Mathematics, Science & Technology

PART II.2

NOTE: This document is a work in progress. Parts II and III, in particular, are in need of further development, and we invite the submission of additional learning experiences and local performance tasks for these sections. Inquiries regarding submission of materials should be directed to: The Mathematics, Science, and Technology Resource Guide, Room 681 EBA, New York State Education Department, Albany, NY 12234 (tel. 518-474-5922).

NEW YORK
THE STATE OF LEARNING

http://www.nysed.gov

INTERMEDIATE

How Is This Disease Being TRANSMITTED?

Standards & Performance Indicators

MST 1
- ▲ defend formal proposals

MST 4
- ▲ living/nonliving environment

MST 6
- ▲ study processes
- ▲ different models

MST 7
- ▲ design solutions
- ▲ observe phenomena
- ▲ work effectively
- ▲ gather/process information
- ▲ generate/analyze ideas
- ▲ observe common themes
- ▲ realize results
- ▲ present results

Adapted from activity 1.3 from the *New York Science, Technology, & Society Education Project* (NYSTEP) Module "Epidemics: Can We Escape Them?"

Resources
- **Epidemics Data Book which includes a copy of the NYSTEP module, "Epidemics: Can We Escape Them?" NYSTEP, 89 Washington Ave, Room 674 EBA, Albany, NY 12234, (518) 486-0858**
- **Stereotypical scientist props (e.g. white lab coat, large magnifying glass, clipboard, etc.)**
- **Copies of mortality cards**
- **Copies of Host and Environmental Messages**
- **Poster paper for wall-sized map**

This lesson is implanted in a thematic unit on water pollution. The issue is made relevant to the students through preliminary data collection on a toxic waste site which is located in the middle of the community.

After introducing the unit through minor play acting, the teacher supplies students with the "Epidemic Scenario" and the *Epidemics Data Book* and describes the "Let's Find the Killer" activity. Over the next 15-20 class sessions, the teacher will post mortality cards, "Host messages," and "Environmental Messages" in a common location. Students will record the mortality data and 'messages' daily.

Students begin the lesson during the conclusion of the local toxic waste site data collection

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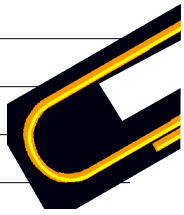
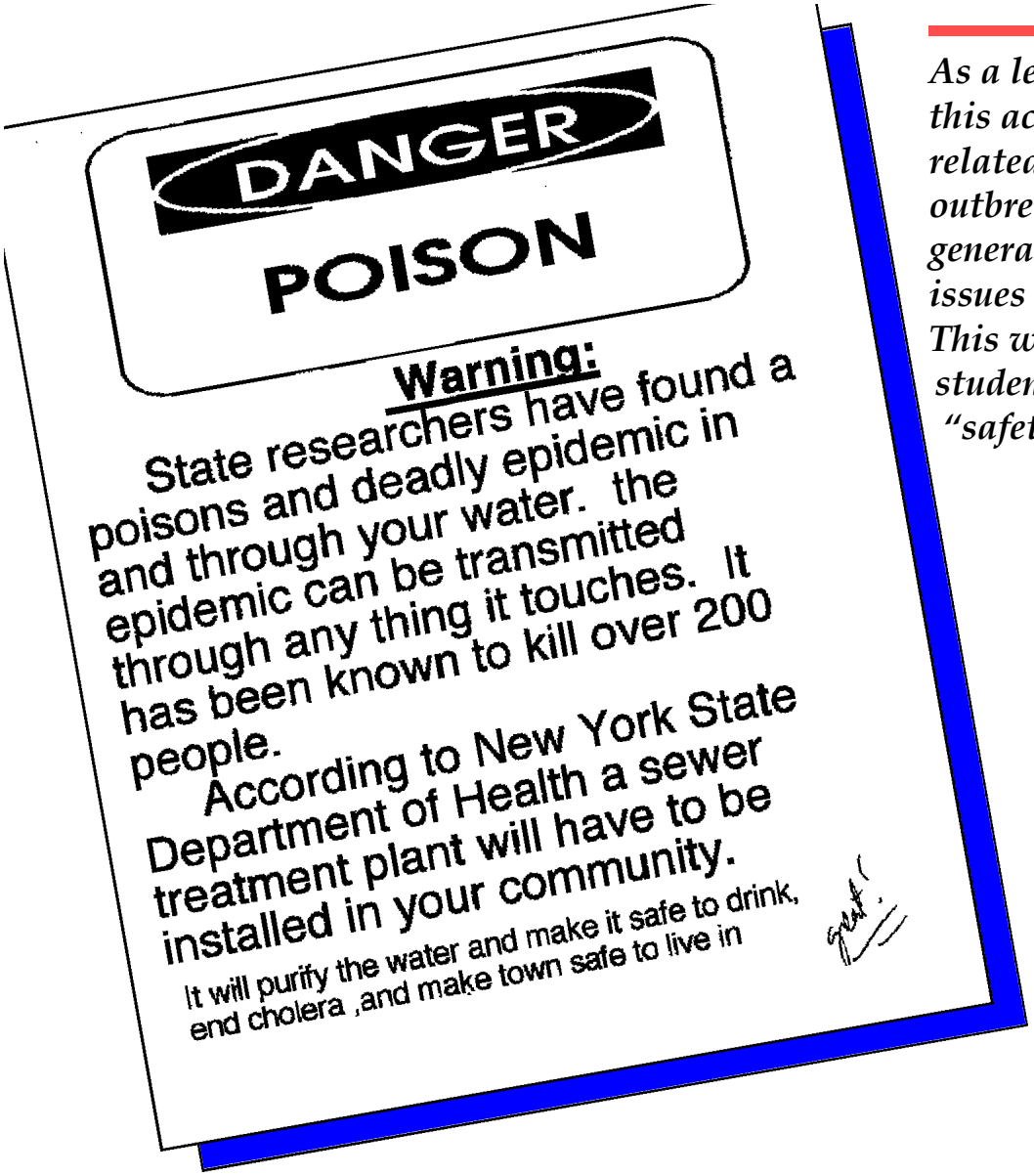


