think will happen to one plant and one animal population in your pond ecosystem when there are adequate (enough) resources, no diseases or predators. Be sure to label the graph properly and give it a title. Complete the sentence below the graph.



The populations in the pond ecosystem increase at rapid rates when the resources are adequate.

4B. Draw a graph showing what you think will happen to one plant and one animal population in the pond ecosystem when the resources are limited. Be sure to label the graph properly and give it a title. Complete the sentence below the graph.



The populations in the pond ecosystem decrease when resources are limited.

(4)

STUDENT ACCOUNTABILITY:

Each member of the team individually answers the questions below:

NAME: **CLASS:** **DATE:** January 13, 1998

1. What did you contribute to this project? In the space below, describe what you contributed to the design and building of the bio-box pond ecosystem, and the information that you contributed in answering the questions that were given to your team. If you need additional space, please feel free to write on the back of this page.

I brought in a shoe box, glue, scissors, markers, construction paper, scotch tape, pictures, leaves, and typing paper. I also went on the computer to do research on the pond ecosystem and I got a couple of pictures of animals that live in the pond ecosystem

C

2. What conclusions can you draw about the interactions in a pond ecosystem? I can conclude that a pond ecosystem has a food chain, and when the food chain is not balanced the animals and plants start dying.

G

3. List at least one (1) thing that you liked about doing this project, and at least one (1) thing that you disliked about doing this project. I liked this whole project. because we got to learn how plants and animals interact in a pond ecosystem. The only bad part was that we did not have a lot of time to do this project

(4)

STUDENT ACCOUNTABILITY:

Each member of the team individually answers the questions below:

NAME: **CLASS:** **DATE:** Dec. 11, 1998

1. What did you contribute to this project? In the space below, describe what you contributed to the design and building of the bio-box pond ecosystem, and the information that you contributed in answering the questions that were given to your team. If you need additional space, please feel free to write on the back of this page. What I contributed to the project was the shelled turtle, the pebbles, the glue, and the magic markers. I did not bring lots of supplies, but I took my share in the project and did most of the work, like measuring paper, drawing, and Cutting alot of things out.

D

2. What conclusions can you draw about the interactions in a pond ecosystem? If the pond is not polluted, the animals and plants will have a good balance and live great. If the water is polluted, the plants will die, have no food for the insects, so the insects will die, and the frog will Starve. Thats why The food web is needed.

H

3. List at least one (1) thing that you liked about doing this project, and at least one (1) thing that you disliked about doing this project. I loved the project, the whole intire thing. It was all exiting having to do something with the pond. The only thing I disliked was the time of work we had. It was so fun. I never wanted to take my hands off of it.

Work Sample & Commentary: *Owl Pellets*
Middle School Science

The task[129]

After a study of structure and function, students were asked to dissect owl pellets and to reconstruct the skeletal remains of animals contained within.

This activity is followed by a research report which includes the following information:

- Owls as predators,
- Conclusions about the diet and habit of the owl that made the pellet,
- How scientists determine the predatory structures and behaviors of dinosaurs, and
- A bibliography of books and internet sources used to compile the report.

After completing the dissection activity and the written component, students designed a labeled pictorial food web showing nutritional hierarchy based upon their analyses of their owl pellet.

Note: Commercially available owl pellets are sterilized and do not present a health or safety problem.

Circumstances of performance

This sample of student work was produced under the following conditions:

√ alone	√ in a group
√ in class	√ as homework
√ with teacher feedback	with peer feedback
timed	√ opportunity for revision

This work sample illustrates a standard-setting performance for the following parts of the standards:[130]

S2a Life Sciences Concepts: Life cycles of organisms.

S2d Scientific Thinking: Use concepts to explain observations.

S5b Scientific Tools and Technologies: Use technology and tools.

S5f Scientific Communication: Represent data and results in multiple ways.

What the work shows

S2a Life Sciences Concepts: The student produces evidence that demonstrates understanding of structure and function in living systems, such as…whole organisms, and ecosystems.

(A) Based upon their analysis of owl pellets and follow-up research, students designed a labeled, pictorial food web showing a nutritional hierarchy.