Grade 8



As a lead-in or extension to this activity, current events related to the Ebola virus outbreak can be used to generate discussion related to issues surrounding epidemics. This will eliminate the student's sense of historical "safety" from epidemics.

Teacher

and *before* discussion begins on sewage treatment. They begin this lesson by reading the "Epidemics Scenario" describing the events surrounding deaths from a mysterious 'killer' in a model city. Using a data booklet tilted, *Epidemics Data Book*, the students record information on deaths caused by a mysterious "killer" during several days of class. Students plot mortality data on a grid of the city for a more graphical representation of the location and frequency of the deaths. They use their data and evidence related to the *host* and the *environment* to try and determine the cause of the deaths as well as the location of the killer. At the end of the investigations, students take action to help stop the killer through a public awareness poster campaign.

Using local resources (County Health Department, village offices, the Department of Environmental Conservation, and newspapers), I assembled materials related to water contamination issues in Groton. As my students work though recording the mortalities on the map activity, there is a component strand of lessons that takes the students through an information search related to two toxic waste sites in town. I use a worksheet format for each of the searches that employs a similar mapping approach as the one used in the NYSTEP activity.

Although the materials illustrated here are specific to my region, the common sources of information used in retrieving materials makes it easily adaptable to most other regions of the State.

ASSESSMENT

"Let's Find the Killer" Grading sheet

Name _____

This grading sheet is to be attached to your data booklet, graph, facts, definition and poster at the completion of this topic. Use this sheet as a check list before you submit your work to insure you have included all the required components.

You have been following the deaths caused by a mysterious killer. Your goal was to use the data to figure out where the killer was located. Now that the assignment is over, you must complete the following for your grade:

Hand-in your *completed* EPIDEMICS DATA BOOKLET **(40 points):**

0	10	20	30	40	
not submitted	incomplete	poorly completed	proficient	exceptional	_____

A **graph** of the death per day **(20 points)**

Proper graphing rules used

0	2	4	6	8	10	
no graph			proficient		all rules applied	_____

Accurate representation of data

0	2	4	6	8	10	
no graph		incomplete data	proficient		data accurate	_____

Prediction about where the killer is located [NOTE:this must be supported with **three (3)** facts drawn from your data.] **(15 points/ 5 points each properly supported prediction)**

Fact #1

0	5	
no evidence	correlates to data	

Fact #2

0	5	
no evidence	correlates to data	

Fact #3

0	5	
no evidence	correlates to data	_____

Describe the disease known as **Cholera (10 points)** yes no _____

A **public notice** promoting a sewer treatment plant in the city. This is a 1 page poster that **must** include the following: **(15 points)**

Heading (to quickly tell what you are saying) **(5 points)** yes no _____

List of several (3-4) advantages a sewer treatment plant will give to the city . **(5 points)**

0	1	2	3	4	5	
none listed			proficient		exceptional	_____

Artistic merit (How good does it look ?) **(5 points)**

0	1	2	3	4	5
none		poorly drawn		proficient	exceptional

Total points (out of 100) _____

J. Overhiser (Groton Middle School)

EPIDEMICS DATA BOOK

"Let's Find the Killer!"

NYSTEP Module "Epidemics: Can We Escape Them?"
Activity 1.3 "How is this disease being transmitted?"

NAME _____

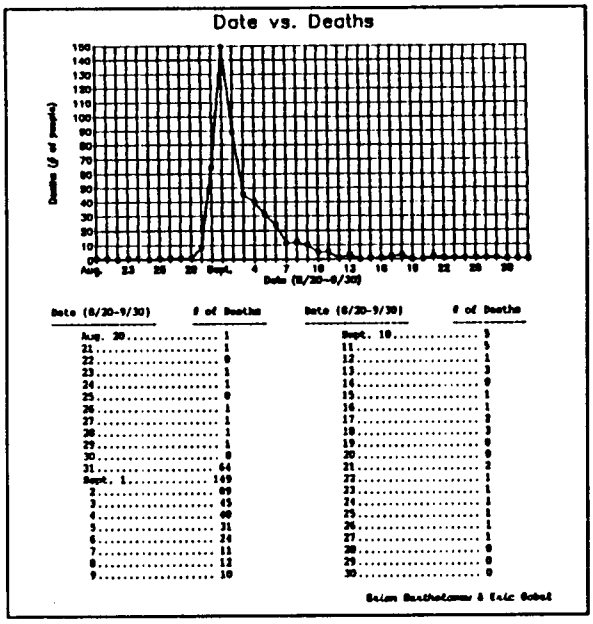
1. STUDENT WORK: EXCELLENT SAMPLE

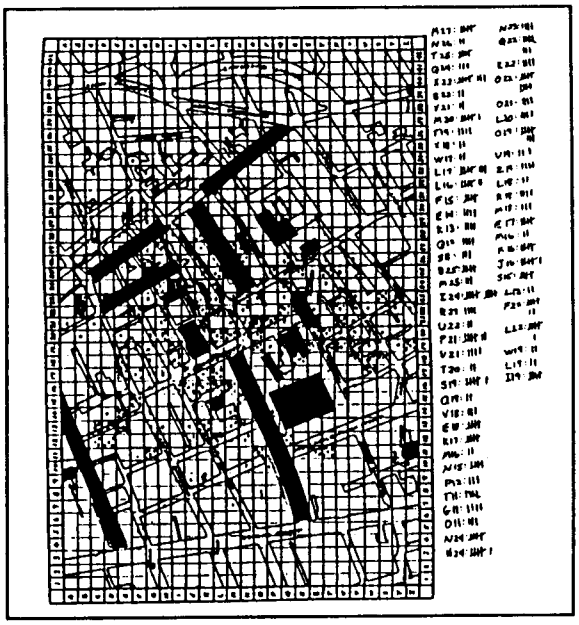
Teacher Commentary

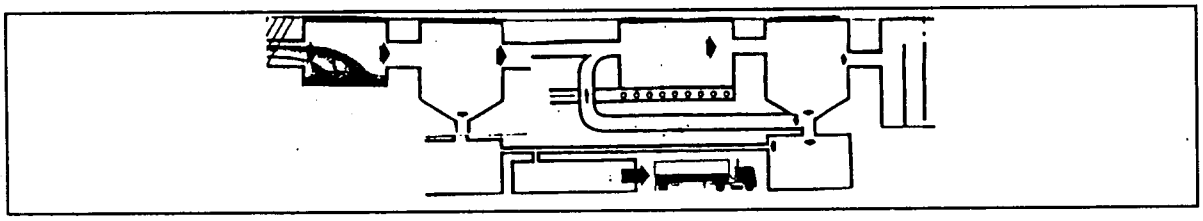
The sample:

- demonstrates that students organized and interpreted data.
- describes questions raised and explores task-related science concepts and principles.
- considers costs, benefits, and risks of building a sewage treatment plant.
- uses computer-generated drawings to illustrate a plan for the sewage treatment plant.
- presents an appropriate solution to the problem.

Student Work #1







Possible Location of Killer:
We think that the killer is located near the pump at the corner of Broad Street and Little Windmill Street.

Three reasons that we think this are:

- There were 10 deaths in the area right next to the pump.
- There were 10 deaths in two areas near the pump that would most likely use it, housing of the very poor and near the street vendors, when someone might want to get a free drink after eating.
- The priest found that almost all of the people using the pump died later, but when the priest removed the pump handle, few people died near the pump.

Raw sewage may be the cause of this rampant epidemic! Some officials now believe that this present epidemic is caused by the raw sewage that our town has produced recently. A few ambitious locals have suggested building a sewage treatment plant to rid our town of this problem. Yet, despite of this tragic epidemic that has taken the lives of literally hundreds of our neighbors, some people in our town refuse to accept the building of a sewage treatment plant by using their tax dollars. As of September 10, today, the deaths due to this plague has been lowered to merely one. But their is no guarantee that this epidemic is finished with us yet. If we, in London, all band together to ward off this plague, then one weapon we might employ would be this proposed sewer treatment plant. Without this establishment to be rid of pathogens, or harmful bacteria, we might never be free of this infectious plague. Please, as a salute to those who have already died, and for those who still live, support the creation of this sewer treatment plant.

Epidemics Project:
Cholera is a very serious disease caused by the bacteria Vibrio cholerae. The way infection occurs is usually through contaminated drinking water. You may suspect you have this disease if you experience the symptoms of: excessive diarrhea, and vomitting. After this you would experience muscle cramps, be very thirsty, and have cold, wrinkled skin. The preceding are a result of lost fluids due the diarrhea experienced earlier. If the lost fluids are not returned to the body, you may go into a coma, and death would come within twenty-four hours. The best way to prevent this is to have a pure drinking water source. But, if you happen to contract this disease, this disease may be treated by a drug called Tetracycline. Taking a saline by IV could save your life, but it costly.