(B) The written “Analysis of Food Web” provides further evidence of understanding of structures and functions in an ecosystem.

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[129] For related work on Interdependence, see “Biomes”, page 104, “Bio Box”, page 225, “Eagles”, page 456, and “The Invincible Cockroach”, page 460.

[130] The quotations from the Science performance descriptions in this commentary are excerpted. The complete performance descriptions are shown on pages 152-187.

The conclusion (D) about the diet of the owl that produced the pellet the student dissected is based on careful observations (C), and indicates an understanding of predatory and digestive structures and functions.

S2d Life Sciences Concepts: The student produces evidence that demonstrates understanding of populations and ecosystems, such as the roles of producers, consumers, and decomposers in a food web....

(D) The conclusion provides evidence of this understanding when it relates physical structure to predatory role.

(E) Additional evidence is provided by the table that organizes research into the ecological roles of organisms whose remains were found in the owl pellet.

S5b Scientific Thinking: The student uses concepts from Science Standards 1 to 4 to explain a variety of observations and phenomena.

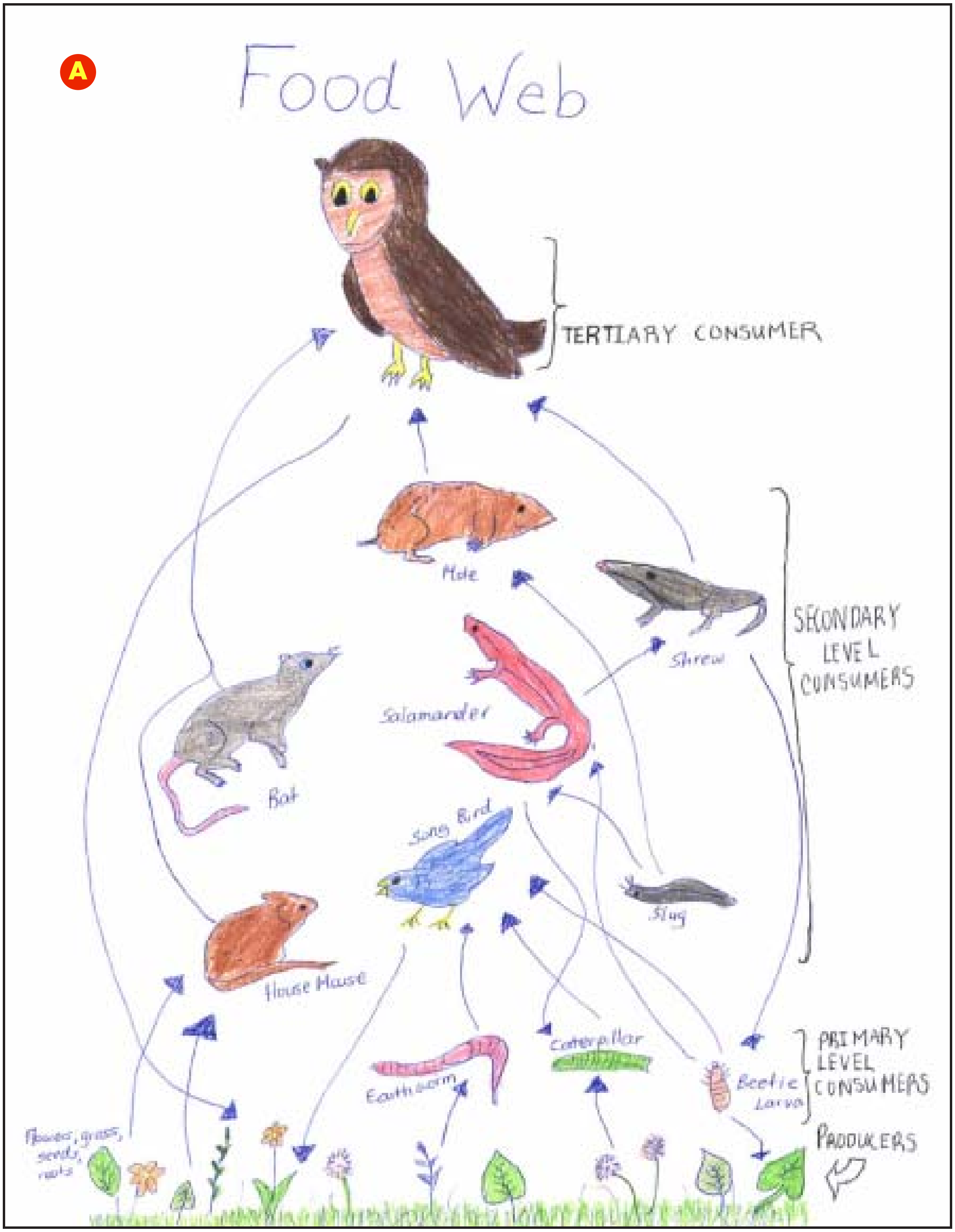
(D) The conclusion accurately applies Science Standard **S2a**, especially as it relates jaw structure to diet.