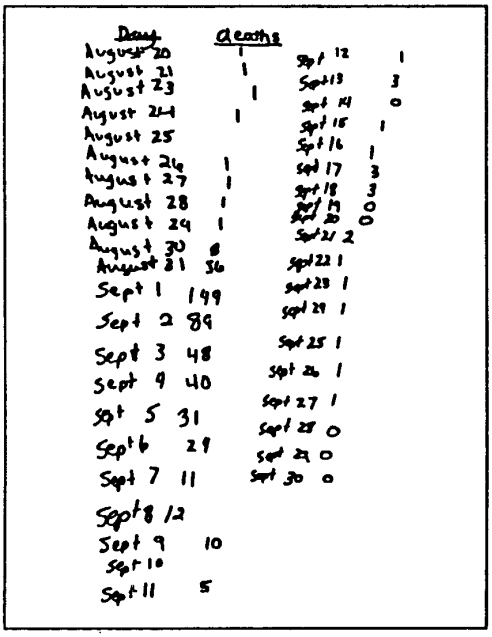
2. STUDENT WORK: PROFICIENT SAMPLE

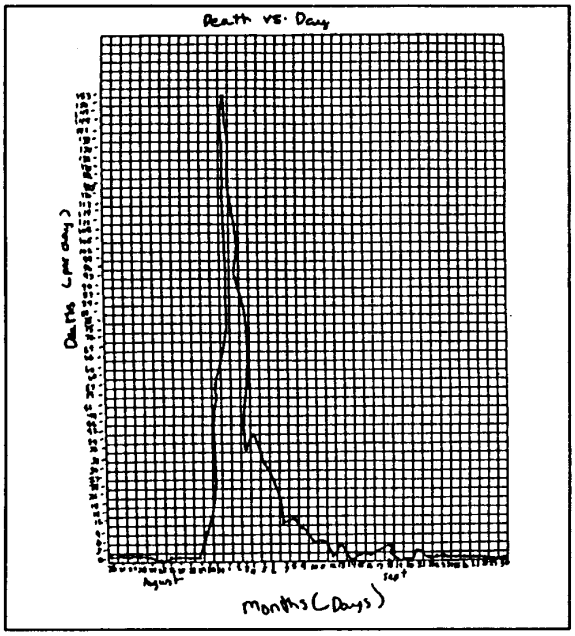
Teacher Commentary

The sample:

- demonstrates that students organized and interpreted data.
- describes questions raised and explores task-related science concepts and principles.
- uses a variety of sources to present accurate and relevant information.
- presents an appropriate solution to the problem.

Student Work #2





I think the killer was located on Broad Street because:

1. That's where the pump was. When the pump was removed the deaths decreased.
2. In host message #4, the women wasn't sick until she came into town from the countryside. Therefore you know the killer is located somewhere in the town.
3. The pump was contaminated, and when people drank water coming from that pump they got cholera and died.
4. In host message #3 it describes the symptoms these people had. They are the same symptoms of cholera, which means there has to be a contaminated well. The only pump is on Broad Street, so you know that's the killer.

Cholera:

Cholera is an acute infectious disease in humans caused by the bacterium Vibrio cholerae. It usually occurs from drinking contaminated water. Symptoms of this disease are: diarrhea, vomiting, loss of fluid and salts, muscle cramps, severe thirst, and cold, wrinkled skin. The preventive is a supply of pure drinking water.

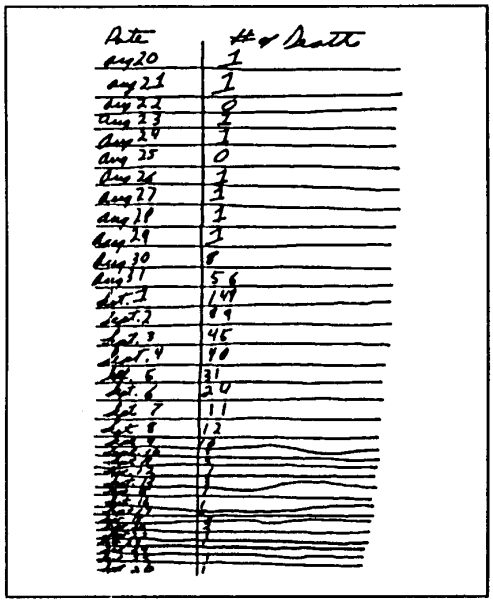
3. STUDENT WORK: ACCEPTABLE SAMPLE

Teacher Commentary

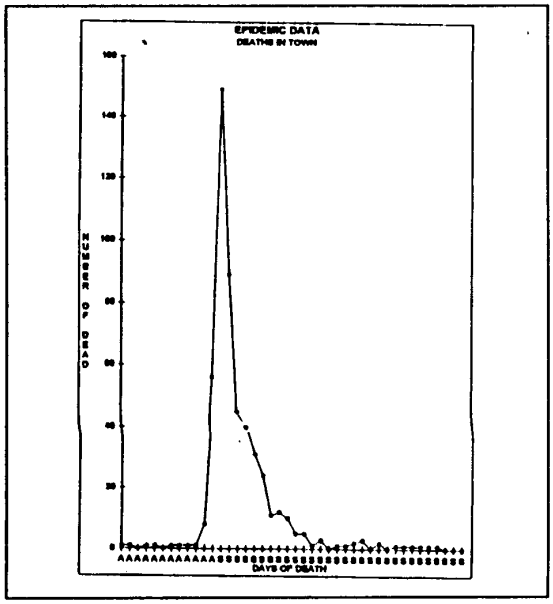
The sample:

- demonstrates that students organized and interpreted data.
- uses the computer to display data.
- presents an appropriate solution to the problem.

Student Work #3



Date	# of Death
aug 20	1
aug 21	1
aug 22	0
aug 23	1
aug 24	1
aug 25	0
aug 26	1
aug 27	1
aug 28	1
aug 29	1
aug 30	8
aug 31	56
sept 1	149
sept 2	89
sept 3	45
sept 4	40
sept 5	31
sept 6	20
sept 7	11
sept 8	12



I think that the killer is between and on Broad Str., Little Wind Mill Str., Nevy Str., and the School. I think they are there because that is where most of the deaths are happening, the pump is there, and because they are blocked in all directions by the new sewer system.

Cholera is an infectious disease that is caused by the bacteria Vibrio Cholerae. People get infected by the bacteria through contaminated drinking water. The

symptoms are usually diarrhea, dizzyness and faintness before vomiting. That lets go of some of the salts and other fluids in the body, gives people muscles cramps, severe thirst, and cold, wrinkled skin. The fluid have to be returned to the body or a person may go into a coma and die in less that 24 hours. Saline solution can save your life, but it cost a lot ornf money. Tetracycline may also help in the recovery of a person.

4. STUDENT WORK: UNACCEPTABLE SAMPLE

Teacher Commentary

The sample:

- is missing a prediction and justification about the identity of the killer.
- does not demonstrate interpretation of data.
- does predict benefits in building a sewage treatment plant.
- presents an appropriate solution to the problem, but does not explain why it is important.

Student Work #4

Poster:

We need it! Groton needs a sewer treatment because 150 died from having Cholera in their water system. If we have a sewer treatment we will be able to cloranate the wataer. Which will kill the bacteria and it will save many peoples lives.

REFLECTION

REFLECTION:

Although the lesson is designed to be a convergent, problem-solving activity, it has divergent potential. I feel the data does not serve to make the answer too obvious, thus allowing students to arrive at varying conclusions. Furthermore, the database is complete enough to support various conclusions. Allowing for personal interpretation can create a sense of ownership to students, giving them confidence in a learning environment.

There is a current, overall emphasis being placed on a constructivist approach to teaching/learning. One major component of constructivist learning models is making learning *relevant* to the learner. Compared to a canned, textbook-style lab activity, the design of this activity supports the students generating their own response based on their own data by conveniently framing science inquiry, mathematics, and technology into the socially relevant issue of epidemics.

COMMENCEMENT

Standards & Performance Indicators

The Parachute

MST 1
- ▲ elaborate explanations
- ▲ test observations
- ▲ present proposals
- ▲ complete research plan

MST 4
- ▲ motion of objects

MST 6
- ▲ collect information
- ▲ predictions

Resources
The parachutes are muslin obtained from a local fabric store. The basket was obtained at a party supply house (plastic wedding basket favors). The paper clasps may be purchased at an office supply store. It may be necessary to put a dot of glue on the rope knots to prevent slipping or unraveling due to drops.

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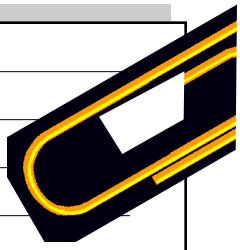


Grades 11 & 12

The Parachute is an activity in which students design and then conduct an experiment to investigate the effects of various factors on the rate of fall of parachutes.

This learning experience was designed as a variance for the Physics Regents examination (35percent Option). In addition to supporting student progress toward meeting the Mathematics, Science, and Technology learning standards, the goal of this experience was to incorporate performance tasks into the examination to assess the skills, processes, and kinds of thinking that are essential in an investigatory science project but are not adequately evaluated in the traditional Regents examination. In this experience, the students were assessed on experimental design, observational skills, graphing and interpretation, critical thinking and synthesis, and error analysis.

Aconstructivist learning model is implicit in this learning experience, with students first engaged, and then involved in exploring a natural phenomenon, explaining their observations, and then applying the knowledge they have constructed to make predictions. Assessment occurs throughout the experience.

To succeed with this learning experience, students need to have an understanding of the concepts of free fall and gravity as well as skills in solving a problem by designing, conducting, and evaluating a scientific experiment using an appropriate model.

STEPS

1. After engaging student interest in parachutes (by referring to Leonardo da Vinci's plans for such a device, for example, and the effect of free fall on human bodies), students are asked to write a procedure to determine the effect of different size parachutes and different masses on the time it takes the masses to fall. Students are asked to study the nature of a parachute and the factors that affect the time of fall.

2. The students are divided into groups and each group is given a stopwatch, several masses, a balance, a meter stick, and materials to construct parachutes.

3. The students work in groups to perform a mutually agreed upon procedure. They record all their data, and repeat steps as needed. From this point on, the students work as individuals consistent with the protocol for an exam. If this were a class activity they might continue to work in groups.

4. After completing the experiment, students are asked to write three observations they made, plot a graph, interpret the graph, and evaluate the reliability of the data and sources of error. They also interpret their experimental data to determine the mathematical relationship between time of fall and the parachute mass.

5. Students are asked to perform the following experiment at home. They push a plastic cup into a sink full of water and observe the resistance to the pushing as they make a hole; and then enlarge the hole in the bottom of the cup. They are then asked to apply their results with the plastic cup to the use of an adjustable hole in the top of a parachute. They are to predict the effect of a hole in the parachute and then cut the hole and actually measure the effect.

6. Students are presented with a diagram of a parachute with an attached basket, and are asked to draw and label the forces acting on this combination which causes its vertical motion. They also must calculate the speed with which the parachute hit the ground.

7. Students are provided with an experimental procedure for measuring the relationship between the diameter of a parachute and the time of fall. They are asked to critique the procedure, indicating if it is clear and if it is adequate to obtain the desired information. They must also compare this procedure to their own procedure.

During the experimental phase, **Step 2**, the teacher coaches the groups to insure that, for example, they construct a functioning parachute, measure the drop distance, and discard the results if the parachute hits an obstacle.