(E) The table showing the organization of the food web accurately applies Science Standard **S2d**.

(F) Students successfully applied Science Standard **S2a** when they assembled the bones found in the pellet, and added the descriptive notes about physical structures to the left of the diagram.

S5f Scientific Thinking: The student works individually and in teams to collect and share information.

(A) (B) (C) (D) (E) (F) Throughout this investigation, students worked in groups to analyze the food web and to assemble the bone structure of the organisms that the owl ate. Use of the words "our" and "we" in (C) and (D) clearly indicate that this was a team effort.


A
Food Web
TERTIARY CONSUMER
Mole
Shrew
SECONDARY LEVEL CONSUMERS
Salamander
Rat
Song Bird
Slug
House Mouse
Caterpillar
Earthworm
Beetle Larva
PRIMARY LEVEL CONSUMERS
PRODUCERS
flowers, grass, seeds, roots

B

Analysis of Food Web

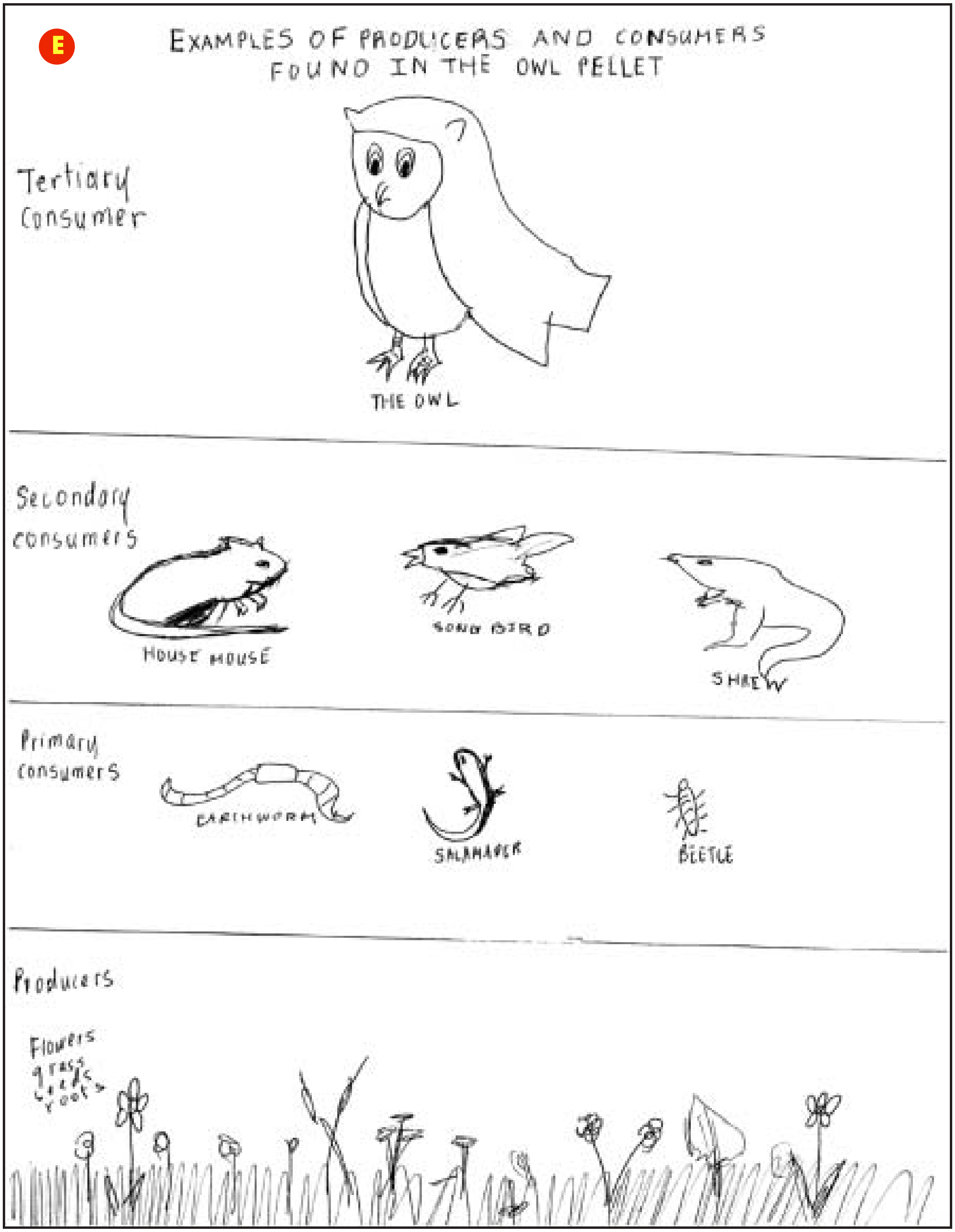
FOR OWL PELLET DISSECTION

Producers: producers are mainly plants such as flowers, grass, seeds, and roots. These organisms are the basis of the food web, and is the essential key to all life because they absorb the sun's energy. They make glucose, which is eaten by other organisms.