The Activity

THE PARACHUTE

No one knows when the first person took a large piece of cloth, held it over his/her head, and jumped off a hill to experience the effect of a parachute. We do know that Leonardo da Vinci provided detailed plans for such a device. Obviously, it is important to anyone who plans to jump out of a plane that manufacturers of parachutes understand how they work.

You will be conducting a series of experiments which will give you some insight into the behavior of a parachute. Working as a group you will have the opportunity to discuss what to do and how to do it. Before a group meeting you may be asked to describe what you think should be done or, after a group meeting, you may be asked to describe, analyze, assess, or critique what was done. Although you will, in part, be working with a group, you are free to report your own results.

ASSESSMENT

Students are assessed throughout the activity on the following:

1. the procedure for the experiment
2. the data obtained.

THE EXPERIMENT

Each group will have been given the following materials:

a stopwatch, a meter stick, four circles of cloth of differing diameters to use as parachutes, five weights, a small basket to hold the weights, and a triple beam balance. The basket has four equal length cords tied to it with clips on the end of each cord so that the basket can be attached to the parachute material.

The aim of the experiment is to determine the effect of different size parachutes and different masses on the time it takes the mass to fall.

Based on the aim of this experiment and the equipment given, describe the procedures you would use to accomplish this aim. Your description may be in outline form, but you must use complete sentences. Be as clear as you can be about what must be done. If something is to be repeated, be clear as to how many times. You may use any or all of the equipment. Use the worksheet provided for your description.

SECTION 1

Write the description of your experiment in the space below. You may use the back if needed. (*5 points)*

RUBRIC *(5 points)*

a) Student provides a procedure which is logically ordered and complete.

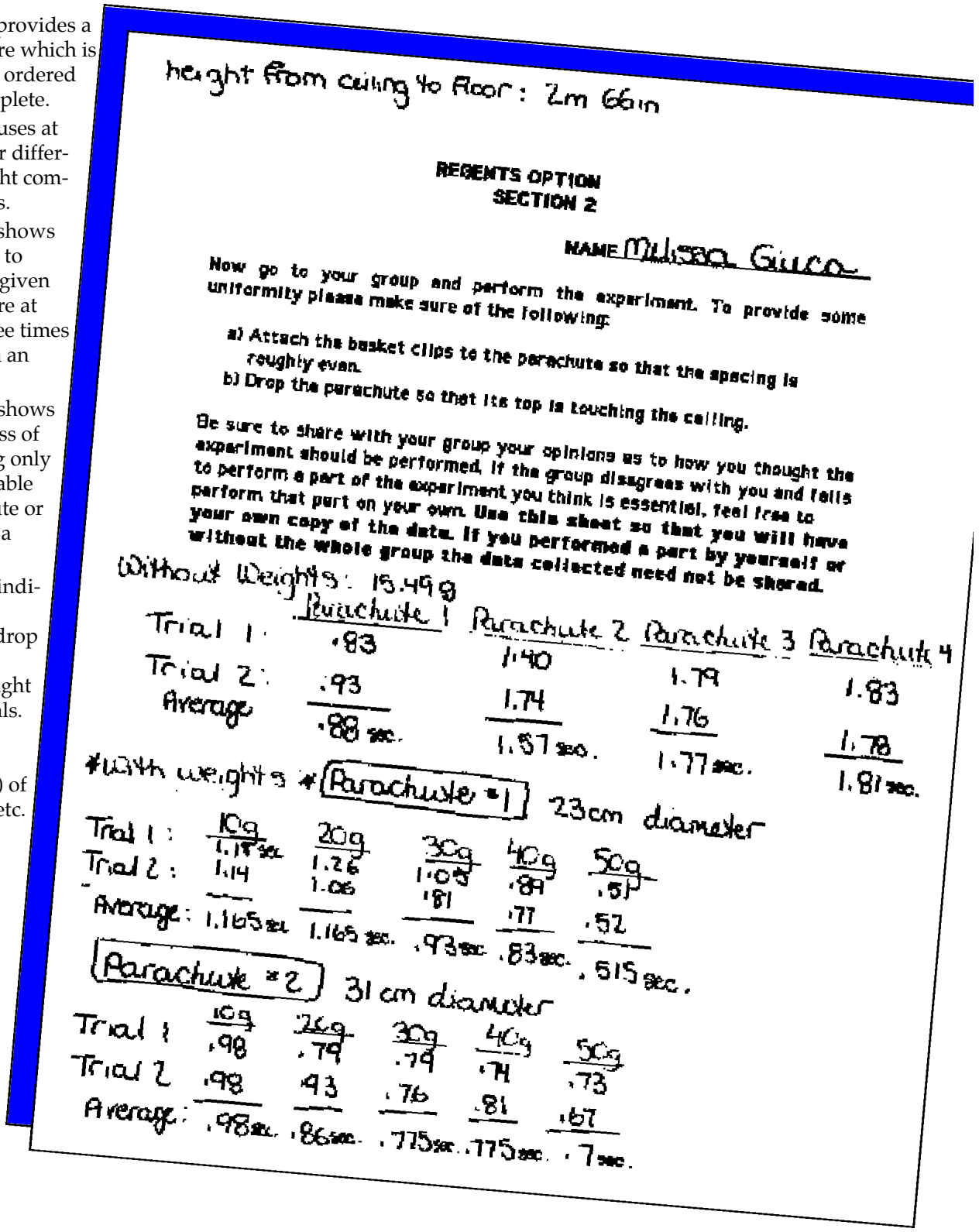
b) Student uses at least four different weight combinations.

c) Student shows the need to repeat a given procedure at least three times to obtain an average.

d) Student shows awareness of changing only one variable (parachute or mass) at a time.

e) Student indicates the need to drop from the same height in all trials.

(4 points)
Any four(4) of the above, etc.



height from ceiling to floor: 2m 66in

REGENTS OPTION
SECTION 2

NAME Melissa Giuca

Now go to your group and perform the experiment. To provide some uniformity please make sure of the following:

a) Attach the basket clips to the parachute so that the spacing is roughly even.
b) Drop the parachute so that its top is touching the ceiling.

Be sure to share with your group your opinions as to how you thought the experiment should be performed. If the group disagrees with you and tells to perform a part of the experiment you think is essential, feel free to perform that part on your own. Use this sheet so that you will have your own copy of the data. If you performed a part by yourself or without the whole group the data collected need not be shared.

Without Weights: 15.49g

	Parachute 1	Parachute 2	Parachute 3	Parachute 4
Trial 1:	.83	1.40	1.79	1.83
Trial 2:	.93	1.74	1.76	1.78
Average	.88 sec.	1.57 sec.	1.77 sec.	1.81 sec.

#with weights # Parachute #1 23cm diameter

	10g	20g	30g	40g	50g
Trial 1:	1.18 sec	1.26	1.09	.89	.51
Trial 2:	1.14	1.06	.81	.77	.52
Average:	1.165 sec	1.165 sec.	.93 sec.	.83 sec.	.515 sec.

Parachute #2 31 cm diameter

	10g	20g	30g	40g	50g
Trial 1	.98	.79	.79	.74	.73
Trial 2	.98	.93	.76	.81	.67
Average:	.98 sec.	.86 sec.	.775 sec.	.775 sec.	.7 sec.

SECTION 2

Now go to your group and perform the experiment. To provide some uniformity, please make sure of the following:

a) Attach the basket clips to the parachute so that the spacing is roughly even.
b) Drop the parachute so that its top is touching the ceiling.

Be sure to share with your group your opinions as to how you thought the experiment should be performed. If the group disagrees with you and fails to perform a part of the experiment you think is essential, feel free to perform that part on your own. Use this sheet so that you will have your own copy of the data. If you performed a part by yourself or without the whole group, the data collected need not be shared.

RUBRIC
This section is not marked. It is performed as a group. Asheet of "Lab Hints" has been provided to encourage a degree of uniformity in the actual procedures of each group. This is done because some of the following parts rely on the data gained in this section.

SECTION 3

A. What are three observations you made based on the parachute experiment you performed? *(3 points*)

RUBRIC *(3 points)* Student describes any three(3) of the following:

a) The greater the mass the shorter the time of fall (the "faster it went" or "the greater the acceleration" will not be accepted since they are measuring time.)
b) The larger the diameter of the parachute, the greater the time to fall.
c) The parachute swung from side to side as it fell.
d) The parachute fell at an angle.
e) Depends on response. "It fell" without descriptor will be given no credit.

(2 points) Any two of the above, etc.

B. Using the data collected for any one of your weights, plot a graph of the time to fall (dependent variable) vs. the diameter of the parachute (independent variable). The diameter axis should extend to 0.5 m. It should be clear as to what this graph shows. Use the graph paper provided. Be sure to put your name on the graph paper. *(3 points)*

RUBRIC *(3 points)*
Both axes are correctly labeled w/units and scaled. The plot contains at least four(4) points. A smooth curve representing the best average line is drawn.

(2 points) The axes are not labeled w/unit or they are not scaled correctly or less than four points have been chosen but the best average line is drawn.

(1 point) The axes are not labeled w/units or are not scaled correctly. Four(4) points have been chosen but the best average line is not drawn.

C. Based on the graph you have drawn, what would be the time for a diameter of .48 m? Use the graph you have drawn to find your answer. Be sure you have made it clear how your answer was found. *(2 points)*

RUBRIC *(2 points)* The student has made a reasonable attempt to extend the line until it passes the .48 m mark. The student has indicated how the point was determined (guidelines, etc.) The answer includes units.

(1 point) The point does not lie on the best average line or the answer does not include units.

D. Extrapolation of given data, though correctly done, can still lead to inaccurate results. What are two possible reasons for this? Use the space below. (*2 points)*

RUBRIC *(2 points)* Any two of the following answers:

a) The line drawn is the best average line and does not represent any point specifically, just the average.
b) When extrapolating, I assumed that the curve followed the trend shown. This may not be true.
c) The best average line or the guidelines may have been drawn incorrectly.

(1 point) Any one of the above.

SECTION 4

A. What are two specific sources of error in the parachute experiment which would have caused your data to be inaccurate? *(2 points)*

RUBRIC *(2 points)* Any two of the following errors:

a) Human timing error at the initial drop or the point of hitting the floor.
b) The basket may have been at different heights since the parachutes deformed differently.
c) Agiven parachute did not always fall at the same angle.
d) Some parachutes swung from side to side more than others.

Hitting the table or the parachute not opening are not errors. They are mistakes causing that trial to be discarded.

B. Based on your experiment, was there a linear relationship between the time to fall and the mass? Justify your answer. *(2 points)*

RUBRIC *(2 points)* The answer depends upon the data. The answer is yes if a given multiple of mass produces the same multiples of time. The answer is not if not. Agraph sketch of the data will be acceptable providing a "yes" or "no" answer is also given.