Primary level/consumers: consumers are herbivores such as gerbils, earthworms and a variety of insects. They feed on the plants. They are the main source of meat for the predators because they contain energy made by producers.

Secondary level/consumers: These consumers consists of carnivores and omnivores such as rodents, salamanders, and birds. They feed on the herbivores and occasionally some producers.

Tertiary level / consumers: These consumers are strictly carni-vores and is represented as the owl in this Food web Their diet consists of animals from the primary and secondary levels.


E
EXAMPLES OF PRODUCERS AND CONSUMERS
FOUND IN THE OWL PELLET
Tertiary consumer
THE OWL
Secondary consumers
HOUSE MOUSE
SONG BIRD
SHREW
Primary consumers
EARTHWORM
SALAMANDER
BEETLE
Producers
Flowers
grass
seeds
roots

F

FOR THE DISSECTION OF OWL PELLET

Identify the functions of some of the bones:
example: teeth, claws, arms, legs.
* Use scientific names only

Skull: To protect the brain

mandable: Teeth to chew and grind.

Scapula
Humorous
Ulna
} Arm to pick up and burrow.

Radius = Part of arm.

Ribs = To protect lungs and heart.

Vertebra: Part of backbone that holds up body

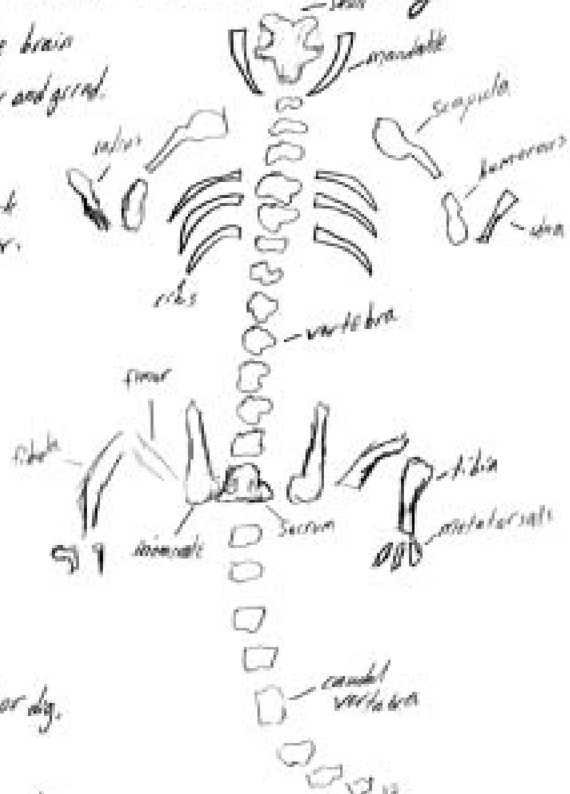
Femur
Fibula
Tibia
} Legs to walk and run.

metatarsals = Toes to grab or dig.

Innominate = Hold the leg.

Sacrum = To hold up innominate.

Caudal Vertabra = Part of tail.



Owls

1. Owls as Predators

Owls are one of the best hunters in the world. Most owls are nocturnal, that means they sleep during the day, and are active during the night. There are however some owls that are active during the day. Owls hunt a variety of animals including mice, rats, moles, shrews, small birds, lemmings, and some types of insects and lizards. Although owls are often on top of the food chain, sometimes they feed on each other such as the Hawk and Great Horned owls would on the Spotted owl. Before launching an attack, owls spend from a few seconds to several hours watching and listening to their pray. When they strike, they attack from relatively short distances from their prey.

2. Conclusions Drawn from the Owl Pellets

a) What are owl pellets?

When an owl eats an animal it swallows it whole, without chewing. Once it reaches their intestines the meat and flesh of the animal gets digested, but the fur, bones, and other things that are too hard to digest are stored in another part of the owl's stomach. They form a small egg sized pellet which is later regurgitated by the owl. The skeletons of the animals eaten by the owl are kept well preserved in the pellets.

b) <u>What did we find in our owl pellet?</u>

C After our group had dissected the owl's pellet we saw a lot of fur and hair. Using the instruments,we had our group members pick out the different bones that were in the pellet. We were able to form an almost perfect skeleton of a shrew. In addition to that we had found two more fractured skulls and some more bones. Using the chart we had in our class room we identified the bones to be bird bones.

c) <u>Conclusions on the owl's diet</u>

D Knowing that this was a barn owl's pellet we can conclude that the barn owl is a carnivore who has the same inner functions as any other owl. We can also conclude that the barn owl feeds on small birds and shrews. By studying the jaw bones of those animals we see that they are also carnivores because they have strong sharp teeth.

d) <u>What is the owls habitat like?</u>

Most owls live in canopies, rocky cliffs, and in very old forests filled with different species of conifers. The climate there is basically mild, cold in the winter, and warm in the summer. There is one exception, and that is the snowy owl; it lives in arctic climates were it is always cold. In regions were most owls live the animals they hunt are mice, moles, rats, small birds, shrews, and some lizards and insects. These animals need a habitat which provides them with smaller animals such as snails, caterpillars, and voles to eat. Those animals need a habitat which provides them with flowers, grass, and roots to feed on. So the places listed above provide perfect habitats for owls because they feed on smaller animals. They provide a perfect habitat for smaller animals because they feed on even smaller animals, and they provide a perfect habitat for even smaller animals because they feed on plants.

3. Based on Finding Dinosaur Bones, How Can Scientists Determine the Story Line of Dinosaurs?

The bones of a dinosaur can tell you a lot about it. You could see how it was structured, and that would tell you it's diet and lifestyle. If you look at the teeth of the dinosaur you could tell if it was a herbivore or a carnivore because a carnivore would need strong, sharp teeth to pierce through the flesh of an animal, and a herbivore wouldn't. You could tell how old the dinosaur was by checking if it's bones were fully developed. You could also tell whether it had any special features to help it survive in it's environment. For example an animal would need strong legs if it chased it's prey for a long distance therefore, it's bones would have adapted to that need. Scientists have been observing and deriving information from dinosaur bones for many years, and that's why we know so much about them even though they died billions of years ago.

References: World Scope Encyclopedia

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