(1 point) Either the correct answer based on the data or the reason.

C. Actual parachutes have an adjustable hole in the top of the chute. With reference to the experiment you performed at home with the cup, what do you think is one reason for that adjustable hole? *(2 points)*

RUBRIC *(2 points)* The answer must show that the experiment was performed by noting any observation (e.g., It went down straighter, the hole size changed the force necessary for a given descent; it went down faster as hole increased in size, it was more stable.) and the relationship this had to their experiment.

(1 point) Astatement as to what an adjustable hole might do without reference to the experiment they performed at home.

SECTION 5

A. Draw and label the vector forces acting on this combination which cause its vertical motion to increase or decrease. Be sure to show the direction of the force and where it is acting. *(3 points)*

RUBRIC *(3 points)* The diagram shows the force acting down on the basket due to the gravitational pull on the weight and is so labeled. The diagram shows the upward force of the air on the parachute and is so labeled.

(2 points) The diagram shows both forces but only one is labeled or the diagram shows both labels but only one force.

(1 point) The diagram shows only one of these forces which is labeled.

The force of the air acting up on the basket will not be counted.

REGENTS OPTION
TAKE-HOME EXPERIMENT
INSTRUCTIONS

a) You have each been given a plastic cup in order to perform the following experiment at home.

1) Fill your bathroom sink to just below the drainage hole.

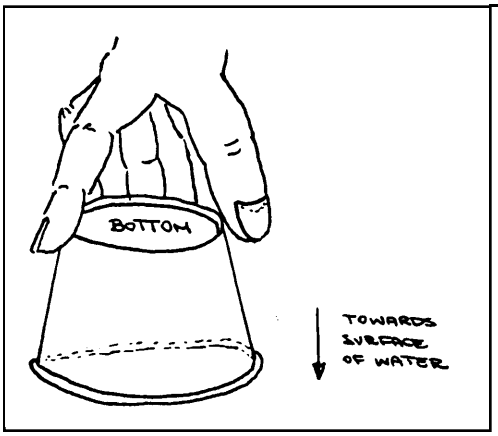
2) Holding the cup gently as close as possible to the bottom invert it so that the open end faces the water (see diagram below).

3) Push the cup slowly down into the water as far as it will go noting the effect as you push it down. Repeat as often as you wish.

4) Remove the cup from the water and punch a small hole (the size of a pencil point) in the bottom of the cup. Repeat step '3' above.

5) Enlarge the hole (bigger than the point but not as big as the width of the pencil) and repeat step '3'.

6) Enlarge the hole to the width of the pencil and repeat step '3'.



B. In speaking to various sky-diving schools, one finds that many factors affect the speed with which you hit the ground. Arough estimate is that it is similar to jumping off a 5 ft. (1.5 m) table.

Note: In the items below you must show your work to receive credit. *(6 points)*
1) Calculate the slowest speed obtained during your parachute experiment.
2) Calculate the speed with which one would hit the floor if jumping off the table noted in "B" above.
3) Using percent of error compare the speeds calculated in "1"and "2" above.

RUBRIC (6 points) The answer must contain the following:

a) The formula to find velocity given height and the acceleration of gravity.
b) The formula to find the velocity given displacement and time.
c) The formula for percent of error.
d) Correct substitution into these formulae.
e) The correct answer reported to the proper number of significant figures.
f) The units of the answer provided (percent of error must be stated in percent, not in decimals.)

(5 points) Any 5 of the above, etc.

SECTION 6

B) The following is an experiment to determine the relationship between the diameter of a parachute and the time it takes for a mass to fall. The equipment is the same as was available previously.
   1) Attach the basket to one of the parachutes using the cord and clips provided.
   2) Place one of the weights in the basket.
   3) Hold the parachute by its top above the floor.
   4) Let the parachute drop and time its descent to the floor.
   5) Repeat steps "3" and "4" three times more.
   6) Place another weight in the basket and repeat steps "3" through "5".
   7) Choose another parachute and repeat steps "1" through "6".

Consider the above experiment in comparison to the one your group did. It has some good points as does yours, and some problems.
Critique the above procedure by stating five(5) reasons why yours is better, or five(5) reasons why this is better or as good, or five(5) reasons why this is worse, or any combination of better, the same, or worse as long as you have a total of five(5).

As you critique, say to yourself, "If I was doing a lab, would this be sufficient? Is it clear? Does it accomplish the aim?", etc.

RUBRIC
(5 points) Any five(5) of the following:

a) It is easier to control a given variable.
b) The variables are truly independent.
c) There is less chance of the equipment malfunctioning or causing an error.
d) There is less chance of human error.
e) This approach is less complicated.
f) The order of operations is more logical.
g) The diagram helps to explain the setup.
h) The approach gives more consistent results.
i) The approach clearly defines what to use and how to use it.
j) Other (Depends on response. Personal preference is not acceptable.)

Use below and the back for your critique. *(5 points)*

REFLECTION

The use of cooperative learning groups promotes meaningful student dialog, encouraging student discussion as they construct relationships, see connections, and make sense of what they are observing. With these approaches, this learning experience is likely to enable students with a wide range of learning styles to meet the targeted learning standards. This activity, as noted, was designed to be a commencement test. However, it lends itself easily to being a research project, or class enrichment activity.

REFLECTION: