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Science Fair

Cooperative teams use the scientific method to solve a mystery and develop their own projects



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Welcome to Science Fair!

Your students are about to become detectives as they investigate the disappearance of the science fair projects at Brightsville School. Throughout their investigation they collect clues, gather evidence, and use logic to solve the mystery.

To find out where the science fair projects are hidden and who took them, your students first learn to think like scientists and use the scientific method to solve problems. Then they are shown how to use these skills to make a good science fair project. A whole class science fair project and directions for planning your own science fair make a nice culmination to the unit.

Science Fair is designed for students in grades 4–8. This unit is quite flexible in that you can adjust the amount of support you give your students. It can be quite challenging for students in eighth grade, and yet still be successfully completed by fourth graders. Students work in groups and individually, and they are assessed daily in both group work and individual assignments. The combination of “hands on” activities and thrill of solving a mystery make *Science Fair* an exciting and motivating experience.



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Purpose and Overview

What is *Science Fair*?

Science Fair is a cooperative group role-play in which student investigators use the scientific method to solve a mystery. As they uncover what happened to the science fair projects at Brightsville School, the investigators learn how to state a problem, form a hypothesis, conduct controlled experiments, make graphs and analyze data, and form conclusions. They also learn how to write a science fair notebook and how to create an attractive display board to create an award-winning project.

The excitement begins when students learn that all the science projects for the Brightsville School Science Fair have mysteriously disappeared and all that is left is a letter challenging them to solve the mystery. In the letter, the thieves hypothesize that your students will not be able to figure out who took the projects or where they are hidden. During a typical day, students get a brief lesson on a portion of the scientific method or an aspect of a science fair. In investigative teams they work on a **Clue Card Activity** that reinforces the day's lesson and earns them **Clue Cards**. Students then work independently on **PI Assignments**, which also reinforce the lesson. The PI (Private Investigator) Assignments earn steps that teams use to move around the **Map of Brightsville School**. As teams enter the different wings of the school, they receive Wing Maps and Descriptions that provide visual and written details of what is inside the rooms of the school. In addition, teams get special clues each day called **Eyewitness Evidence**. Students enter the information from Clue Cards, Eyewitness Evidence, and Wing Maps and Descriptions in their **Investigator Notebooks**, which they study and use to eliminate suspects and locations where the projects may have been hidden. By working together and using logic, teams can solve the mystery and learn if the hypothesis made by the thieves on the first day is correct.

What do students learn?

The activities within this unit are correlated to national and state education standards. To obtain specific standards information for *Science Fair*, go to www.teachinteract.com or contact us at 1-800-359-0961.

By using *Science Fair*, your students will:

Knowledge

- Understand and apply the steps of the scientific method
- Know how to select a science fair project
- Know how to evaluate science fair projects

Purpose and Overview

- Identify parts of a science fair notebook
- Identify parts of a science fair display board

Skills

- Identify a problem and form a hypothesis
- Conduct a controlled experiment
- Make observations
- Graph and analyze data
- Write a science fair notebook
- Create an attractive display board
- Use judging guidelines to improve projects
- Use logic to solve a mystery

Attitudes

- Gain confidence as they learn to use the scientific method
- Feel excitement as they observe and conduct science experiments
- Feel satisfaction and excitement as they solve the mystery
- Feel satisfaction as they complete a science fair project

How are students organized?

Students work in Investigation Teams. There can be no more than six teams and no more than six students per team. Four students per team is recommended. There are also independent activities (PI Assignments) that students complete each day in addition to the team activities.

How much time is required?

Science Fair requires 12 days of class time. Each lesson is approximately 50 minutes. The optional whole-class science fair project adds five to eight days to this time frame. See the Unit Time Chart on page 14.

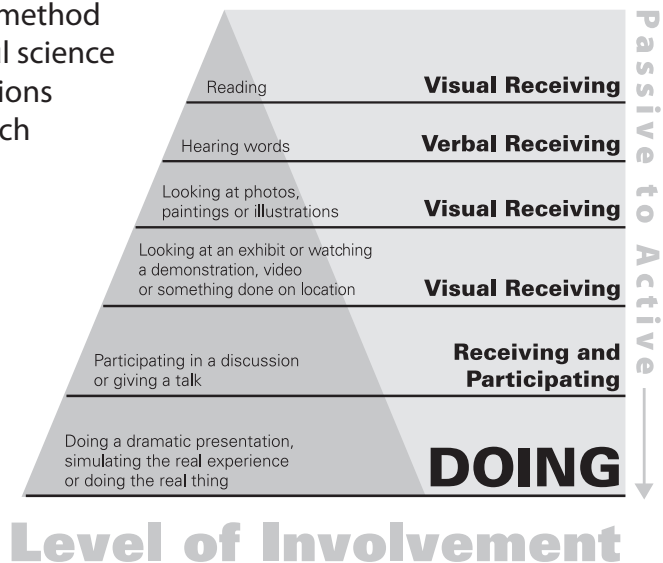
How is learning assessed?

Students are assessed four ways. First, there are daily assignments done by each student. These give you an accurate evaluation of each student's understanding of the concepts presented in the daily lessons. Second, there are group activities that allow you to observe how well students perform "hands on" work and how well they cooperate in groups. Third, there is an

authentic assessment where students use the scientific method to solve a problem. Finally, there is a formal multiple-choice test for students to take at the end of the unit.

Why use *Science Fair*?

Using *Science Fair* is a fun and exciting way to take students step by step through the scientific method and show them how it applies to a successful science fair project. There are clear, concise explanations of each step of the scientific method, and each step is reinforced by individual assignments and hands-on team activities. The mystery format keeps students actively involved in the scientific method as they collect clues and use logic to solve the crime. Students are assessed daily and will be able to use their knowledge of the scientific method to complete a successful science fair project. Students will enjoy the challenge of solving the mystery and working as a team toward a common goal.



Adapted from Edgar Dale's "Cone of Experience"

Differentiation

Science Fair offers many ways to differentiate instruction. It is flexible enough to use with young students, yet can be challenging for older ones. Each lesson is reinforced with individual assignments and group work. There are numerous hands-on activities and a variety of ways to learn about, and experience, science.

Here are some ways to differentiate this unit:

- Provide small group support while the rest of the class works independently.
- Have students work in pairs on independent work.
- Vary the amount of support, making lessons easy or more challenging.
- Vary points awarded based on student abilities and quality of work.

Components

The Science Fair Package

The complete *Science Fair* package includes a Teacher Guide and a set of Clue Cards.

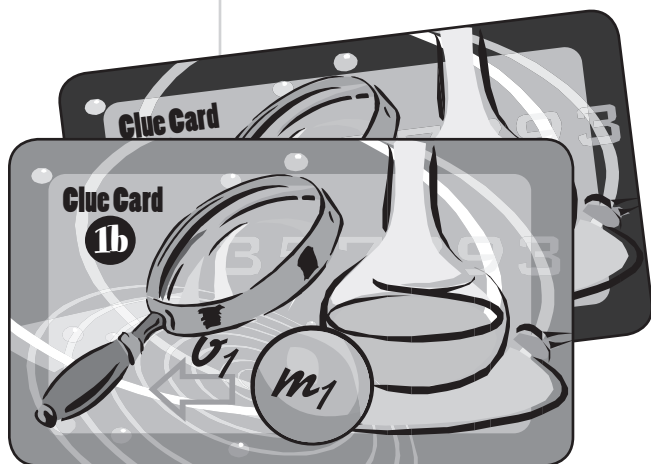
The Teacher Guide contains all the information you need to run a successful unit. Preparation and setup instructions, daily directions, helpful teaching tips, reproducible forms (Masters), assessment methods, and answer keys are included. A Student Guide and an Investigator Notebook are provided as Masters and can be found in the Teacher Guide.

The Student Guide explains the Science Fair mystery and provides helpful information for the investigation. The Investigator Notebook is the workhorse for each team. It contains lists of possible suspects and hiding places. By using these lists and paying attention to all of the clues, each team should be able to solve the mystery. This notebook also includes a school tour and a map of the school.

In addition to the package components, the following elements are used daily in *Science Fair*.

- **Clue Card Activities** are daily team activities that reinforce the day's lesson. Each activity earns each team up to three Clue Cards.
- **Clue Cards** contain clues to help solve the mystery. Each numbered clue is divided into three parts (a, b, and c). If team members cooperate and work hard on the **Clue Card Activity**, their team receives all three clues.
- **PI Assignments** are individual activities that reinforce the day's lesson and have a point value. The points each student earns are combined with their teammates' points and are used to move around the **Map of Brightsville School**.

- The **Map of Brightsville School** has dots leading from one wing to another. Teams move along these dots with points earned from the **PI Assignments**. One point is equal to one dot. Teams begin in the middle of the courtyard and can go in any direction they choose following the dots. They cannot "jump" from one path to another. Teams must visit each wing of the school in order to "search" it. If possible, teams should visit each wing twice to get all the information available.



- **Wing Maps and Wing Descriptions** provide details about each wing in the school. This information helps student teams identify possible hiding places for the science fair projects. As teams travel the map, they must visit each wing. The first time they enter a wing, teams receive a Wing Map. When a team has collected all Wing Maps, that team may go back to each wing to get a Wing Description of the rooms.
- **Eyewitness Evidence** consists of major clues or hints given to students each day of the investigation. This evidence simulates clues left by the Brightsville Brain Trust (kids who stole the projects). Some of the major clues are the places where each piece of evidence is found.

Getting Started

Read this Teacher Guide carefully to get an understanding of how the unit works and how to prepare.

Decisions to Make

1. *Will you pre-assess students?*

If you are unsure of how much your students know about the scientific method and science fair projects, you may want to administer a pre-assessment. The **Science Fair Test** covers both topics in 10 short questions and works well as a pre-assessment.

2. *How will you balance your teams?*

Determine how many teams you want and how many students will be on each team. Teams of four usually work the best. We recommend no more than six teams and no more than six students per team.

Most of the time teams will be grouped heterogeneously, but do consider other options. You could group four high-achieving students on one team and have them work independently from the rest of the class without any teacher support. Alternatively, you can have a group of low-achieving students work together with extra teacher support.

3. *How much support will you provide teams?*

Think about the amount of support you want to provide teams. Lesson plans for the first three days include teacher support. You might decide that your students do not need this support and can work more independently. Or you might decide to continue this support beyond Day 3 if students are experiencing difficulties.

4. *How will you handle the hands-on activities?*

Depending on your students' abilities, some of the hands-on activities may require more than one class period. In these cases, if you would like students to do the activities themselves, allow for additional time in your unit. Alternatively, you may choose to do the activities as demonstrations and have students observe.

5. *How will you manage the PI Assignments?*

The PI Assignments are written to be individual activities. You might choose, however, to pair students for these activities, or do some as a whole class, depending on the difficulty of the Assignment and your students' abilities. Consider making transparencies of the **PI Assignments** (recommended) and using these instead of making individual copies.

Preparation and Setup

1. Gather Materials

In addition to the materials included in this package, you will also need a variety of supplies for the science experiments, and a few items for each team. The quantities needed and the days on which they are needed are listed below. The materials are also listed in the Daily Lesson Plans.

Investigation Day 2

- Common classroom supplies: chalkboard eraser, pens, pencils, markers, books, crayons, and tissue

Investigation Day 3

One set for classroom demonstration and/or one per team if doing hands-on experiments of the following:

- candle (birthday candle, tea light, or votive)
- 3 jars: one small, one medium, and one large (all sides of jar mouth must touch the table when placed upside down)
- matches or lighter
- stopwatch
- inflated balloon (less than 9" in diameter when inflated)
- 30 pieces of hole-punched paper (10 each of red, green, and white construction paper), stored separately in small plastic bags
- three pieces of construction paper (one each of red, green, and white)
- magnifying glass or microscope
- 2 Tbsp. each of salt, baking soda, sugar, and flour (keep separated)

Investigation Day 4

One set for classroom demonstration and/or one per team if doing hands-on experiments of the following:

- marble
- paper tube (12" x 18" piece of construction paper, rolled and taped)
- metric ruler or metric tape measure

Investigation Day 6

One set for classroom demonstration and/or one per team if doing hands-on experiments of the following:

1 electromagnet =

- new size D battery

- 2 ft of insulated wire (bell or solid single-strand wire that easily wraps around a nail) with insulation removed one-half inch from each end
- large steel nail, such as 16 D
- masking tape
- 2 dozen small paper clips
- potholders

Investigation Day 9

One set per team of the following:

- 2 pieces of letter-size multiuse paper to make paper airplanes, or two paper airplanes, one long (folded lengthwise) and one short (folded widthwise)
- 1 piece of letter-size multiuse paper crumpled into a ball

2. Make Copies

- **Student Guide**—one (1) per student
- **Investigator Notebook**—one (1) per team
- **Map of Brightsville School**—one (1)
Enlarge the map to create a wall-size version that can be used to track the progress of all teams.

OPTION: Alternatively, have student teams use the map in their Investigator Notebooks to track their own progress. In this case, the teams will only be able to see their own progress.
- **Investigation Team Markers**—one (1)
Cut apart.
- **Science Fair Test**—one (1) per student
Make an additional set if using this as a pre-assessment.
- **Clue Card Activities 1–9**—one (1) per team
- **PI Assignment Answer Sheet**—one (1) per student
- **Investigation Team Score Sheet**—one (1) per team
Fill in with team names and team members.
- **PI Assignments 1–7**—one (1) transparency of each or one copy per student
- **Teacher Transparency 1: Practice Sheet**—one (1) transparency and one (1) copy per student
- **Teacher Transparencies 2–9**—one (1) transparency of each

- **Eyewitness Evidence 1–10**—one (1) per team
Create color-coded sets (use red, blue, green, yellow, purple, and orange to match Clue Cards). Use heavy stock and laminate for durability. Cut apart along the dotted lines and paper clip together.
OPTION: Alternatively, you can write the Eyewitness Evidence on the board and have students copy it into their Investigator Notebooks.
- **Wing Maps and Wing Descriptions**—one (1) set per team
Create color-coded sets (use red, blue, green, yellow, purple, and orange to match Clue Cards). Use heavy stock and laminate for durability. Cut apart along the dotted lines and paper clip together.
- **Planning a Science Fair Project**—one (1) per student

3. *Prepare Evidence Bags*

Create an Evidence Bag for each team. You can use file folders, large resealable plastic bags, brown paper bags, plastic tubs, or large envelopes as Evidence Bags. Teams will decorate the bags on Day One. In each bag, place the Investigator Notebook and Student Guides needed for each team. Teams will use these bags to also store the Clue Cards, Wing Maps and Wing Descriptions, and Eyewitness Evidence they earn throughout the unit.

Unit Time Chart

Science Fair requires 12–19 days of instruction. Each lesson is approximately 50 minutes. Follow the suggested time frame for 12 days to complete the basic unit, or extend your unit to 19 days by including a whole-class science fair project.

Week 1				
Day 1 • Introduction to the mystery • Group students • Practice working with clues • Pre-assessment	Day 2 <i>Investigation Day 1</i> • Scientific method: Problem and hypothesis	Day 3 <i>Investigation Day 2</i> • Scientific method: How to conduct an experiment	Day 4 <i>Investigation Day 3</i> • Scientific method: Three ways to collect data	Day 5 <i>Investigation Day 4</i> • Scientific method: Graphing and analyzing data
Week 2				
Day 6 <i>Investigation Day 5</i> • Scientific method: Drawing conclusions	Day 7 <i>Investigation Day 6</i> • Scientific method: Repeated experimentation	Day 8 <i>Investigation Day 7</i> • Creating science fair notebooks and display boards	Day 9 <i>Investigation Day 8</i> • Judging science fair notebooks	Day 10 <i>Investigation Day 9</i> • Problem-solving using the scientific method
Week 3				
Day 11 <i>Investigation Day 10</i> • How to plan a science fair project	Day 12 • Conclusion of the Investigation • Solution to the mystery • Post-assessment	Day 13 OPTIONAL Whole-class science fair project <i>Project Day 1</i> • Overview of project • Begin notebooks • Form hypothesis	Day 14 <i>Project Day 2</i> • Experiment 1: Dry Towel Strength	Day 15 <i>Project Day 3</i> • Experiment 2: Wet Towel Strength
Week 4				
Day 16 <i>Project Day 4</i> • Experiment 3: Absorbency	Day 17 <i>Project Day 5</i> • Record and analyze results • Write conclusion	Day 18 <i>Project Day 6</i> • Begin display board design	Day 19 <i>Project Day 7</i> • Complete display board design • Debrief	

Introduction to the Mystery

Objectives: Students learn about a mystery at Brightsville School that involves a problem and a hypothesis. They receive their **Student Guide** and **Investigator Notebook**, and are placed on teams. They get an overview of the unit and practice the skills they will need to solve the mystery.

MATERIALS

- **Student Guides**—one per student
- **Investigator Notebooks**—one per team
- Evidence Bags—one per team
- **Team Markers**—one per team
- colored markers or crayons
- **Teacher Transparency 1: Practice Sheet**—one transparency and one copy per student or team
- **Science Fair Test**—one per student (if using as pre-assessment)

Directions:

1. Introduce the Mystery

Your help is needed to solve a mystery at Brightsville School. As you uncover clues and evidence and work to solve the mystery, you will learn about the scientific method and science fair projects.

Students will likely have questions. Explain that their questions will be answered over the next few days.

2. Hand out Student Guides

Give each student a copy of the **Student Guide** and give students time to read it silently, or read it aloud as a class.

3. Group Students

Put students into teams and assign each team a color. Have each team choose a name. Here are some ideas for team names:

- Super Sleuths
- Private Eyes
- Investigators



Read or say

- Gumshoes
- Detectives
- FBI
- Names of TV mystery shows
- Names of famous detectives like Sherlock Holmes

4. Hand out Team Materials

Give each team an **Investigator Notebook**, Evidence Bag, and a **Team Marker**. Have teams decorate (use team color) and write their team name on each piece.

5. Review Brightsville School Map

If you enlarged the map to hang on the wall, display it in a prominent place in the classroom.

Have each team open their **Investigator Notebook** to the School Tour on page 3. Read the School Tour aloud. Explain that teams must move around the school (map) to gather clues to help them solve the mystery. In order to earn points to move on the map, they will complete individual PI Assignments. Each time a team enters a wing it receives a **Wing Map** or a **Wing Description**. The first time the team reaches the wing, they receive a map of the rooms within the wing. The second time, they receive a written description of what is in the wing. Point out that this information may not seem important at first, but do become quite important as teams earn more clues.

6. Explain Log Sheets

Point out the log sheets in the **Investigator Notebook**. These logs will be used to record all of the clues and evidence students will earn throughout Science Fair.

Eyewitness Evidence: used to record each piece of Eyewitness Evidence and the location in which each was found.

Brightsville School Campus Locations: used to mark off the locations that do not contain the science fair display boards and/or materials

Student Data Sheet: used to keep track of information learned about individual students

7. Introduce Practice with a Mini Mystery

To practice our detective skills and learn how to fill out the log sheets, we're going to work together to solve a mini mystery.



Read or say

A few days before the science fair, someone hid Shelly's project. The thief took her display board (a three-sided piece of cardboard that explained her project) and hid it in one room. Then the thief took her materials (notebook and scientific instruments) and hid them in another room. Finally, the thief left clues about who hid the project and where the display board and materials can be found. We are going to study the clues and find out the following:

- Where is her display board?
- Where are her materials?
- Who hid the science fair project?

Project the **Teacher Transparency 1: Practice Sheet** and give a copy to each team.

8. Complete Practice Location Clues Chart

Read aloud the Location Clues then explain how to use the clues to deduce the answer. Model filling in the chart on the overhead as teams fill in their own charts:

- Clue 2 says the display board is too large to be hidden in Classroom A. Put a large X next to Classroom A in the Display Board column to show this location has been ruled out.
- If the display board cannot fit in Classroom A, then it cannot fit in Classroom B, since both rooms are the same size. Put an X next to Classroom B in the display column.
- Since the display board cannot be in Classroom A or in Classroom B it must be hidden in the Library. Write "Found here" next to Library in the display column.
- Clue 3 says the materials are hidden in a classroom with a sink. Put an X in the Materials column next to Library because it is not a classroom, and an X next to Classroom A because it does not have a sink. The materials must be hidden in Classroom B since it is the only classroom with a sink. Write "Found here" next to Classroom B in the Materials column.

Here's how the completed location chart should look:

Room	Display Board	Materials
Classroom A	X	X
Classroom B	X	Found here
Library	Found here	X



Read or say

We now know the materials were hidden in Classroom B and the display boards were hidden in the Library. Now let's find out who took the projects.

9. Complete Practice Evidence Log and Student Data Sheet

Complete the chart together using the following directions:

- Read Evidence A and B aloud. Tell students that while these pieces of evidence are of no use at this time, they should record them because they will be important once more information is learned.

Evidence	Where Found	When Received
Person who hid the project did not experiment with a living organism		

- Read Clue A aloud. Next to Lindsay's name in the Science Project column write "goldfish." Write "Clue A" in the Project Data Source column. Explain to your students that by writing down the source of the proof they will be able to check their work in case they make a mistake.
- Continue with Clue A by explaining why it is now known that Lindsay did not hide the project. Evidence A stated that the person who hid the project did not experiment with a living organism; Lindsay's experiment was with a living organism. Therefore, Lindsay did not hide the project.
- Show how the above information is marked on the Student Data Sheet:

Name	Science Project	Project Data Source	After-School Activity	Proof of Activity	X Not a Suspect	Proof
Jeff						
Lindsay	goldfish	Clue A			X	Evidence A
Mark						
Tami						

- Read Clue B aloud and fill in the practice chart together. Everyone should know that Mark did not take the project since he went to soccer (Clue B) and the person who went to soccer did not take the project (Evidence B). The chart now looks like this:

Name	Science Project	Project Data Source	After-School Activity	Proof of Activity	X Not a Suspect	Proof
Jeff						
Lindsay	goldfish	Clue A			X	Evidence A
Mark			soccer	Clue B	X	Evidence B
Tami						

- Read Clue C aloud and have the teams solve the rest of the mystery on their own. After a few minutes stop and have each team announce who they think took the project.
- They should now know the project was taken by Jeff because Clue C said Tami went to soccer camp and Evidence B stated that the person taking the project did not go to soccer; Tami is innocent. The only person not eliminated by the clues and evidence is Jeff.
- Here is how the chart looks after all clues have been marked:

Name	Science Project	Project Data Source	After-School Activity	Proof of Activity	X Not a Suspect	Proof
Jeff					GUILTY	
Lindsay	goldfish	Clue A			X	Evidence A
Mark			soccer	Clue B	X	Evidence B
Tami			soccer	Clue C	X	Evidence B

10. Review Student Data Sheet

Have each team turn to the Student Data Sheet on pages 7–8 of their **Investigator Notebook**. Explain that they will complete this sheet in much the same way as the practice sheet. The only difference is that this one is longer and more complicated. By using **Wing Maps** and **Wing Descriptions, Eyewitness Evidence, and Clue Cards**, they will be able to solve the mystery.

11. Collect Evidence Bags

Have teams place their Investigator Notebook and all Student Guides in their Evidence Bags. Collect Evidence Bags from each team at the end of each day.

12. Give Pre-assessment

If you are giving the **Science Fair Test** as a pre-assessment, give it at this time. It will also be used at the end of the simulation as a post-assessment.

Science Fair Test Answer Key

1	a
2	d
3	a
4	d

5	a
6	a
7	b
8	c

9	d
10	a

Investigation Day 1

Objective: Students are introduced to the scientific method. They learn about stating problems and forming hypotheses.

MATERIALS

- **Teacher Transparency 2: Deja's Project**
- **Clue Card Activity 1**—one per team
- **PI Assignment Answer Sheet**—one per student
- **PI Assignment 1**—one transparency and/or one per student
- **Teacher Transparency 9: Student Data Sheet**—one transparency
- **Eyewitness Evidence 1**

Directions:

1. *Return Evidence Bags*

2. *Explain the Scientific Method*

Most of the students at Brightsville School did a science fair project that followed the scientific method. But what is the scientific method? It's a way scientists solve problems and answer questions. Its most basic form has four steps.

Step 1: State the Problem

Let's say you come home from school one day and flip on the switch to your bedroom's light. The light does not go on. You have a problem.

Step 2: Form a Hypothesis

A hypothesis is your solution to the problem. In this case you hypothesize, or guess, that the light bulb is burned out.

Step 3: Test your Hypothesis

Test your hypothesis by doing an experiment. You replace the light bulb you think is burned out with a



Read or say

new one. Then you flip the switch. You observe that the light goes on.

Step 4: Form a Conclusion

Form a conclusion based on your observations from the experiment. A conclusion is the answer to the original problem. Based on your observations you conclude that the light bulb was burned out. Your hypothesis is correct and the problem is solved.

This is the scientific method in its simplest form.

3. Show the Scientific Method Applied to a Science Fair Project

Now, let's see how one of the students at Brightsville School used the scientific method in her science fair project. Deja Cleveland got into an argument with some boys at school. They said that ice water boils faster than room-temperature water. They said the molecules in cold water are close together and this causes them to get hotter faster than warm water. Deja didn't believe it at all so she decided to do her science fair project on boiling water. This is how she used the scientific method.

Project **Teacher Transparency 2: Deja's Project**. Point out the four steps of the scientific method and discuss Deja's project with your students. Remind your students that this is only part of Deja's science fair project.

4. Introduce PI Assignments

Hand out the **PI Assignment Answer Sheet**.

Throughout *Science Fair*, you will be challenged to complete PI Assignments. These "Private Investigator" Assignments are individual activities, but the points you earn for successfully completing them are applied to your team. Use this sheet to record your answers to the PI Assignments. At the end of each day you will put your answer sheets in your team's Evidence Bag. I will score them and return them the next day. The points you earn for each PI Assignment will move your team along the Brightsville School Map.



Read or say



Read or say



Read or say

Teaching tip



For each PI Assignment and Clue Card Activity you will discuss the answers as a class. You can have students exchange papers and correct one another's work, or allow students to correct their own work.

5. Complete PI Assignment 1

For PI Assignment 1 we're going to take a closer look at Step 1 of the scientific method—stating the problem. A problem arises when you see something happen and wonder about it. You might wonder why milk goes sour, what kind of battery lasts the longest, what kinds of exercise can make you stronger and faster, or as in the earlier example, why a light won't go on.

The most interesting science fair projects are those that choose a problem to solve.

Project the **PI Assignment 1** transparency and/or give students a copy. Read the first part together. Have your students mark their answers on the **PI Assignment Answer Sheet**. When all students have finished, review and discuss the correct answers. Students should then place their PI Assignments in their team Evidence Bag.

PI Assignment 1

① 2 3 ④ ⑤ 6 7 ⑧ ⑨ 10

- Problems 1, 4, 5, 8, and 9 are the best kinds of problems for a science fair project because experimentation is necessary to find the answer to the problems.
- Problems 2, 3, 7, and 10 do not require experimentation and would most likely end up being research reports.
- Problem 6 is also a research report kind of project unless the student actually makes models of teeth, gums, and braces and conducts tests on how the teeth are straightened.

6. Introduce Clue Activities

In addition to the individual PI Assignments, you will be challenged to complete Clue Activities. These are group activities that you will work on with your team. Your performance on these activities is very important, as you can earn 1–3 clues that will help you solve the mystery. The better work your team does on the activity, the more clues you will earn!



Read or say

7. Complete Clue Card Activity 1: Problems and Hypotheses

For Clue Card Activity 1, we're going to focus on Step 2 of the scientific method—forming a hypothesis. A hypothesis is your solution or explanation to the problem. It does not have to be a correct solution, and many times it won't be correct. But it should be a reasonable solution, a good guess based on what you observe.

Let's go back to the earlier example of the light that did not go on. When the light didn't go on, you changed the bulb, and the light worked. But what if the light didn't go on?

You would have to make a new hypothesis. What else might have caused the problem?

Maybe the power is out, the switch is broken, the fuse or circuit breaker is broken, or the new light bulb you put in is bad. These are all different hypotheses to test.

Notice that getting the hypothesis wrong just means you make another one and try again.

Hand out **Clue Card Activity 1** to each team, read the directions aloud, then allow time to complete the activity. When all students have finished, review and discuss the hypotheses they listed. Accept any reasonable answers. Teams should then place their Clue Card Activity in their team Evidence Bag.

Possible hypotheses:

Problem 1:

- There is not enough sunlight.
- There is too much sunlight.
- There is not enough water.
- There is too much water.
- The soil needs fertilizer.
- They are the wrong kind of plants for the climate.

Problem 2:

- The batteries are dead.
- The light is burned out.
- The contacts are rusty.
- The switch is broken.
- The batteries are in the wrong way.



Read or say

Problem 3:

Mop up the water.
Sweep the water away.
Wait for the water to evaporate.
Have the school janitor blow it away with a leaf blower.

8. Record Information on Student Data Sheet

Have each team turn to the Student Data Sheet on pages 7–8 of their **Investigator Notebook**. Project **Teacher Transparency 9: Student Data Sheet** and work through filling in the information together.

Find Deja's name. Across from her name in the Science Project column, write "Boiling Water." Explain that this information about Deja's project was found in today's lesson. Then, in the Source of Project Data column, write "Day 1 lesson." Remind students to use the Student Data Sheet to keep track of all the information they collect.

9. Give Eyewitness Evidence

Hand out **Eyewitness Evidence 1** or write it on the board. Tell students where the evidence was found. Have each team write the evidence and the location in their **Investigator Notebook**. Teams should store the evidence in their Evidence Bags for future reference.

Eyewitness Evidence 1 (Found in the Computer Lab)

The places where you find our evidence are just as important as the clues themselves. Record the location of the evidence in the order you find it.

Tell students they will receive **Clues** and points tomorrow after you have scored their PI Assignments and Clue Activities.

10. Collect Evidence Bags

For tomorrow:

Record each student's PI Assignment 1 score on the **Team Score Sheet** and tally these scores to arrive at a team's total points for PI Assignment 1. These points will move the team markers on the **Map of Brightsville School**.

Score each team's Clue Card Activity 1 and enter the number of clues they earned on the **Team Score Sheet**.

Teaching tip

Remember, you choose how many clues (1–3) teams earn based on their effort and results, but try to give out all three whenever possible. You might require students to do extra work to earn clues not awarded for the Clue Card Activity, or award them later when the team exhibits good behavior or puts forth extra effort on another activity.



Investigation Day 2

Objective: Students learn how to conduct an experiment.

MATERIALS

- **Clue Cards 1a–1c**—one per team
- **Teacher Transparency 9: Student Data Sheet**—one transparency
- **Clue Card Activity 2**—one per team
- **PI Assignment 2**—one transparency and/or one per student
- **Eyewitness Evidence 2**
- Common classroom supplies: chalkboard eraser, pens, pencils, markers, books, crayons, and tissue

Directions:

1. Award Clues and Points

Return Evidence Bags.

Award Clue Cards (1a–1c) earned for Clue Card Activity 1. Have each team turn to the Student Data Sheet in their **Investigator Notebook** and project **Teacher Transparency 9: Student Data Sheet**. Write in the information learned from Clue 1a (each team should have earned at least one clue) together as follows:

Name	Science Project	Project Data Source	After-School Activity	Proof of Activity	X Not a Suspect	Proof

Name	Science Project	Project Data Source	After-School Activity	Proof of Activity	X Not a Suspect	Proof
Holly			home	Clue 1a		

Have teams that earned Clues 1b and 1c add this information to their Student Data Sheets. Point out that Clue 1c includes information they may use later on in the unit and they should read all the clues they receive each day.

If you feel teams need additional help, work with teams individually or work together as a class if all teams earned all three clues. Record information for Clues 1b and 1c as follows:

Name	Science Project	Project Data Source	After-School Activity	Proof of Activity	X Not a Suspect	Proof
Lee			baseball	Clue 1c		
Reyna			dentist	Clue 1b		

Announce and/or write on the board the number of points earned by each team for PI Assignment 1. Have teams move their markers on the **Map of Brightsville School** (one point earned = one dot on the map). If any team enters a wing, give them a **Wing Map** for that wing. Teams should record any information they can from the Wing Maps. Wing Maps and Wing Descriptions should be stored in the team's Evidence Bag for future reference.

2. Introduce Conducting an Experiment



Read or say

Today we are going to explore Step 3 of the scientific method—testing a hypothesis. We've already learned how to state a problem and form a hypothesis. After a hypothesis has been formed, an experiment needs to be designed to test it. In a science fair project the experiment is called a "method of investigation" and may involve more than one experiment. There is not a special way to conduct an experiment; however, certain rules must be followed.

First, you must keep careful records of everything you do. You must keep these records so accurate that another person could read your experiment, do it, and get the same results.

Second, you need to consider all of the things that can affect an experiment's outcome. These things are called variables. Whenever you do an experiment, you must control these variables. In other words you must keep everything the same, except for what you are testing, to keep the experiment fair. Here's an example.

In the sixteenth century a scientist, Galileo Galilei, did a famous experiment in which he dropped two objects off a tower in Pisa, Italy. He said both objects

would hit the ground at about the same time regardless of the objects' weight. Do you think this is true? Let's see."

Recreation of Galileo's Experiment

Take out a large chalkboard eraser and a small pencil. Hold the pencil at your waist and the eraser over your head and drop them.

Ask students if the experiment was fair. (No, they were dropped from different heights.)

Drop the objects from the same height, but this time let the eraser drop a little later than the pencil.

Ask students if the experiment was fair. (No, they were dropped at different times.)

Drop the objects from the same height at the same time but push down on the pencil so it hits the ground first.

Ask students if the experiment was fair. (No, the pencil was pushed down harder than the eraser.)

Do the experiment one last time. Drop the objects from the same height at the same time and have students observe the results.

3. Discuss Galileo's Experiment

Explain that for this experiment all the variables were the same except for the weight of the object. This way the experimenter knows that if one object hits first (or last or at the same time) it will be because of the weight and nothing else. Let your students experiment with objects they have at their desks to see if Galileo was correct. Suitable objects are pencils, small books, erasers, crayons, and markers. They should see that objects hit the ground at about the same time.

Have students observe the following: Take a dictionary or heavy textbook and a piece of tissue. Hold them out and drop them. Ask your students if they know what variable is not being controlled? The answer is air. The air can affect the rate at which objects fall. To show that the tissue and book both fall at the same rate of speed put the tissue on top of the book. Explain to your students that if the book falls faster there will be a gap between the book and the tissue. Drop the book. The tissue will stay on top of the dictionary.

Explain to students that whenever they conduct an experiment, they must be fair. To be fair they must control as many variables as possible. If they are aware of variables that cannot be controlled, they must include this fact in their notes.

4. Complete Clue Card Activity 2: Controlling Variables

Hand out **Clue Card Activity 2** to each team, read the directions aloud, then allow time to complete the activity. When all teams have finished, review and discuss the correct answers. Accept any reasonable answer not listed and accept the answers in any order. Teams should then place their Clue Card Activity in their team Evidence Bag.

Clue Card Activity 2 Answer Key:**Amy's Project**

- a. location of plants
- b. amount of sunlight each plant receives
- c. kind of soil
- d. kind of plant
- e. size and health of plants
- f. temperature of the water
- g. amount of water
- h. source of water (tap, bottled, drinking fountain)

Wayne's Project

- a. size of cups
- b. amount of hot chocolate in each cup
- c. temperature of the hot chocolate before it is poured into the cups
- d. intervals at which temperature is measured
- e. is the same thermometer used for measuring each cup

5. Complete PI Assignment 2

Two students at Brightsville School were surprised by the results of their experiments. The answers to their problems were completely different from what they expected. After studying their experiments, they each discovered a very important variable that was not controlled.

Project the **PI Assignment 2** transparency and/or give students a copy. Have students read about Steven's and Brianna's projects, then answer the questions that follow each project on their **PI Assignment Answer Sheets**. When all students have finished, review and discuss



Read or say

the variables that were not controlled. Students should then place their PI Assignments in their team Evidence Bag.

Possible Answers to PI Assignment 2:

Steven's Project

The low-fat milk was not purchased at the same time as the others so it was most likely older and therefore would spoil faster. The low-fat milk was also opened and had been in use. The whole milk and skim milk were opened just before the experiment began.

Brianna's Project

Soils hold different amounts of water. If there is too much water the plant grows poorly or even dies. Brenda had a good idea to poke holes in the bottom of the cups, but she did not poke the same number of holes. A cup with five holes drains better than a cup with one hole. The cups with poor drainage probably formed small pools of water and caused the seeds to rot. A better way to conduct this experiment would be to put an equal number of holes in the bottom of the cups to allow for drainage and to keep the moisture of the soil samples the same.

6. Give Eyewitness Evidence

Hand out **Eyewitness Evidence 1** or write it on the board. Tell students where the evidence was found. Have each team write the evidence and the location in their **Investigator Notebook**. Teams should store the evidence in their Evidence Bags for future reference.

Eyewitness Evidence 2 (Found in the Art Room)

Your science fair projects are hidden in two different rooms, but they are not hidden in a room where you find our evidence.

7. Record Data

Have each team record the information they collected from **Eyewitness Evidence**, **Clue Card Activity 2**, and **PI Assignment 2** in the Student Data Section of their **Investigator Notebook**.

If you feel students still need assistance in recording data, work through the information together as follows:

- Point out that **Clue Card Activity 2** said Amy did a science fair project on plants and water temperature, and Wayne did one on cups and heat. Write this information in the Science Project column

and write "CCA2" for **Clue Card Activity 2** in the Source of Project Data column.

- Explain that **PI Assignment 2** showed Steven did an experiment on milk and Brianna did one on beans. Have students record this information in the same way they recorded the information they collected on Amy and Wayne.
- Direct students to the location chart in the **Investigator Notebook. Eyewitness Evidence 2** says the science fair projects are not hidden in a room where the Evidence is hidden. Therefore, an X should be entered in the Display and Materials columns across from Computer Lab and Art Room because Evidence has been found in these rooms. Remind students that by using this piece of Evidence alone they will be able to eliminate many of the rooms.

8. Collect Evidence Bags

For tomorrow:

Record each student's PI Assignment 2 score on the **Team Score Sheet** and tally these scores to arrive at a team's total points for PI Assignment 2. You may award up to five points per student for this PI Assignment. Due to the difficulty of this assignment you may be generous in giving out points.

Score each team's Clue Card Activity 2 and enter the number of clues they earned on the Team Score Sheet.

Investigation Day 3

Objective: Students learn three ways to collect data from their experiments.

MATERIALS

- **Clue Cards 2a–2c**—one per team
- **Teacher Transparency 9: Student Data Sheet**
- **Clue Card Activity 3**—one per team
- **PI Assignment 3**—one transparency and/or one per student
- Materials for Collecting Data Experiments—one set per team if doing hands-on experiments; one set if doing demonstration (see Directions #3)
- **Eyewitness Evidence 3**

Directions:

1. Award Clues and Points

Return Evidence Bags.

Award Clue Cards (2a–2c) earned for Clue Card Activity 2. Have each team turn to the Student Data Sheet in their **Investigator Notebook** and record the information from the clues they earned.

If you feel students still need assistance recording data, project **Teacher Transparency 9: Student Data Sheet** and record Clue 2a (and Clue 2c, if necessary) together. Not enough information is known to record Clue 2b at this time, but students should remember and save the information. The chart should be filled in as follows:

Name	Science Project	Project Data Source	After-School Activity	Proof of Activity	X Not a Suspect	Proof
Jia			music practice	Clue 2a		
Brian			gym	Clue 2c		

Announce and/or write on the board the number of points earned by each team for PI Assignment 2. Have teams move their markers on the **Map of Brightsville School**. If any team enters a wing, give them a **Wing Map** for that wing. Teams should record any information they can from the Wing Maps. Wing Maps and Wing Descriptions should be stored in the team's Evidence Bag for future reference.



Read or say

2. Introduce Collecting Data

While conducting your experiments you will have many observations to make. These observations usually fall into three categories: measurement, counting, and description. You can measure things like temperature, height, weight, distance, speed, and time. You might count the number of worms found in certain kinds of soil, or the number of animals living in a small pond. You would use your senses to describe things you see, hear, feel, smell, and taste as they relate to your experiment.

Brianna wrote her observations in a notebook. She recorded the height of each plant (measurement) and described the bean plants as they grew (description).

During an experiment you must make careful observations. Today you will practice making observations in all three categories: measurement, counting, and description.

3. Complete Clue Card Activity 3: Collecting Data

Hand out **Clue Card Activity 3** to each team. Students should use this sheet to record the data using measurement, counting, and description from the three experiments you will complete in class. If doing hands-on experiments, give each team the materials needed prior to each experiment.

Teaching tip



To reinforce the skill of forming hypotheses, have students predict the outcome of each experiment before beginning. You might do this as a class or have students make individual hypotheses.

Measurement

Materials Needed

- candle (birthday candle, tea light, or votive)
- 3 jars: one small, one medium, and one large (all sides of jar mouth must touch the table when turned upside down)
- matches or lighter
- stopwatch

Instructions

Start with Jar A. Light a candle, cover it with a jar, and use a stopwatch to time the number of seconds the candle burns. When the candle goes out, stop the watch and record the time. Write how long each candle burned under the three different jars. Repeat the process with Jar B and Jar C. Do three trials with each of the three jars.

Teaching tip



Use your own judgment in allowing students to light their own candles.

Counting**Materials Needed**

- inflated balloon (less than 9" in diameter when inflated)
- 30 pieces of hole-punched paper (10 each of red, green, and white construction paper), stored separately in small plastic bags

Instructions

Test the hypothesis that white paper is more attracted to a negatively charged balloon than red or green paper. Have one student (or one from each team) rub the balloon in his or her hair 10 times, then put the balloon on the 10 red pieces of paper and lift up the balloon. Count the number of papers on the balloon. Make tally marks to show how many pieces of paper were picked up. Do this again with the green and white paper. Be aware that when creating static electricity the balloons may pop and the paper may fly around. Do three trials with each of the three colors of paper.

Description**Materials Needed**

- magnifying glass or microscope
- 2 Tbsp. each of salt, baking soda, sugar, and flour (keep separated)

Instructions

Give students $\frac{1}{8}$ teaspoon of the following: salt, baking soda, sugar, and flour. Make sure there are no clumps! Have them carefully observe each powder, draw a picture of each kind, and write a brief description of each powder. When they have finished, take the powders away and give them $\frac{1}{8}$ teaspoon of baking soda. Don't tell them what it is—this is the "mystery powder" they have to identify. If you wish to make this more challenging, mix the salt, sugar, and flour together and have teams identify the powder that is missing from the mixture.

4. Complete PI Assignment 3

Project the **PI Assignment 3** transparency and/or give students a copy.

Jared wanted to find out what kind of soil worms preferred. He divided a baking pan into four sections. Then he filled each section with a different kind of soil. In the pan's center he dropped 30 worms. Next he covered the pan with aluminum foil and placed it



Read or say

in the refrigerator. After one week he removed the pan and counted the number of worms in each soil sample. Jared's Data was recorded in a table.

Tim conducted an investigation on how different surfaces affected the distance his toy car would travel. For his experiment he built a ramp and collected five different surfaces. The surfaces he used were wood, sandpaper, carpet, cardboard, and linoleum. Tim put the ramp on one of the surfaces and then let his car run down the ramp and on to the surface. Each time he measured the distance the car traveled from the bottom of the ramp to the point where it stopped. Then he changed surfaces. He tested each surface every day for five days. Tim's Data table shows how he recorded his data after the first day.

Allow students time to study the tables and answer the five questions at the bottom of the page on their **PI Assignment Answer Sheets**. When all students have finished review and discuss the correct answers. Students should then place their PI Assignments in their team Evidence Bag.

PI Assignment 3 Answer Key:

1. Jared
2. Tim
3. sensory descriptions
4. Jared could have described how healthy or unhealthy the worms looked.
5. He found 28, so that is what he had to record. Most likely he will find the other two worms either dead or crawling around inside the refrigerator.

5. Give Eyewitness Evidence

Hand out **Eyewitness Evidence 3** or write it on the board. Tell students where the evidence was found. Have each team write the evidence and the location in their **Investigator Notebook**.

Eyewitness Evidence 3 (Found in a Restroom)

In addition to this mystery we made, we each entered a science fair project, but our projects do not use any kind of measuring instruments.

6. Record Data

Have each team record the information they collected from **Eyewitness Evidence**, **Clue Card Activity 3**, and **PI Assignment 3** in the Student Data Section of their Investigator Notebook.

Allow students time to discuss the mystery within their groups. You might also discuss it as a class. They should know by now that Steven, Deja, Brianna, and Tim did not steal the projects. All of their projects involved measurement, and Eyewitness Evidence 3 says that the students who hid the projects did not do any measuring.

7. Collect Evidence Bags**For tomorrow:**

Record each student's PI Assignment 3 score on the **Team Score Sheet** and tally these scores to arrive at a team's total points for PI Assignment 3.

Score each team's Clue Card Activity 3 and enter the number of clues they earned on the Team Score Sheet. Unless a team did not complete the assignment, they will receive all of the clues on **Clue Card 3**.

**Teaching tip**

From this point on, the directions are limited for guiding students through the mystery. Support your class or individual teams as needed. A key to the Student Data Sheet can be found on page 112.

Investigation Day 4

Objective: Students learn how to make and use graphs.

MATERIALS

- **Clue Cards 3a–3c**—one per team
- **Clue Card Activity 4**—one per team
- **PI Assignment 4**—one transparency and/or one per student
- **Teacher Transparency 3: Graphing and Analyzing Data**
- Materials for Great Marble Roll—one set per team if doing hands-on experiments; one set if doing demonstration (see Directions #4)
- **Eyewitness Evidence 4**

Directions:**1. Award Clues and Points**

Return Evidence Bags.

Award **Clue Cards** (3a–3c) earned for Clue Card Activity 3. Have each team turn to the Student Data Sheet in their **Investigator Notebook** and record the information from the clues they earned. The only clue that can be recorded at this time is Clue 3b.

Announce and/or write on the board the number of points earned by each team for PI Assignment 3. Have teams move their markers on the **Map of Brightsville School**. If any team enters a wing, give them a **Wing Map** for that wing. Teams should record any information they can from the Wing Maps. Wing Maps and Wing Descriptions should be stored in the team's Evidence Bag for future reference.

2. Introduce Graphing and Analyzing Data

Project **Teacher Transparency 3: Graphing and Analyzing Data**.

A graph is an important part of a science fair project. It serves two purposes. First, it helps you analyze the data you collected, and second it helps you explain your findings to others. The two kinds of graphs you will use the most often in a science fair project are a bar graph and a line graph.



Read or say

A *bar graph* is a good way to compare groups. Look at the bar graph of handspans. This graph shows the handspans of students in a fourth-grade class at Brightsville School. The *population* in this case is the fourth grade students. You will notice that the handspans go from 14 cm to 20 cm. The difference between these numbers is called a *range*. The fourth-grade class has a handspan range of 6 cm ($20\text{ cm} - 14\text{ cm} = 6\text{ cm}$). The middle number in this range is 17 cm. This middle number is called the *median*. By using range and median you can make fairly accurate predictions about the population you are studying. For example, you have been studying fourth grade handspans. By using the information from this graph you should be able to answer these questions:

- What would be the approximate handspan range of another fourth-grade class at Brightsville Elementary School? (6 cm)
- If a new fourth-grade student entered Brightsville Elementary School, what would this student's handspan most likely be? (close to the median of 17 cm)
- Based on what you know about fourth-grade handspans, could you predict the range and median for a third-grade class? A fifth-grade class? (greater for a fifth-grade class and less for a third-grade class)

Without the help of a graph, answering these questions would have been more difficult.

A *line graph* is used when data is changing because one variable affects another. Here's an example:

Michelle studied the bounce of a ping-pong ball. She made a line graph to study it. The horizontal line gives the height from which the ball was dropped. The vertical line tells how high the ball bounced. Notice that Michelle dropped the ball from only four heights—15, 30, 45, and 60 centimeters.

She plotted the distance the ball bounced from each height and connected them with a line. Using this graph, Michelle can make many predictions. If she wanted to find out how high a Ping-Pong ball would bounce when dropped from 50 cm, she would find the point where 50 cm meets the graph line she drew, then move across to find the number of centimeters it would bounce—about 32 cm. By extending the line in both directions, Michelle could make a prediction of how high the ball would bounce from 75 cm and 10 cm. Look at the graph and predict how high the ball would bounce from each of these heights. (Allow time to do this. The answers are: about a 5 cm bounce from 10 cm and about 48 cm from 75 cm.) If the points on your graph are not straight you can draw a straight line between the points or draw a curved line that connects the points.

3. Complete PI Assignment 4

Project the **PI Assignment 4** transparency and/or give students a copy.



Read or say

Jamie did a science fair project on the amount of rainfall at her grandparents' home. The local newspaper and local TV station reported different amounts of rain. Jamie wanted to see which one matched what she measured so she recorded the rainfall each month from September through February. This graph shows the rainfall she measured each month.

The second graph shows the results of Miguel's experiments with electromagnets. He studied the relationship between the number of coils and the strength of an electromagnet.

Allow students time to look over the graphs and write the answers to the following questions on their **PI Assignment Answer Sheet**. You might write the questions on the board or overhead.

1. Who made a bar graph?
2. How many coils were on the electromagnet that picked up six paper clips?

3. If Jamie had recorded March's rainfall, would it most likely be more or less than February's rainfall?
4. If Miguel wrapped 11 coils around the nail, how many paper clips would it most likely pick up?
5. What is the range of rainfall?

Collect the **PI Assignment Answer Sheets** when students finish and go over the answers.

PI Assignment 4 Answer Key:

1. Jamie
2. 10
3. less
4. 7
5. 9 inches

4. Complete Clue Card Activity 4: The Great Marble Roll

Hand out **Clue Card Activity 4** to each team. Students should use this sheet to record data from this activity. If doing this hands-on, give each team a set of the materials needed.

The Great Marble Roll

Materials Needed

- marble
- paper tube (12" x 18" piece of construction paper, rolled and taped)
- metric ruler or metric tape measure

Instructions

One student holds the ruler straight up while another student puts one end of the tube on the floor and the other end against the ruler at the 2 cm mark. A third student puts the marble in the top of the tube and gently lets the marble roll through the tube and across the floor. A fourth student uses the ruler to measure the number of centimeters the marble rolled and records this distance on the Great Marble Roll Data Sheet. Repeat this process from the heights of 8 cm, 12 cm, and 18 cm.

After the data has been collected, explain that one variable (the height of the tube) affects the other variable (the distance the marble rolls), which can be illustrated using a line graph. Show how to graph this information using the Great Marble Roll Graph. Note: The left side of

the graph has been left blank as the distances the marble rolls vary greatly depending on the type of surface used. Determine the distances needed for the graph and have students write in the information before graphing the data. When teams finish their graphs, have them answer the following questions:

1. About how far would the marble roll if the tube was 3 cm high?
2. About how far would the marble roll if the tube was 20 cm high?

The answers to **Clue Card Activity 4** will vary depending on the surface and how each team dropped the marble in the tube.

Discuss the predictions made by each team. Then have teams repeat the marble roll again, from the 3 cm and 20 cm heights. Were their predictions accurate? If not, ask: What variable could have been overlooked? Were you careful in all of your measurements? Did you graph the data accurately?

5. Give Eyewitness Evidence

Hand out **Eyewitness Evidence 4** or write it on the board. Tell students where the evidence was found. Have each team write the evidence and the location in their **Investigator Notebook**. Teams should store the evidence in their Evidence Bags for future reference.

Eyewitness Evidence 4 (Found in the office)

Neither of us participates in music or after-school sports.

6. Record Data

Allow time for teams to discuss the mystery and record the information they collected from **Eyewitness Evidence 4**, **Clue Activity 4**, and **PI Assignment 4** in the Student Data Section of their **Investigator Notebook**.

7. Collect Evidence Bags

For tomorrow:

Record each student's PI Assignment 4 score on the **Team Score Sheet** and tally these scores to arrive at a team's total points for PI Assignment 4.

Score each team's Clue Card Activity 4 and enter the number of clues they earned on the Team Score Sheet.

Teaching tip

If teams are not earning enough points to move from wing to wing, double or triple the points earned on the PI Assignments.



Investigation Day 5

Objective: Students practice drawing conclusions based on data.

MATERIALS

- **Clue Cards 4a–4c**—one per team
- **Clue Card Activity 5**—one per team
- **PI Assignment 5**—one transparency and/or one per student
- **Teacher Transparency 3: Graphing and Analyzing Data**
- **Eyewitness Evidence 5**

Directions:

Note: Today's activities are brief. You may use the extra time to review the Student Data Sheet and let the students discuss the mystery.

1. Award Clues and Points

Return Evidence Bags.

Award **Clue Cards** (4a–4c) earned for Clue Card Activity 4. Have each team turn to the Student Data Sheet in their **Investigator Notebook** and record the information from the clues they earned.

Announce and/or write on the board the number of points earned by each team for PI Assignment 4. Have teams move their markers on the **Map of Brightsville School**. If any team enters a wing, give them a **Wing Map**. As teams enter wings for the second time, give them the **Wing Description** for that wing. Teams should record any information they can from the Wing Maps and Wing Descriptions and store them in the team's Evidence Bag for future reference.

2. Introduce Drawing Conclusions

A conclusion is the end product of the scientific method. Let's briefly review the steps in the Scientific Method process. First, you start with a problem. Then you come up with a possible solution to the problem. This is the hypothesis. Next, you design an experiment to test your hypothesis. You collect data from the experiment and analyze it. Finally you form a conclusion.

In the conclusion you decide if your hypothesis is correct. The most important part about writing a



Read or say



Read or say

conclusion is to be honest. You must base your conclusions on the data you have collected. Let's look at the graphs you used in PI Assignment 4.

Project the **PI Assignment 4** transparency.

Using just this graph you cannot conclude that more rain fell in March than February because March is not part of the graph. Can Miguel conclude that the more coils around the nail the stronger the electromagnet becomes?

Allow time for discussion. The data shows both. At first the number of coils does not seem to change the magnet's strength, but after eight coils it does get stronger.

Even though it is well known that electromagnets get stronger as the number of coils increases, Miguel's data does not completely support it. Based on his data he cannot conclude that increasing the number of coils increases the electromagnets strength. Miguel needs to do more testing and should look for uncontrolled variables that could change the results of his experiment.



Read or say

Teaching tip

For more practice drawing conclusions, have students make conclusions based on the results of their data collections on Investigation Day 3 (Clue Card Activity 3).



3. Complete Clue Card Activity 5: Drawing Conclusions

Hand out **Clue Card Activity 5** to each team and read the directions aloud. Project **Teacher Transparency 3: Graphing and Analyzing Data**. When all teams have finished, review and discuss the correct answers. Teams should then place their Clue Card Activity in their team Evidence Bag.

Clue Card Activity 5 Answer Key:

The conclusions based on data are 1 and 6. Students often say that 3 is a good conclusion, but remind them that although 23 students had their hands measured there may have been other students in the class who were absent that day or who chose not to have their hands measured.

4. Complete PI Assignment 5

Project the **PI Assignment 5** transparency and/or give students a copy.



Read or say

Ron has always been fascinated by rockets. For his science fair project he decided to see what kind of gases would make his balloon rocket travel the greatest distance, but during his experiments he noticed there was no consistency to his results. Then he realized that the balloon he was using for his experiment might be losing its strength from repeated testing and that could account for the different results. He came up with the following hypothesis:

The more I use a balloon to propel my rocket the shorter the distance it will travel.

For his experiment he used three balloons. He tested each balloon three times in a row and recorded his results on the table that you see. Study the table and the graph then write a conclusion for Ron's experiment on your PI Assignment Answer Sheet.

Collect the **PI Assignment Answer Sheets** when students finish and discuss the correct answer.

PI Assignment 5 Answer Key:

The hypothesis is incorrect. In fact, the results are the opposite of what was hypothesized. The rocket travels further the more times a balloon is used.

5. Give Eyewitness Evidence

Hand out **Eyewitness Evidence 5** or write it on the board. Tell students where the evidence was found. Have each team write the evidence and the location in their **Investigator Notebook**. Teams should store the evidence in their Evidence Bags for future reference.

Eyewitness Evidence 5 (Found in the Library)

Most of you walk by your projects every school day.

6. Record Data

Allow time for teams to discuss the mystery and record the information they collected from **Eyewitness Evidence 5**, **Clue Activity 5**, and **PI Assignment 5** in the Student Data Section of their **Investigator Notebook**.

You may point out that Clues 4a and 4b will be helpful later on as they get more clues. If you feel it necessary to provide extra help, have the team reread the School Tour in the Student Guide to find the owner of the trunk in Clue 4c.

7. Collect Evidence Bags

For tomorrow:

Record each student's PI Assignment 5 score on the **Team Score Sheet** and tally these scores to arrive at a team's total points for PI Assignment 5.

Score each team's Clue Card Activity 5 and enter the number of clues they earned on the Team Score Sheet.

Investigation Day 6

Objective: Students learn about and practice repeated experimentation.

MATERIALS

- **Clue Cards 5a–5c**—one per team
- **PI Assignment 4**—one transparency OPTIONAL
- **Clue Card Activity 6**—one per team
- Materials for electromagnet experiment—one set per team if doing hands-on experiments; one set if doing demonstration (see Directions #3)
- **PI Assignment 6**—one transparency and/or one per student
- **Eyewitness Evidence 6**

Directions:

1. Award Clues and Points

Return Evidence Bags.

Award **Clue Cards** (5a–5c) earned for Clue Card Activity 5. Have each team turn to the Student Data Sheet in their **Investigator Notebook** and record the information from the clues they earned.

Announce and/or write on the board the number of points earned by each team for PI Assignment 5. Have teams move their markers on the **Map of Brightsville School**. If any team enters a wing, give them a **Wing Map** or **Wing Description** for that wing. Teams should record any information they can from the Wing Maps and Wing Descriptions and store them in the team's Evidence Bag for future reference.

2. Introduce Repeated Experimentation

An important part of the scientific method is the need for repeated experimentation. This means you need to do an experiment several times before you draw any conclusions. Let's see how this is done.

Yesterday you learned that Ron did an experiment with rockets. His rocket was just a straw with a balloon attached. He tied one end of a string to the back of a chair. Then he threaded the string through the straw



Read or say

and tied the other end to the back of another chair. The straw could easily glide back and forth. For his experiment he blew up the balloon to a diameter of 4", pinched the end shut, and taped the balloon to the straw. He dragged the straw back to the chair and let go. The straw was launched. It zoomed along the string and stopped. He measured the distance from the chair to where the balloon stopped. Ron did this two more times using the same balloon and measuring the distance. Then Ron repeated the experiment by doing it again with another balloon, and then he did it again with a third balloon. When he finished he had done his experiment three times. This is an example of repeated experimentation.

Remember Miguel's experiment with the electromagnet? He did not repeat his experiment. He tested the coils only once.

Project PI Assignment 4 or draw Miguel's graph on the board.



Read or say

The data does not look right. Why did his electromagnet pick up three paper clips with two coils and did not get any stronger until he had eight coils? He should have repeated this experiment several times. If the results were the same then the experiment provided accurate data. If the results were different he probably failed to control a variable.

Ask the class what variables need to be controlled. You might also tell them that after the mystery was solved and the projects returned, Miguel noticed that some paper clips were larger than others.



Read or say

When you repeat an experiment you must do it exactly the way you did it the first time. Not only should you do it the same, but you should get about the same results. If you do not get about the same results, you need to find out why. Did you control all the variables? Did you make accurate measurements? Never do an experiment just once. It should be done several times. In the Great Marble Roll your results might have been better if you had measured the fall

of the marble five or 10 times from each height and graphed the average distance the marble rolled.

Some experiments are harder than others to repeat. If you cannot repeat an experiment, increase the number of samples you are studying. For example, what if you spent eight weeks doing an experiment on plants? You probably wouldn't want to do another eight-week experiment. The solution to this kind of problem is to increase the number of plants. Instead of doing an experiment on three plants, use 12. Jason used 30 worms in his experiment. This is much better than if he had used only four. Remember to repeat experiments! Then you will be able to write a conclusion with much more confidence having done the experiment three or four times instead of just once."

3. Complete Clue Card Activity 6: Repeated Experimentation

Explain that you are going to repeat Miguel's experiment with electromagnets, but use more coils. Hand out **Clue Card Activity 6** to each team and read the directions aloud. Students should use this sheet to record data from this activity. If doing this hands-on, give each team a set of the materials needed.

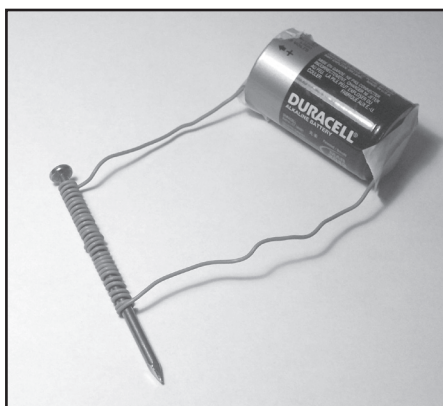
Materials Needed

1 electromagnet:

- new size D battery
- 2 ft of insulated wire (bell or solid single-strand wire that easily wraps around a nail) with insulation removed one-half inch from each end
- large steel nail, such as 16 D
- masking tape
- 2 dozen small paper clips
- potholders

Directions

Tape one end of the wire to the battery and then wrap the wire around the nail to make 10 coils.



Teaching tip

Practice creating the electromagnet a few times before having students try it. If your electromagnet does not work, it is most likely a poor connection at the ends of the battery. Be sure the wires at both ends are making good contact with the battery.



Complete the circuit and make an electromagnet by taping the other end of the wire to the battery. **WARNING! The ends of the wires can get very hot. Use potholders to hold the wire in place.** Use the nail head to pick up the paper clips. To disengage the electromagnet, remove the wire from one end of the battery.

Begin with 10 coils and connect both ends of the wire to the battery. Observe how many paper clips are picked up. Then remove the wire from the battery to break the circuit and write the results under "Trial 1." Repeat three more times. Then rewrap the nail to make 20 coils. When students have finished testing 20 coils four times, have them test 30 coils four times.

When all teams have finished, review and discuss their results. Teams should then place their Clue Card Activity in their team Evidence Bag.

Clue Card Activity 6 Answer Key:

There is not a right or wrong answer for this activity. Sometimes the nail gets magnetized so it is stronger by the end of the experiment than it was at the beginning. Also, the arrangement of the paper clips will change the number the magnet can pick up. If the paper clips are stacked, more will be picked up than if they are scattered.

4. Complete PI Assignment 6

Project the **PI Assignment 6** transparency and/or give students a copy.

Allow students time to read about Ryan and Shane's projects and write the answer on their **PI Assignment Answer Sheet**. When all students have finished discuss the correct answer. Students should then place their PI Assignments in their team Evidence Bag.

PI Assignment 6 Answer Key:

None. Neither boy repeated his experiment. Here's what could have been done to repeat the experiments.

Ryan's Project:

1. Repeat the experiment several times on different days.
2. Do the experiment once but use more pans. Instead of just three pans try nine.

Shane's Project:

1. Repeat the experiment several times on different days.
2. Repeat the experiment on a cloudy day.
3. Use more than two bottles. Try using five bottles with black and five with white.

5. Give Eyewitness Evidence

Hand out **Eyewitness Evidence 6** or write it on the board. Tell students where the evidence was found. Have each team write the evidence and the location in their **Investigator Notebook**. Teams should store the evidence in their Evidence Bags for future reference.

Eyewitness Evidence 6 (Found in Teachers' Room)

The two places where your projects are hidden share a common wall.

6. Record Data

Allow time for teams to discuss the mystery and record the information they collected from **Eyewitness Evidence 6**, **Clue Card Activity 6**, and **PI Assignment 6** in the Student Data Section of their **Investigator Notebook**.

Remind students to look at the Wing Maps they've collected to get more use out of the clues and evidence they've received.

7. Collect Evidence Bags

For tomorrow:

Record each student's PI Assignment 6 score on the **Team Score Sheet** and tally these scores to arrive at a team's total points for PI Assignment 6.

Score each team's Clue Card Activity 6 and enter the number of clues they earned on the Team Score Sheet.

Investigation Day 7

Objective: Students learn how to make a science fair notebook and a display board.

MATERIALS

- **Clue Cards 6a–6c**—one per team
- **Clue Card Activity 7**—one per team
- **Teacher Transparency 4: A Science Fair Display Board**
- **PI Assignment 7**—one transparency and/or one per student
- **Eyewitness Evidence 7**

Directions:

1. Award Clues and Points

Return Evidence Bags.

Award **Clue Cards** (6a–6c) earned for Clue Card Activity 6. Have each team turn to the Student Data Sheet in their **Investigator Notebook** and record the information from the clues they earned.

Announce and/or write on the board the number of points earned by each team for PI Assignment 5. Have teams move their markers on the **Map of Brightsville School**. If any team enters a wing, give them a **Wing Map** or **Wing Description** for that wing. Teams should record any information they can from the Wing Maps and Wing Descriptions and store them in the team's Evidence Bag for future reference.

2. Introduce Exhibiting a Science Fair Project

After you have finished the experiment for your science fair project, you need to put the results of your investigation into a science fair format. This usually involves a science fair notebook and a display board.

Think of your science fair notebook as a written report. It should be neat and easy to read. The grammar, punctuation, and spelling should be correct. The science fair notebook usually has five parts: Introduction, Method and Materials, Results and Data, Conclusion, and Summary.



Read or say

The purpose of the introduction is to introduce your science fair project to an audience. The audience will be the judges and the people who come to see the science fair. In the introduction you will explain the problem that you investigated, state your hypothesis, and give any background information you want to provide.

In the method and materials section you will explain your method of investigation. You will tell the equipment that was used and how your experiment was conducted. Your explanation should be so complete that another researcher could repeat your experiment. The information you collect from your investigation goes in the results and data section. This section is really two parts. The first part is a record of the data you collected. This may be presented in graphs, tables, or charts. The second part is the analysis of this information. It is where you tell what all the data you collected means. In the conclusion you give the answer to your problem and state whether your hypothesis was correct or not. The summary is a brief description of your science fair project. You explain the problem and whether or not your hypothesis solved the problem. You explain how the experiment helped you reach your conclusion. Finally, explain what further research, if any, is needed.

Project **Teacher Transparency 4: A Science Fair Display Board**

The display board is important because you want it to quickly capture the judges' and audience's attention so they will stop and take a closer look at your project. Science fair display boards may give a summary of the main parts of your science fair notebook or include the entire notebook. You state the problem and hypothesis, the methods you used, the results you obtained, the conclusion you reached, and a summary of your project. Attached to the display board are pictures, graphs, and charts that help you tell the story of your science fair project. Everything about the display board must be neat and attractive.



Read or say



Read or say

3. Complete Clue Card Activity 7: The Science Fair Notebook

Richard Winston wrote four drafts of his science fair notebook. When he arrived at school on the day of the science fair, he realized he had the wrong draft of his science fair notebook. This is what it looked like.

Hand out **Clue Card Activity 7** to each team, read the directions aloud, then allow time to complete the activity. When all teams have finished, review and discuss the correct answers. Teams should then place their Clue Card Activity in their team Evidence Bag.

Clue Card Activity 7 Answer Key:

1. 14 mistakes

There are nine spelling errors. **Intrduction** for introduction, **our** for are, **investegation** for investigation, **wait** for weight, **for** instead of four, **tim** for time, **notbook** for notebook, **Candel** for Candle and **brun** for burn.

There are five punctuation errors. In paragraph 1 the first sentence ends with a question mark instead of a period. In the second paragraph periods are needed after the words "out" and "notbook." In the last paragraph periods are needed after the words "burn" and "ones."

2. The conclusion is not based on the data. The long, thin candles burned longer, on average, than the short thick ones. Also the time 4:62 should be 5:02.

3. The summary was left out.

4. Complete PI Assignment 7

Project the **PI Assignment 7** transparency and/or give students a copy. Read the directions aloud:

Richard Winston made at least four minor mistakes and one major mistake on his display board. Study his display board and list the mistakes he made.

Allow students time to study the display board and record the errors on their **PI Assignment Answer Sheet**. When all students have finished, discuss the correct answers. Students should then place their PI Assignments in their team Evidence Bag.

PI Assignment 7 Answer Key:

Minor Errors:

1. The title is not level
2. The n in burn is reversed



Read or say

3. The question mark is backward
4. Poor spacing of method and materials

The One Major Error:

5. A conclusion was not included on the display board

5. Give Eyewitness Evidence

Hand out **Eyewitness Evidence 7** or write it on the board. Tell students where the evidence was found. Have each team write the evidence and the location in their **Investigator Notebook**. Teams should store the evidence in their Evidence Bags for future reference.

Eyewitness Evidence 7 (Found in Office)

Everything we took is hidden in objects that have the shape of rectangular prisms.

6. Record Data

Allow time for teams to discuss the mystery and record the information they collected from **Eyewitness Evidence 7**, **Clue Activity 7**, and **PI Assignment 7** in the Student Data Section of their **Investigator Notebook**.

7. Collect Evidence Bags

For tomorrow:

Record each student's PI Assignment 7 score on the **Team Score Sheet** and tally these scores to arrive at a team's total points for PI Assignment 7.

Score each team's Clue Card Activity 7 and enter the number of clues they earned on the Team Score Sheet.

Investigation Day 8

Objective: Students practice judging science fair notebooks.

MATERIALS

- **Clue Cards 7a–7c**—one per team
- **Clue Card Activity 8**—one per team
- **Teacher Transparencies 5–7: Notebook 1, 2, and 3**
- **PI Assignment 8**—one transparency and/or one per student
- **Eyewitness Evidence 8**

Directions:

1. Award Clues and Points

Return Evidence Bags.

Award **Clue Cards** (7a–7c) earned for Clue Card Activity 7. Have each team turn to the Student Data Sheet in their **Investigator Notebook** and record the information from the clues they earned.

Announce and/or write on the board the number of points earned by each team for PI Assignment 7. Have teams move their markers on the **Map of Brightsville School**. If any team enters a wing, give them a **Wing Map** or **Wing Description** for that wing. Teams should record any information they can from the Wing Maps and Wing Descriptions and store them in the team's Evidence Bag for future reference.

2. Introduce Judging a Science Fair Project

Yesterday you learned about the science fair notebook and the display board. It is possible to have done excellent work and still not get the first place ribbon you expected. Why is that? In most cases it has to do with the science fair rules and judging guidelines.

Science fairs have rules for the participants to follow. These rules tell how to enter the competition. They describe the kinds of experiments that are allowed, and those that are not allowed. The rules give the size requirements of the display boards and tell when the projects are due. When entering a science fair project,



Read or say

you must make sure to read and understand all of the rules.

It is also important to be familiar with the judging guidelines, which are used to evaluate the science fair projects. If you read and study these guidelines before beginning your science fair project, you'll know what the judges expect to see. If you leave out something that the judges consider important, your project could lose many points. If the judges are told to award 50 out of 100 points for creativity and you are doing an experiment that is done every year, you will not receive very many points no matter how good your project is. If creativity is worth only 10 points, then you should not be concerned about your project being one that has been done before. So remember to study the judging guidelines.

3. Discuss Judging Guidelines for Brightsville School

Direct students to the last page of their **Student Guide**.

Let's examine the judging guidelines used by the judges at the Brightsville School science fair.

Notice there are four main categories: Creativity, Scientific Thought, Thoroughness, and Neatness. Each of these categories has the maximum amount of points the judges can award. Creativity is worth up to 30 points. If a judge comes across a very imaginative project, the judge would most likely give it 30 points. If the same judge sees a project on volcanoes that looks like other volcano projects, then the volcano project may get only 10 or 15 points.

The judging guidelines tell the judge what to look for in each category. After careful study of the guidelines, the judge begins to evaluate the projects. The amount of points given a project in each category is up to the judge. After all the categories are judged, the points are added up giving the project the judge's final score. Most science fairs have more than one judge. A project's final score is the sum of all points given by all the judges."



Read or say



Read or say

4. Begin PI Assignment 8

For today's PI Assignment you get to be a science fair judge. I will show your team the summaries of three science fair notebooks. Use the judging guidelines to score each notebook. Record the project number and scores on your **PI Assignment Answer Sheet** under PI Assignment 8. We will judge the first project together. Project **Teacher Transparency 5: Notebook 1**.

In the Notebook # column write "1" because we will be scoring Notebook 1. Now read through the notebook (silently or aloud with the whole class).

Now, let's give scores in each category starting with creativity. This is a clever project because Cindy has to collect the paramecia—this is not a project one usually sees and it's interesting. Let's give her 25 points.

For scientific thought we need to think about her experiment. Does she have a hypothesis? Does the experiment test her hypothesis? Cindy tested her paramecia in water, hot water, vinegar water, salt water, and soapy water. Were these good choices? Do paramecia come in contact with all of these substances? What things could she have tested that paramecia do come in contact with? (Possible answers include warm water, muddy water, rain water, chemical sprays.)

Next, does she control the variables? What are the variables? (Did she use the same size jars? Did she have the same amount of liquid in each jar? Were all of the paramecia healthy? Did each jar contain the same number of paramecia?) Is the experiment valid?

What do you think of her observations? Are they descriptive enough?

Does she have a conclusion based on the data? Look at her hypothesis and then look at her conclusion. Do you see a problem? How is her hypothesis stated differently in the conclusion? (She says paramecia can

survive only in fresh water but her hypothesis is about adding things to fresh water.)

Did she repeat her experiment? Did she use large enough numbers of paramecia to get good results?

Overall, she followed the scientific method, but her hypothesis was stated differently in the conclusion, not all variables were controlled, she did not repeat her experiment, and did she not keep accurate records. Let's give her 30 points.

Cindy was not very thorough. She did not record the amount of liquid in the jars or the number of paramecia she observed. When she added substances to the jars she did not record how much was added. We'll give her five points.

In the neatness category let's give her all 15 points. It was typed and there were no mistakes. When we add up all of the categories she gets a total score of 75.

Now it is time for you to score a notebook on your own.

Project **Teacher Transparency 6: Notebook 2** and **Teacher Transparency 7: Notebook 3** and allow time students to score the notebooks. Remind students that they must work alone and cannot talk to other student judges.

5. Discuss Results of PI Assignment 8

Which notebook received the most points?
Why? Would you give this project a first, second, or third-place ribbon? Some science fairs give first place ribbons to projects getting over 90 points, second place to projects with 80–89 points, and third place ribbons to projects with 70–79 points. Do you think this is fair? What did you like about these projects? What did you dislike? Would it be hard to score 40 projects? 100 projects? How would you improve one of the projects you scored so it would receive more points?



Read or say



Read or say

Use the following critiques of these projects to stimulate further discussion.

Notebook 2, Susan's Water Temperature Experiment: The judges liked this project. It was an original idea and involved considerable effort and scientific thought. However, Susan should have noted whether the times were in the morning or evening; she should have kept the same time each day. She also failed to mention if she took the temperature from exactly the same places. Some of the judges questioned her analysis of the data. They felt there wasn't enough data to prove that the air temperature affected the water temperature. Nevertheless, Susan was awarded a first-place ribbon.

Notebook 3, Andy's Anemometer: This project was simple yet unique. Unfortunately, Andy's good idea for a project was poorly conducted. He said he measured in the morning, afternoon, and night, but his chart said evening. Did he measure the wind speed in the evening or at night? He should have given the time of day for all of his measurements. He also failed to analyze the data thoroughly. His hypothesis was wrong, but he said it was right. The data in his tables was added incorrectly and he did not graph the results. Andy did not receive a ribbon.

6. Complete Clue Card Activity 8: Display Boards

Today's Clue Card Activity shows the information that Ben is going to put on a display board for his science fair project on batteries. He also plans to put on a large title and some pictures of his experiment. Unfortunately he is leaving out two important things that should go on a display board. What are they? Write your answer on the bottom of the page.

When all teams have finished, have them share their answers. Teams should then place their Clue Card Activity in their team Evidence Bag.

Clue Card Activity 8 Answer Key:

Ben left out graphs and, most important of all, a conclusion.



Read or say

7. Give Eyewitness Evidence

Hand out **Eyewitness Evidence 8** or write it on the board. Tell students where the evidence was found. Have each team write the evidence and the location in their **Investigator Notebook**. Teams should store the evidence in their Evidence Bags for future reference.

Eyewitness Evidence 8 (Found in the Music Room)

The display boards are hidden in a place where children are seen more than adults, but the materials you had on display are in a room where children are not allowed to enter.

8. Record Data

Allow time for teams to discuss the mystery and record the information they collected from **Eyewitness Evidence 8**, **Clue Activity 8**, and **PI Assignment 8** in the Student Data Section of their **Investigator Notebook**. You might remind them of the science fair projects they learned about today: Ben's Batteries, Cindy's Paramecia, Andy's Anemometer, and Susan's Water Temperature.

9. Collect Evidence Bags

For tomorrow:

Record each student's PI Assignment 8 score on the **Team Score Sheet** and tally these scores to arrive at a team's total points for PI Assignment 8. Because there is not a right or wrong answer for the PI Assignment, given each student five points.

Score each team's Clue Card Activity 8 and enter the number of clues they earned on the Team Score Sheet.

Investigation Day 9

Objective: Students solve a problem by forming a hypothesis, conducting an experiment, analyzing data, and writing a conclusion.

MATERIALS

- **Clue Cards 8a–8c**—one per team
- **Clue Card Activity 9**—one per team
- Materials for paper airplane experiment—one set per team
 - 2 pieces of letter-size multiuse paper to make paper airplanes, or two paper airplanes, one long (folded lengthwise) and one short (folded widthwise)
 - piece of letter-size multiuse paper crumpled into a ball
- **Eyewitness Evidence 9**

1. Award Clues and Points

Return Evidence Bags.

Award **Clue Cards** (8a–8c) earned for Clue Card Activity 8. Have each team turn to the Student Data Sheet in their **Investigator Notebook** and record the information from the clues they earned.

Announce and/or write on the board the number of points earned by each team for PI Assignment 8. Have teams move their markers on the **Map of Brightsville School**. If any team enters a wing, give them a **Wing Map** or **Wing Description**. Teams should record any information they can from the Wing Maps and Wing Descriptions and store them in the team's Evidence Bag for future reference.

2. Complete Clue Card Activity 9

You have been reading about the science fair projects at Brightsville School and have even judged a few of them. Now it is time for you to show what you have learned by doing a project of your own. Let's start with the problem.

Problem

One day after school, Ahmed, Lee, and Ron got into an argument about paper airplanes. Ron said that if you took two single sheets of



Read or say

paper and folded each one into a paper airplane, the plane that was longer would fly further than a plane that was shorter. Ahmed said it wouldn't matter and that a shorter plane would go just as far as a longer plane provided the papers they were made from were the same in every way and thrown with the same force. Lee said he could crumple a piece of paper into a ball and make it go further than either plane. Who is right? Talk it over quietly with your team, but do not begin any experimenting just yet.

Hand out **Clue Card Activity 9** to each team and read the following directions:

Your team is to think about the problem and then write a hypothesis. Next you will design an experiment to test your hypothesis and write it down under Methods and Materials. You may use the backside of the paper if you need more room. Then you will conduct the experiment at least three times. Record the data from your experiment in the Results box. After you have all of the data recorded, make a graph of your results, analyze the results, and write a conclusion.

Reread the problem aloud and answer any questions your students may have. Give your students the paper airplanes if you made them in advance. If not, show them how to fold the paper to make paper airplanes. Make sure the airplanes are all folded the same way. Some students, especially younger ones, may not have done this before, so you or someone else in the room might have to fold the paper for them (Hint: have some planes made in advance). Give students time to complete their experiments and discuss their conclusions. Use the following questions to facilitate the discussion:

- What were your hypotheses?
- Did the results surprise you?
- What variables needed to be controlled?
- How did you control the force of each throw?
- Besides throwing the planes, how else could they be launched?
- How did you record the results?
- How did you graph the data?
- What was your conclusion?



Read or say

Teaching tip

Make some paper airplanes in advance to use as folding samples. To save class time, make all airplanes in advance.



3. Give Eyewitness Evidence

Hand out **Eyewitness Evidence 9** or write it on the board. Tell students where the evidence was found. Have each team write the evidence and the location in their **Investigator Notebook**. Teams should store the evidence in their Evidence Bags for future reference.

Eyewitness Evidence 9 (Found in Music Room again)

Our individual science fair projects do not involve living organisms or electricity.

4. Record Data

Allow time for teams to discuss the mystery and record the information they collected from **Eyewitness Evidence 9** and Clue Card Activity 9 in the Student Data Section of their **Investigator Notebook**.

5. Collect Evidence Bags

For tomorrow:

Score each team's Clue Card Activity 9 and enter the number of clues they earned on the **Team Score Sheet**. Since there is no PI Assignment today, also award up to five points per student for completing this activity.

Investigation Day 10

Objective: Students learn how to plan a science fair project.

MATERIALS

- **Clue Cards 9a–9c**—one per team
- **Planning a Science Fair Project, A Step-by-Step Guide**—one per student
- **Clue Cards 10a–10c**—one per team
- **Eyewitness Evidence 10**

1. Award Clues and Points

Return Evidence Bags.

Award **Clue Cards** (9a–9c) earned for Clue Card Activity 9. Have each team turn to the Student Data Sheet in their **Investigator Notebook** and record the information from the clues they earned.

Announce and/or write on the board the number of points earned by each team for Clue Card Activity 9. Have teams move their markers on the **Map of Brightsville School**. If any team enters a wing, give them a **Wing Map** or **Wing Description** for that wing. Teams should record any information they can from the Wing Maps and Wing Descriptions and store them in the team's Evidence Bag for future reference.

2. Introduce Planning a Science Fair Project

Science fair projects take a long time to complete, so it's important to get started early. How early? If you want to do a really good job and have a chance of winning, you should start planning months before the science fair.

Hand out **Planning a Science Fair Project, A Step-by-Step Guide**. Read through the steps as a class, answering any questions students have.

3. Give Additional Wing Information

At your discretion, allow teams to enter any wing of the school to receive a **Wing Map** or **Wing Description**. Not all teams will want or need to do this as they may have already received all the information about the wings or have all the clues they need to solve the mystery.



Read or say

4. Give Eyewitness Evidence

Hand out **Eyewitness Evidence 10** or write it on the board. Tell students where the evidence was found. Have each team write the evidence and the location in their **Investigator Notebook**. Teams should store the evidence in their Evidence Bags for future reference.

Eyewitness Evidence 10 (Found in the Yard)

The projects are not hidden in a room where food is cooked or eaten, nor is it in a room where medicine is stored.

5. Give Clue Cards and Record Data

Award **Clue Cards** (10a–10c). Since there is no Clue Card Activity 10, award these cards at your discretion. You might award them for overall cooperative work, participation in class discussions, or exceptional investigative skills. Allow time for teams to record the information they collected from the **Clue Cards** and **Eyewitness Evidence 10** in the Student Data Section of their **Investigator Notebook**. Give students the remainder of the class period to work on solving the mystery. Encourage them to review all the clues and evidence they've received during the unit and record any information they may have overlooked along the way. Tell students that tomorrow is the last day to identify who took the projects and where they are hidden.

6. Collect Evidence Bags

Conclusion of the Investigation

Objective: Students reveal and discuss their solution to the mystery.

MATERIALS

- **Teacher Transparency 8: Student Data Answer Key**—one transparency
- **Science Fair Test**—one per student

Directions:

1. Announce “Special Assembly”

Tell students that the two weeks have expired and the principal of Brightsville School has called a special assembly to find out who took the science fair projects and exactly where they are hidden. Announce that the assembly will take place in 20 minutes. (Note: Allow more or less time depending on how much time your students need to solve the mystery.)

2. Write Solutions to the Mystery

Have teams study all of the information they have collected during the unit then write the answers to the following on a piece of paper:

1. Name the two students who hid the science fair projects.
2. Tell the room and where in the room the display boards are hidden.
3. Tell the room and where in the room the materials are hidden.
4. Form a hypothesis that explains how the students were able to hide the projects.

At the bottom of the paper have each team write its name and each team member sign his/her name.

3. Hold Assembly

Begin the special assembly. The principal has just asked the students to announce who they think hid the projects. Select one student from each team to read the team’s solution to the mystery.

Was the Brightsville Brain Trust's hypothesis correct? Were the other students unable to figure out who took the projects and where they were hidden? The team with the most correct answers is the winner of *Science Fair*. Hopefully you'll have more than one winner!

4. Discuss the Solution

Inform students that the principal also worked on the solution to the mystery and knows for sure who did it. Here is the principal's solution. Walk through solving the mystery with the class. Use the overhead or chalkboard to show the elimination process.

Solution to the Mystery

Where are the projects hidden?

First we'll find the location of the science fair projects. Let's do this by eliminating all of the places the projects cannot be hidden.

List on the board or overhead projector all the possible locations:

- Art Room
- Cafeteria
- Computer Lab
- Janitor's Office
- Janitor's Storage
- Kitchen
- Librarian's Workroom
- Library
- Learning Center
- Music Room
- Nurse's Office
- Office
- Principal's Office
- Restroom
- Stage
- Supply Room
- Teachers' Room
- Yard

Does anyone think the projects are hidden in the Art Room?

Listen to your students' responses. Ask for evidence, clues, and reasons for their decision. Guide them to the correct answer: the projects are not hidden in the Art Room because Eyewitness Evidence was found there and Eyewitness Evidence 2 says the projects are not hidden in a room where clues are found.

What other locations can be eliminated using Eyewitness Evidence 2?

Your students should list the Computer Lab, Restroom, Office, Library, Teachers' Room, Music Room, and Yard. If they miss one or more of these locations, go back and have them list all of the places Eyewitness Evidence was found. Cross out or erase all of these locations.

What locations are left?

Students should see that the Cafeteria, Janitor's Office, Janitor's Storage, Kitchen, Librarian's Workroom, Learning Center, Nurse's Office, Principal's Office, Stage, and Supply Room are still left.

Does anyone think the projects are hidden in the Cafeteria?

Listen to your students' responses. Ask for evidence, clues, and reasons for their decision. Guide them to the correct answer: the projects are not hidden in the Cafeteria because food is cooked there and Eyewitness Evidence 10 says projects are not hidden in a room where food is cooked or eaten, nor is it in a room where medicine is stored.

What other locations can be eliminated by using Eyewitness Evidence 10?

Students should list the Kitchen and Nurse's Office. Cross these two and the Cafeteria off the list.

Students should see that the Janitor's Office, Janitor's Storage, Librarian's Workroom, Learning Center, Principal's Office, Stage, and Supply Room are left.

Does anyone think the projects are located in the Janitor's Office?

Students should say no because the only one to enter that room was the janitor (Clue 7c). If they don't arrive at this answer, have them go back and look at the clues until they see Clue 7c. Cross Janitor's Office off the list.

Does anyone think the projects are hidden in the Janitor's Storage?

Listen to your students' responses. Ask for evidence, clues, and reasons for their decision. Guide them to the correct answer: the projects are not hidden in the Janitor's Storage because Eyewitness Evidence 6 says the two rooms where projects are hidden have a shared wall between them. The rooms that share a wall with the Janitor's Storage have already been eliminated so the projects are not hidden in the Janitor's Storage. If your students are confused, have them look at the Wing Map of the F Wing. Point out that the Janitor's Storage shares walls with the Music Room and Computer Lab, which have both been eliminated.

What other rooms can be eliminated using Eyewitness Evidence 6?

Students should recognize that the Principal's Office, Learning Center, and Librarian's Workroom can be eliminated. Refer to the Wing Maps if necessary to guide your students through the elimination process.

Cross out the Janitor's Storage, Principal's Office, Learning Center, and the Librarian's Workroom from the list. This leaves only two rooms: the Stage and the Supply Room.

Which room has the materials and which room has the supplies?

Allow time for discussion. If students do not come up with the correct answer (materials are in the Storage Room and the display boards are hidden on the Stage) you may guide them through the following: Eyewitness Evidence 8 says the materials are hidden in a room where children are not allowed. We know children are not allowed in the Supply Room because this was told to us during the school tour. Since the materials are in the Supply Room, the only remaining place for the display boards is on the Stage.

Where in the Supply Room are the materials hidden?

If students do not come up with an answer, guide them through the following: During the school tour you were told the shelves were half filled with writing paper and construction paper. You were also told that Mrs. Lorimyer comes in at the first of every month to deliver supplies to the teachers. When you investigated the Supply Room, however, your Wing Description said the shelves were "packed tight with paper." Who could have stacked the paper? Certainly not Mrs. Lorimyer, because she only comes in at the first of the month, not at the end. The extra paper must have come from the boxes of paper against the wall. By taking the paper out of the boxes and stacking it on the shelves, the Brain Trust could hide the materials in the empty paper boxes. Even if you missed this clue, you should have realized that the only objects in the Supply Room that were shaped like rectangular prisms were the boxes. It is the only place the materials could have been hidden.

Where do you think the display boards were hidden on the Stage?

Students should arrive at this answer, but if they don't, guide them through the following: We know from Eyewitness Evidence 7 that the display boards are hidden in objects shaped like rectangular prisms. The Stage has only two objects that are rectangular. They are the mattresses and the trunk. Since the trunk was welded shut and could not be opened, the only place left is in the mattresses, which had been hollowed out just so the display boards could be hidden in them. As you'll soon find out, the person who donated the mattresses for the school play is one of the members of the Brain Trust. So let's find out who did it!

Who took the projects?

The Brain Trust identified who they were in the Eyewitness Evidence. The first piece of evidence said the location of the evidence is just as important as the evidence itself. If you were to write down the location of each piece of evidence in the order in which it was given, you would get this. (Write this on the board for your students to see.)

Computer Lab	Teachers' Room
Art Room	Office
Restroom	Music Room
Office	Music Room
Library	Yard

Look carefully at the first letter of each location. Now put those letters together. What do you see?

If students do not recognize the names Carol and Tommy, then continue.

Notice that the first letter of each room spells some words. What words are spelled?

The names of the two members of the Brightsville Brain Trust—Carol and Tommy. If you missed this evidence, you could still figure out who hid the projects by analyzing the Student Data you collected.

Project **Teacher Transparency 9: Student Data Sheet** on a screen so all students can see it.

By keeping careful records of the clues and data you collected from PI Assignments and daily lessons, you should know the names of the students who did not do a science fair project, and you should know the kind of project done by the other students. Let's start at the top of the list with Aaron and identify the students who did not do a science fair project. You need to name the student and tell us the proof or source of your information. Use Teacher Transparency 8 as a reference. It shows the students who did not do a project and gives the proof. Students not doing a project are: Aaron, Ahmed, Ashley, Holly, Jia, Lee, Natalie, and Reyna.

Now let's list the science fair project of each student. What was Amy's project? How do you know?

Use the Student Data Sheet Answer Key, Teacher Transparency 9 to guide the discussion. Continue through all of the names. Give help as needed.

We now know what each student did. Let's use the clues to eliminate the suspects. First, how can we eliminate Aaron?

Students should point out that Eyewitness Evidence 3 eliminates all students who did not do projects and students who did projects requiring measurement.

Who else can we eliminate using Eyewitness Evidence 3?

Put an X in the Not a Suspect column as students eliminate suspects. Continue to refer to Teacher Transparency 8 as needed. All names should be crossed off except for: Amy, Bobby, Brianna, Brian, Carol, Cindy, Jared, Lee, Matt, Michelle, Miguel, and Tommy.

Can we eliminate Amy?

Students should say "yes" because Amy did an experiment on plants and Eyewitness Evidence 9 eliminates all students doing projects with living organisms or electricity.

Who else can we eliminate using Eyewitness Evidence 9?

Amy, Brianna, Cindy, Jared, Matt, Michelle, and Miguel can all be removed as suspects. Put an X in the Not a Suspect column.

This leaves us with just five suspects: Bobby, Brian, Carol, Lee, and Tommy. Can we eliminate Bobby?

Yes, he played baseball after school (Clue 12). Eyewitness Evidence 4 says students who participated in music or after school sports did not take the projects.

Who else can be eliminated with Eyewitness Evidence 4?

Brian was at gym and Lee was at baseball.

The only two left are Tommy and Carol. How do you think they were able to hide all of the projects?

Discuss this with your students. Let them share their hypotheses then read the following:

Tommy supplied the mattresses for the play (Clue 7a) and Carol was the star of the play (Clue 7c). No one would think anything unusual to see them on the Stage. Tommy and Carol said they had work to do on the Stage and then they hid under the mattresses

until the Cafeteria was closed. No one noticed they were missing because all of the students were involved in the play day activities. Then, just before the judges arrived, they climbed over the back wall and entered the Supply Room. While the judges were scoring the projects, they went to work emptying the boxes of paper to make room for all of the science fair materials they were about to hide. When the principal locked the Cafeteria doors at 4:30, they opened the Supply Room door from the inside and quickly put all the science fair materials in the empty boxes. Then they put these boxes back against the wall and put the few remaining boxes of paper in front and on top so it would look like the entire stack of boxes was just paper. Next they removed the top of the mattress and box spring and stuffed the display boards inside. They had planned this so thoroughly and worked so quickly that they were done by 5:30, at which time they quietly slipped out the back door of the Cafeteria. They both arrived at home before their parents returned from work.

5. Read the Punishment

If your students solved the mystery, read the punishment below given to the Brightsville Brain Trust. If they didn't solve it, wait a few days before reading the punishment.

When Tommy and Carol were identified as the culprits in this mystery, a big meeting with their parents was held in the Principal's Office. After Tommy's father found out what happened, he wanted to send Tommy to a military academy so he would learn some discipline. Carol's parents told her she was on restriction for the rest of her life. Fortunately for Tommy and Carol, the principal calmed things down. Then he lectured them for the next half hour. First, they were lectured about being irresponsible. Second, they were lectured about sneaking into locked rooms and trespassing. Then they were told about all the things that were ruined, and how all of the parents were disappointed because they did not see the science fair projects. Next they were told that the paper they removed had to be returned to the boxes because it was to be used during



Read or say

summer school. And, finally, they were reminded how their little prank disrupted the school routine for the last two weeks.

It was agreed that both would receive the same punishment. First, they each would have to deliver speeches to upper grade students on how responsibility comes with age. In the lower grades they would have to deliver speeches on the importance of honesty and respecting the property of others. Neither of them would be allowed to attend the week-long student environment camp, and both of them would be put on restriction for the rest of the school year.

6. Give Science Fair Test

If you are giving the **Science Fair Test** do so now. When all students have finished, review the answers as a class and use the test to begin debriefing.

Science Fair Test Answer Key:

1	a
2	d
3	a
4	d
5	a

6	a
7	b
8	c
9	d
10	a

7. Hold Debriefing Session

Have a discussion about what was learned in *Science Fair*. Among the topics to cover are:

Scientific Method

- What did you learn about the scientific method?
- Which parts of the scientific method do you now understand better?
- Which parts of the scientific method confuse you?

Science Fairs

- What will you do differently in your science fair projects?

Teaching tip

If you are planning to do the Whole-Class Science Fair Project, you may want to hold the debriefing after your class project is complete.



- b. What is one thing you learned from this unit that will help you with future science fair projects?
- c. What did you learn about the science fair notebook?
The display board?
- d. What advice would you give to people or students doing their first science fair project?

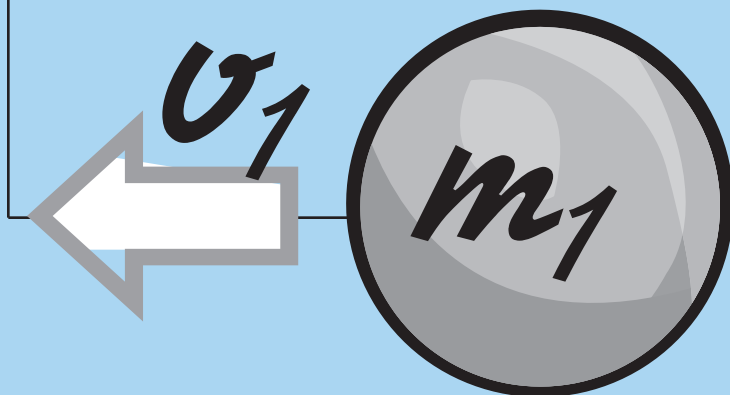
The Mystery

- a. What did you like best about the mystery? The least?
- b. What would you do differently to make solving the mystery easier?

Miscellaneous

- a. What did you like the best about *Science Fair*? The least?
- b. Should next year's students do this unit?
- c. Will you be able to make better science fair projects as a result of this unit?

Science Fair



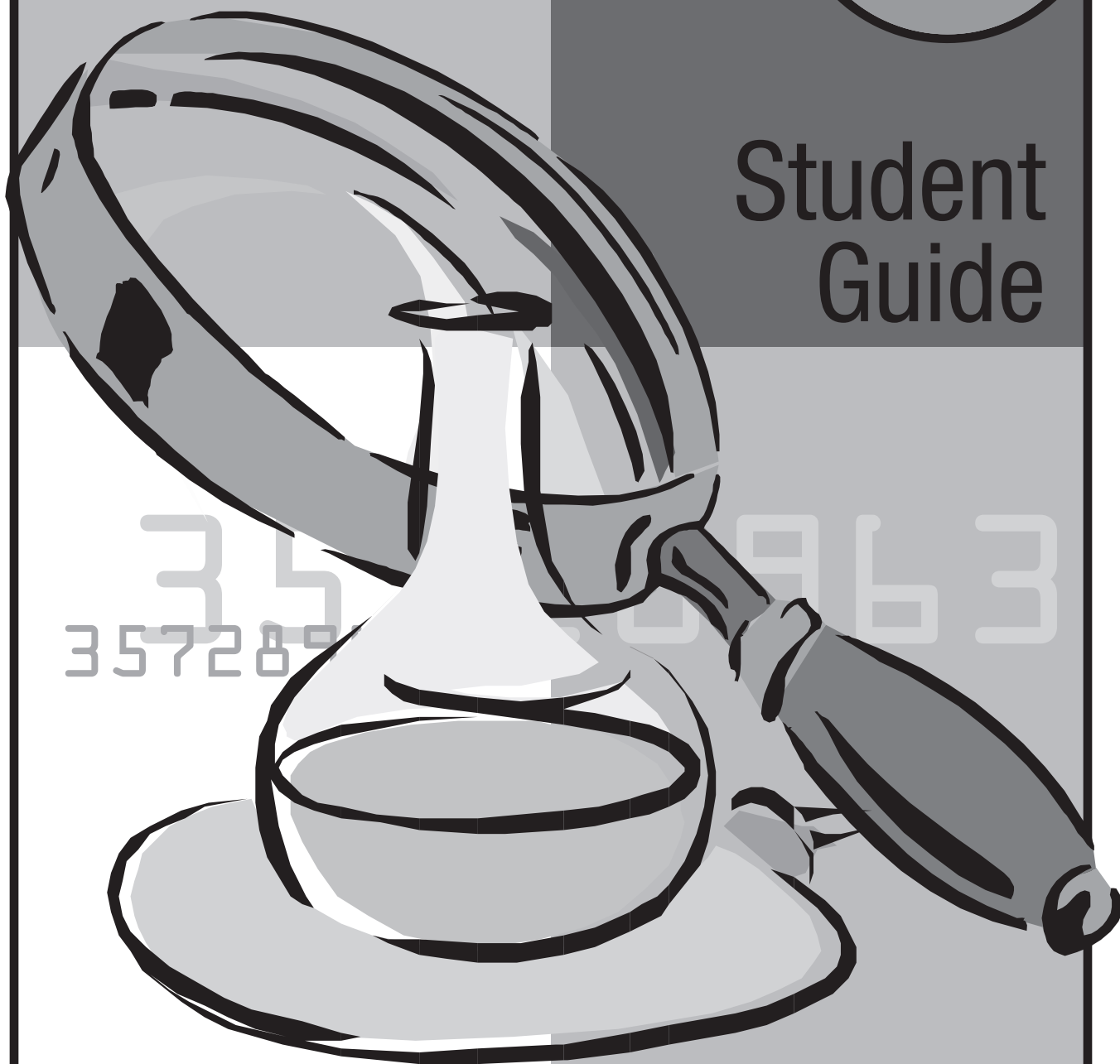
Student
Guide and
Investigator
Notebook

Science Fair

v_1

m_1

Student
Guide



Imagine that you worked hard on a science fair project. You spent months researching and conducting experiments. You made a display board to show the results of these experiments. You had pictures, graphs, and diagrams to completely explain everything you did. You had a neatly written notebook that contained all of your research. You proudly entered this project in your school's science fair, confident that you would win the grand prize. But on the evening of the science fair when the doors opened you discovered that your project and all of the other projects were missing. How would you feel? Shocked? Angry? Curious? Maybe you would just stand there in disbelief. Well, this is exactly what happened at Brightsville School. Two students decided to hide all of the science fair projects. They did not do this as a joke. They did it as a science fair project! They wanted to test their hypothesis that they could hide all of the projects, leave lots of clues, and not one student in the school would be able to find out who took the projects or where they were hidden. They even wrote it up as a science experiment. Here's how the first part of their experiment looked:

Problem

On April 23 two students entered the Brightsville School Cafeteria and hid all of the science fair projects.

Hypothesis

During the next 10 days no one will be able to find out where the science fair projects are hidden or who took them.

In this unit you will try to prove their hypothesis is wrong. You will prove that you can solve this mystery. As you investigate, you will learn about the scientific method and science fairs. You will conduct experiments, analyze and record the data, and judge other students' science fair projects. You will learn how to create a great project and how to avoid making an unsatisfactory one. You will not only become a better scientist, but an expert detective as well, as you work to solve this science fair mystery.



The Mystery

Brightsville School always holds its annual science fair in the school Cafeteria on the same evening as Open House. On April 23, the day of Open House, the school staff had set up the Cafeteria for the evening Open House and Science Fair Display. Tables were arranged by grade level.

Then, from 10 a.m. until noon, the students with the best projects at each grade level carefully arranged their displays on the tables in the Cafeteria. By lunchtime all the science fair projects were ready to be judged, and the Cafeteria was closed. The students ate sack lunches in the courtyard outside the Cafeteria. The judges arrived at 12:30 p.m. and stayed until 3:00 p.m. During this time the Cafeteria was closed to everyone else. By 4:30 p.m. the principal had received the judges' scores and placed ribbons on all winning projects. Ten minutes later, the principal locked all Cafeteria doors and went home.

Promptly at 7:30 p.m. the Cafeteria doors were unlocked to begin the science fair. Students, parents, and teachers were shocked to discover that all of the science fair projects had disappeared! All that remained was a letter, a mystery guide, and some Investigator Notebooks. Here is the letter and mystery guide. You will receive your notebooks a little later.

Mystery Guide

The Investigation

1. You must uncover the names of the two students in The Brightsville Brain Trust, the team who hid your science fair projects.
2. You must determine the two rooms where the science fair projects are hidden. You will find the display boards in one room and the materials in another. If you're really

good, you might even discover the exact location of the hiding places in each room.

The Rules

1. You cannot go searching through the rooms looking for your projects. We will leave you Clue Cards, Eyewitness Evidence, and Wing Maps and Wing Descriptions that give you all the information you need to solve the mystery.
2. You have exactly two weeks (10 days) from today to solve the mystery. Your solutions must be read out loud at a special school assembly. (The Brain Trust promises to do something else if the principal doesn't let us have an assembly.) If just one of you solves the mystery, we will come forward, and admit our hypothesis was wrong. If no one solves the mystery, then we will conclude that our hypothesis is correct. On the day after the assembly, we will give you the exact location of your science fair projects, but we will keep our identities secret until the last day of school.

Helpful Hints

1. Carefully record all information you get in your Investigator Notebook.
2. Study the information daily.
3. Work together as a team.

Dear Students,

For our science fair project we made all of the other projects disappear. It is our hypothesis that you won't be able to do two things in two weeks:

- *Find the science fair projects*
- *Figure out who took them*

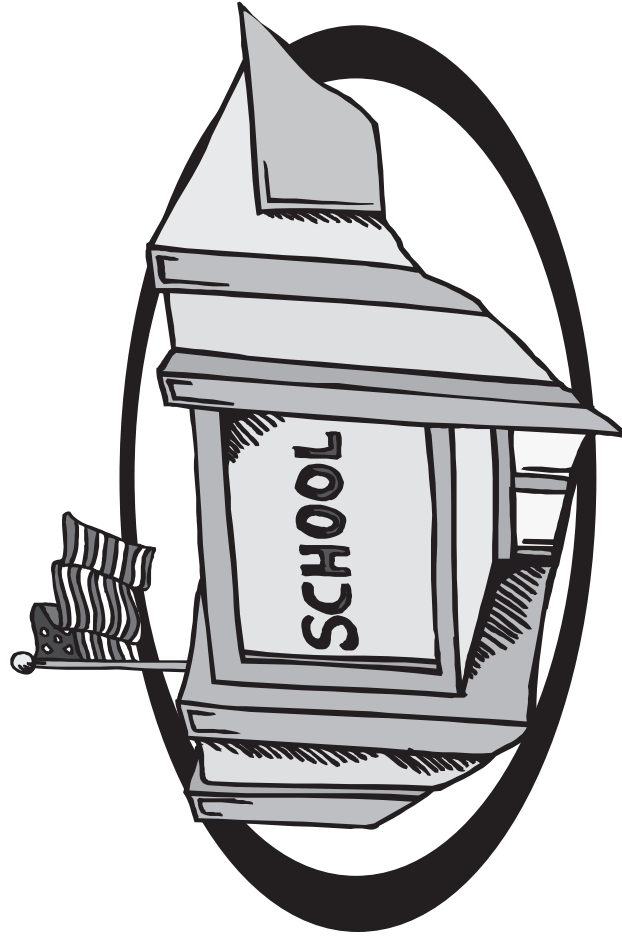
To give you a little help we prepared a mystery guide and left you Investigator Notebooks.

— The Brightsville Brain Trust

Guidelines for Judging Science Fair Projects at Brightsville School

1 Creativity	30 points
• Is this project original? Does it stand out from other projects?	
• Is a fresh approach made for a problem that has been done before?	
• Is there ingenious use of equipment, materials, and handling of data?	
2 Scientific Thought	40 points
• Is the problem explained and the hypothesis clearly stated?	
• Is the experiment clearly organized with good control of variables?	
• How accurately was the data collected and analyzed?	
• Is the conclusion based on data?	
3 Thoroughness	15 points
• Is the study complete, or was an important part of the problem left out?	
• Is there evidence of repeated experimentation?	
4 Neatness	15 points
• Are labels, charts, graphs, and printing neat and accurate?	
• Does the overall project look neat and well organized?	
Total Possible Points → 100	

Science Fair Investigator Notebook



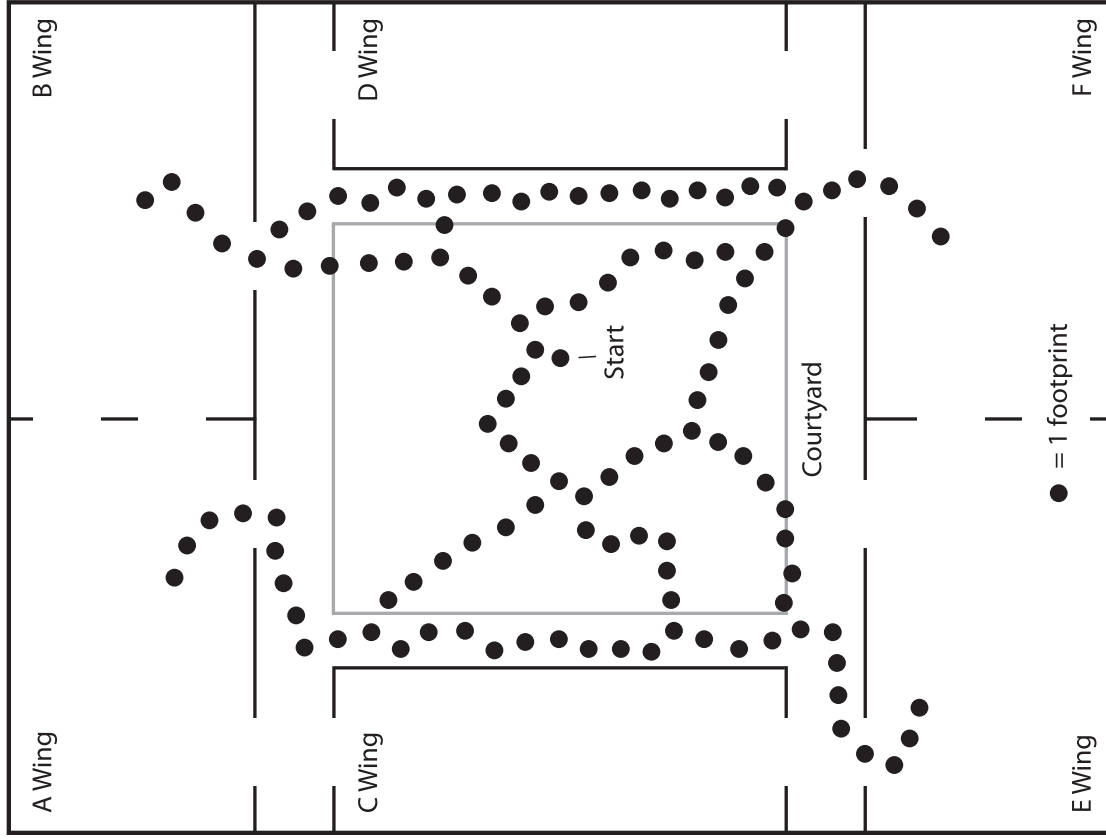
Crime Scene: Brightsville School

Date of the Crime: April 23

Time of the Crime: Between 4:40 p.m. and 7:30 p.m.

Name

Investigator Notebook



School Tour

You might think you know all about the school, but do you really know everything? Are your familiar with the six wings of the school? Do you know what rooms are in each wing? Do you know what's open and what's locked? Probably not! So we'll take you on a tour to show you what the school looked like the morning of the science fair.

C and D Wings

These wings contain only classrooms. We're going to give you a big clue right now. Ready? Your projects are not hidden in these classrooms! So, let's look at the other wings where we could have hidden your projects.

A Wing

A Wing includes the Restrooms, Janitor's Office, Stage, Supply Room, and Cafeteria. The Janitor's Office is a small room with just a desk and a chair. Next to the Janitor's Office is the Stage, which is a raised platform. On the Stage you can see the set for "The Princess and the Pea." There is a large trunk on the Stage, which was loaned to the school by Bobby Jeffers. The wall at the back of the Stage doesn't go to the ceiling. You can climb to the top and look into the Supply Room. There are shelves along the back wall of the Supply Room. These shelves are half-filled with paper. Opposite the shelves, against the Stage wall, is where the extra paper is stored in dozens of boxes. The door is locked. The only person who goes to the Supply Room is Mrs. Lorimyer, and she only goes there the first week of each month to get supplies for teachers. The rest of A Wing is the Cafeteria.

cut

Investigator Notebook

B Wing

In the B Wing is the Kitchen, Teachers' Room, School Office, Principal's Office, and Nurse's Office. At the back of the Kitchen is a large food locker where food is stored. The food locker is always locked. Next to the Kitchen is the Teachers' Room. In the Teachers' Room is a closet where extra maps and large rolls of paper are kept. The closet door is usually unlocked. The Principal's Office and School Office are open during the day but locked when everyone goes home. The Nurse's Office is quite small. The cabinets in her room are locked.

E Wing

The Art Room, Learning Center, and Library are all located in E Wing. The Art Room is filled with cabinets. They are usually locked, but on top of them are stacks and stacks of boxes. The Learning Center is used for small group tutoring and its cabinets are unlocked. You have all been to the Library, so you know that it contains rows and rows of bookshelves.

F Wing

F Wing houses the Librarian's Workroom, the Music Room, the Computer Lab, and the Janitor's Storage. The Librarian's Workroom is where the librarian repairs books and stores magazines. There is a back door that leads to the Music Room, which has the school's largest closet. Here Mr. Crooner, the music teacher, keeps all the band instruments. The only time he locks the closet doors is on weekends. The Computer Lab is the only room in the school with a security alarm system. (A loud horn and buzzer go off if someone enters and does not punch in a code number that deactivates the alarm system.) The Janitor's Storage is like a giant closet. Whenever anything on campus breaks, it has a good chance of being placed here. There's one door to the storage area and it is usually locked.

Investigator Notebook

Eyewitness Evidence Log

EVIDENCE NUMBER	WHERE FOUND	EVIDENCE
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

Brightsville School Campus Locations

Mark an "X" next to a location once you have determined that the science projects are not hidden there.

Locations	Display Boards & Materials
Art Room	
Cafeteria	
Classrooms in C Wing	X
Classrooms in D Wing	X
Computer Lab	
Janitor's Office	
Janitor's Storage	
Kitchen	
Learning Center	
Librarian's Workroom	
Library	
Music Room	
Nurse's Office	
Principal's Office	
Restrooms	
Office	
Stage	
Supply Room	
Teachers' Room	
Yard	

Investigator Notebook

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Investigator Notebook

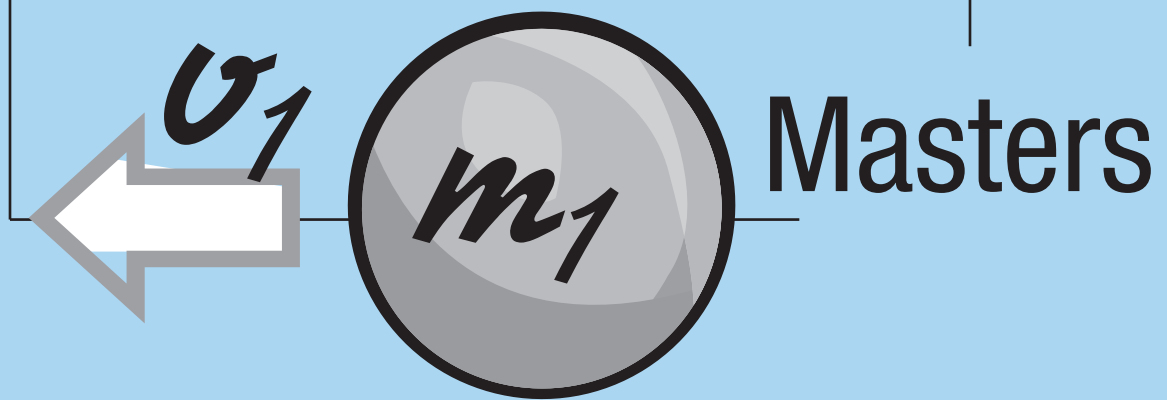
Student Data Sheet

Student Name	Science Project	Source of Project Data	After-School Activity	Proof of After School Activity	X—Not a Suspect	Proof
Aaron						
Ahmed						
Amy						
Andy						
Angela						
Ashley						
Ben						
Bobby						
Brianna						
Brian						
Carol						
Cindy						
Deja						
Holly						
Jamie						

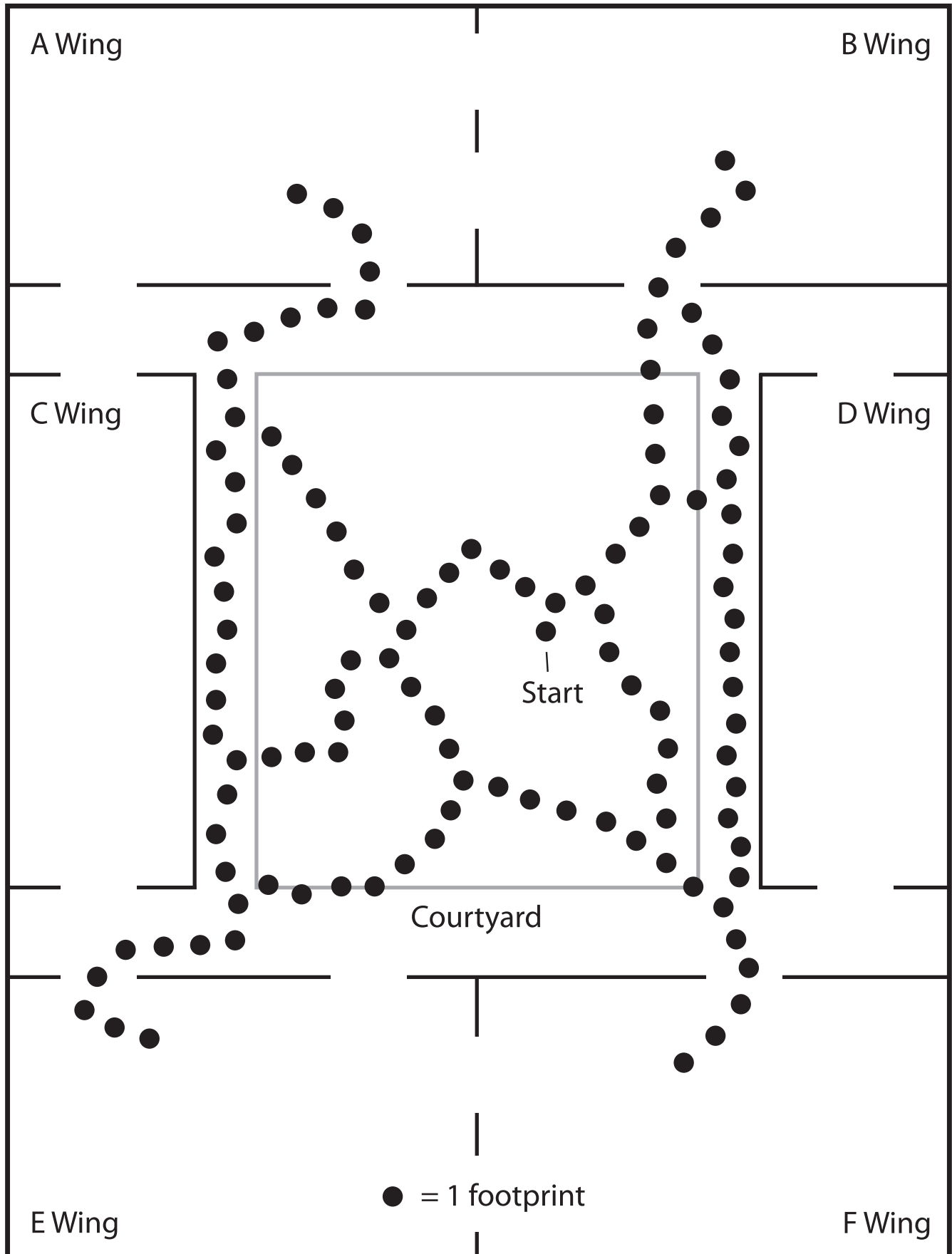
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Student Name	Science Project	Source of Project Data	After-School Activity	Proof of After School Activity	X—Not a Suspect	Proof
Jared						
Jia						
Kim						
Lee						
Matt						
Michelle						
Miguel						
Natalie						
Reyna						
Richard						
Ron						
Ryan						
Shane						
Steven						
Susan						
Tim						
Tommy						
Wayne						

Science Fair



Map of Brightsville School



Team Markers



Science Fair Test

1 The scientific method is:

- a. a way of studying and solving problems
- b. a series of experiments
- c. not allowed in most science fairs
- d. an explanation for things that happen in nature

2 The hypothesis is a:

- a. controlled experiment
- b. graphing of data
- c. conclusion
- d. reasonable guess about a problem's solution

3 Anything that affects the outcome of an experiment is called a:

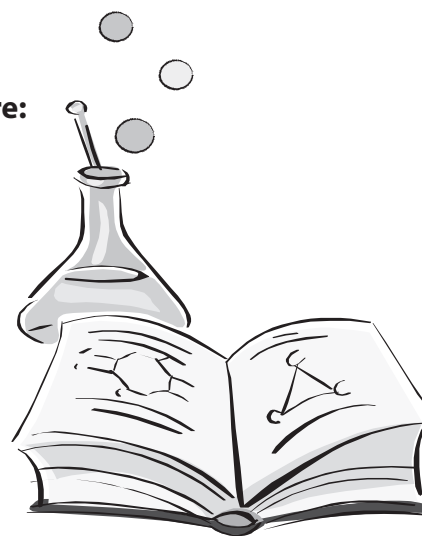
- a. variable
- b. method
- c. conclusion
- d. hypothesis

4 One way to analyze data is with:

- a. control of variables
- b. an experiment
- c. a scientific method
- d. a graph

5 The three categories of observations are those that require:

- a. measurement, counting, and use of senses
- b. seeing, hearing, and touching
- c. seeing, smelling, and hearing
- d. seeing, measuring, and counting



6 A conclusion must be based on:

- a. data from experiments
- b. a hypothesis
- c. feelings that arise as an experiment progresses
- d. measurements from earlier experiments

7 Repeated experimentation means:

- a. to add variety to types of experiments
- b. to do experiments exactly the same way over and over
- c. to redo a famous experiment from the past for a science fair project
- d. to study famous experiments from the past

8 The study of judging guidelines for a science fair project is:

- a. not allowed
- b. not necessary
- c. very important
- d. not recommended

9 The science fair display board:

- a. is the first part of a science fair project the judges see
- b. should capture the judge's and audience's attention
- c. should be attractive and easy to read
- d. all of the above

10 The five parts of the science fair notebook are:

- a. introduction, method and materials, results and data, conclusion, and summary
- b. introduction, repeated experimentation, graphs, analysis, and conclusion
- c. summary, introduction, experiment, results, and data
- d. introduction, method and materials, control of variables, conclusion, and summary

Clue Card Activity I

Problems and Hypotheses

Directions: Write at least three reasonable hypotheses for each problem. The hypotheses must be testable by boys and girls your age using materials that are easily available. Use the back of this sheet if needed to write additional hypotheses.

Problem 1: → The flashlight does not go on.

Hypotheses

1. _____
2. _____
3. _____
4. _____

Problem 2: → The plants in the planter box outside our classroom die within one month of being planted.

Hypotheses

1. _____
2. _____
3. _____
4. _____

Problem 3: → What is the fastest way to get the puddles off the outdoor basketball courts?

Hypotheses

1. _____
2. _____
3. _____
4. _____

Clue Card Activity 2

Controlling Variables

Directions: Two students at Brightsville School did experiments that involve measuring temperature. Read about their experiments and list all of the things they needed to control (variables) before beginning their experiments.

Amy's Project

I am a good gardener. I know plants need good soil, sunshine, and water, but I want to find out if there is more I can do to improve my garden.

Problem: What makes plants grow strong and healthy?

Hypothesis: Plants need good soil, sunlight, and water, but warm water will make plants grow even stronger and healthier than cold or hot water.

Method of Investigation: I used 24 plants. I divided them into six groups of four plants each. I watered one group with hot water, one with warm water, one with cold water. During the next month I observed how well they grew.

What variables did Amy need to control?



Wayne's Project

I like to drink hot chocolate, but it usually gets cold before I finish. I want to find out how to keep my hot chocolate hot.

Problem: What is the best kind of cup to keep hot chocolate hot?

Hypothesis: Coffee mugs are best for keeping hot chocolate hot.

Method of Investigation: I collected two of each of the following: coffee mugs, teacups, Styrofoam cups, glass mugs, metal cups, and plastic cups. I filled each one with exactly 1 cup of hot chocolate. I recorded the temperature every five minutes.

What variables did Wayne need to control?



Clue Card Activity 3

Collecting Data

Measure

	Time 1	Time 2	Time 3
Jar A			
Jar B			
Jar C			

Count (use tally marks)

Red			
Green			
White			

Observe (use your senses)

Salt

Sugar

Flour

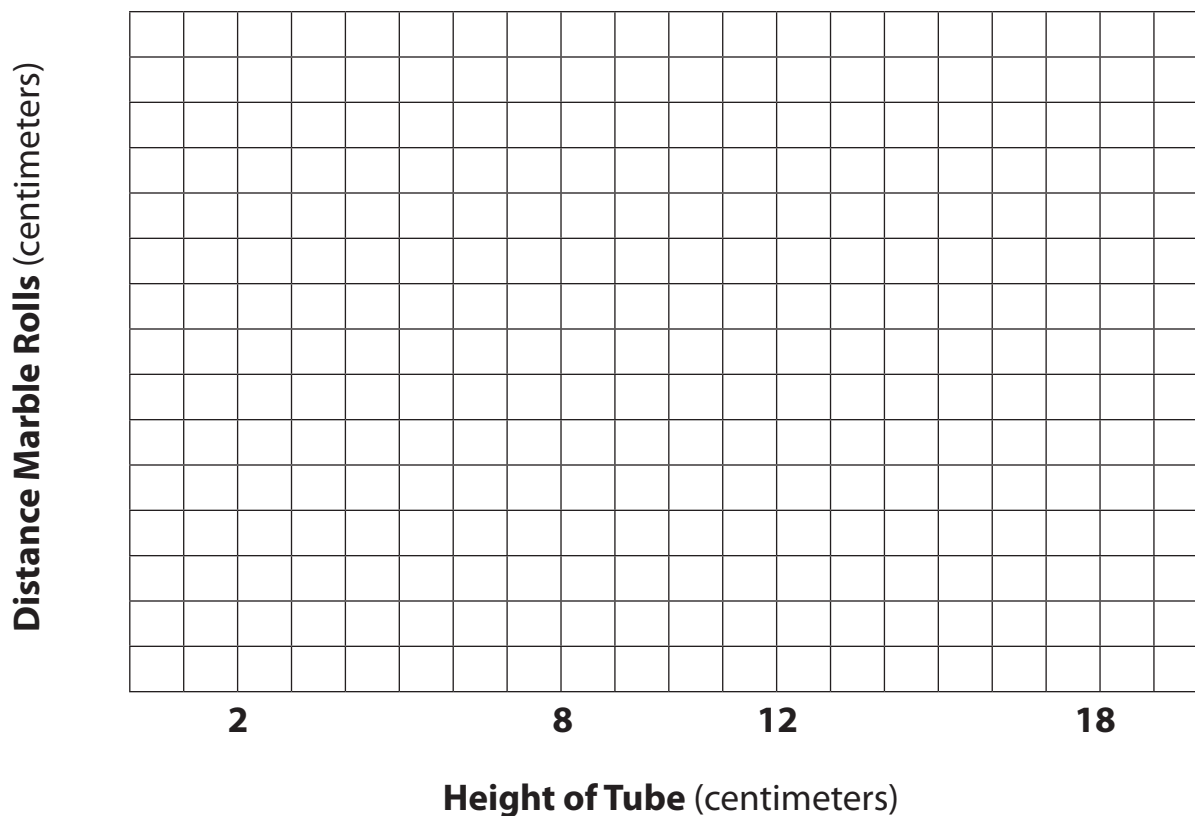
Baking Soda

The mystery powder is _____

Clue Card Activity 4

The Great Marble Roll

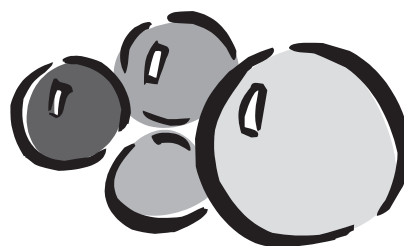
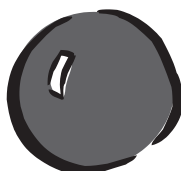
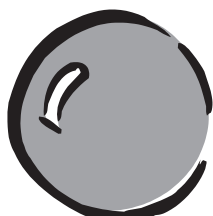
Data Sheet



Questions

1. About how far would the marble roll if the tube was 3 cm high?

2. About how far would the marble roll if the tube was 20 cm high?

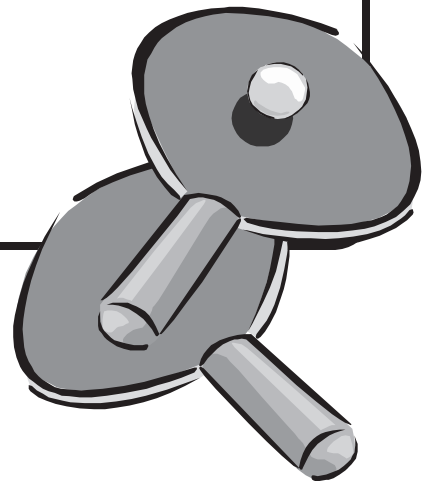


Clue Card Activity 5

Drawing Conclusions

Directions: Seven conclusions were made from the Hand Span Graph and Ping-Pong Ball Bounce Graph. Two of these conclusions are correct because there is data to support them. Circle the number of each correct conclusion.

1. *Most students had hand spans of 16 or more centimeters.*
2. *The tallest student had the largest hand span.*
3. *There are 23 students in the class where the hand spans were measured.*
4. *The girls' hand span, on average, is two centimeters smaller than the boys' hand span.*
5. *The white Ping-Pong ball bounced higher than the yellow one.*
6. *The Ping-Pong ball never bounced higher than the height from which it was dropped.*
7. *The Ping-Pong ball bounced higher on cement than on hardwood floors.*



Clue Card Activity 6

Repeated Experimentation

Directions: Read the hypothesis given below. Conduct the experiment. Repeat the experiment four times. Record the results and answer the questions that follow.

Hypothesis: An electromagnet gets stronger as the number of coils increases.

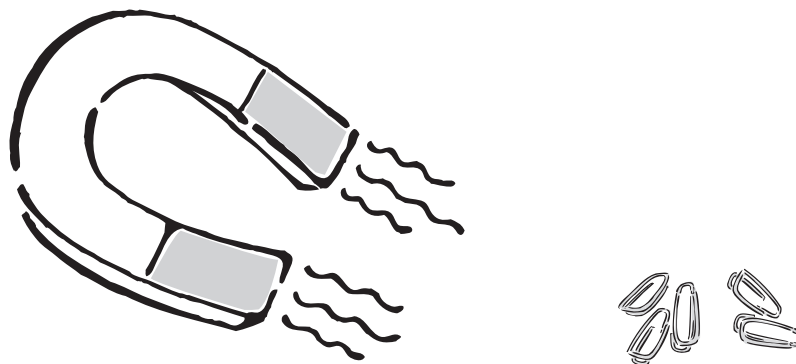
Experiment: Make an electromagnet with 10 coils of wire wrapped around a nail. Count the number of paper clips it can pick up. Do this three more times. Repeat this experiment with 20 coils and 30 coils.

Number of Coils on the Magnet	Number of Paper Clips Picked Up			
	Trial 1	Trial 2	Trial 3	Trial 4
10				
20				
30				

1. Were the results about the same with each trial? _____

2. Is the hypothesis correct? _____

3. Did you notice anything unusual or unexpected by repeating this experiment? Explain.



Clue Card Activity 7

The Science Fair Notebook

Directions: Read Richard Winston's science fair notebook then answer the questions at the bottom of this sheet.

Introduction

Candles come in different sizes? Some are long and thin. Some are thick. The purpose of this investigation is to find out if thick candles burn longer than thin ones. My hypothesis is that thick candles burn longer than thin ones.

Method and Materials

Eight candles were purchased. Each candle had the same weight, but four were long and thin, and four were short and thick. The candles were lit at the same time and allowed to burn until they went out. The length of time it took for each candle to burn was recorded in a notebook.

Results and Data

Long Thin Candle	Time	Short Thick Candle	Time
A	4:35	E	4:15
B	4:62	F	3:45
C	4:29	G	4:40
D	4:20	H	3:19

Conclusion

As stated in my hypothesis the thickness of the candle did affect the time it took for a candle to burn. The thin candles did not burn as long as the thick ones.

1. How many errors in spelling and punctuation? _____
2. What is the error in scientific thought? _____

3. What was left out of the notebook? _____

Clue Card Activity 8

Display Boards

Ben's Batteries

Statement of the Problem: The batteries in my flashlight always seem to burn out. I want to find out what brand of battery lasts the longest. For my hypothesis I think the most expensive battery, Brand D, will last the longest.

Method and Materials: For my experiment I bought four brands of size D batteries. I labeled these brands Brand A, Brand B, Brand C, and Brand D. I also purchased four new flashlights. I put two batteries from each brand into the flashlights. So I had four new flashlights with two new batteries in each one. The only difference between the flashlights was the brand of batteries. I turned on each flashlight and wrote down the time it took for the light to go out. When all of the batteries had worn down I repeated the experiment exactly the same way with two new batteries of each brand.

Results and Data:

	<i>Experiment 1</i>	<i>Experiment 2</i>
Battery	Life of Battery in Hours	Life of Battery in Hours
Brand A	6	5
Brand B	7	7
Brand C	4	5
Brand D	8	9

Summary: I wanted to find out which brand of battery lasted the longest. I put samples of each brand in flashlights and recorded the time it took for the battery to run down. I repeated this experiment two times, and as I expected my hypothesis was correct.

Name the two things Ben left off of his display board that should have been included.

1. _____ 2. _____

Clue Card Activity 9

Your Own Science Experiment

Hypothesis: _____

Method and Materials: _____

Results:

[illegible]

Graph:

[illegible]

Conclusion: _____

PI Assignment Answer Sheet

Name _____

Team _____

Points
Earned☐**PI Assignment 1**

1 2 3 4 5 6 7 8 9 10

☐**PI Assignment 2**

Steven's Project _____

Brianna's Project _____

☐**PI Assignment 3**

1. _____

2. _____

3. _____

4. _____

5. _____

☐**PI Assignment 4**

1. _____

2. _____

3. _____

4. _____

5. _____

☐**PI Assignment 5**

Conclusion: _____

☐

PI Assignment 6

1. _____

☐

PI Assignment 7

Minor Errors

1. _____

2. _____

3. _____

4. _____

The One Major Error

5. _____

☐

PI Assignment 8

Judge's Score Sheet					
Notebook #	Creativity 30 points	Scientific Thought 40 points	Thoroughness 15 points	Neatness 15 points	Total Points 100 possible

Team Score Sheet

Team Name:

PI Assignments

Team Members

1

2

3

4

5

6

7

8

Total Points

Team Score Sheet

Team Name:

PI Assignments

Team Members

1

2

3

4

5

6

7

8

Total Points

PI Assignment 1

Choosing a Project

A good science fair project is one that has a specific problem to solve. The materials needed for the experiments must be available to you. If you worked in a multimillion dollar research laboratory this would not be a problem, but since you do not, you must limit yourself to materials you can get. Listed below are 10 problems that were used by students at Brightsville School in their science fair projects. Five of these projects are good because they require considerable testing and can be done with materials readily available. The other five require equipment that is unavailable to most students, or the problems are more of a research report rather than a scientific investigation. What are the five best projects listed below?

- ☐ 1. What brand of paper towel absorbs the most water?
- ☐ 2. Do stars shine?
- ☐ 3. How does a person make a fire extinguisher?
- ☐ 4. What is the effect of different stimuli on paramecia?
- ☐ 5. How is a fabric's strength affected by moisture?
- ☐ 6. How do braces straighten teeth?
- ☐ 7. What are the parts of the brain?
- ☐ 8. Which brand of tape is the strongest?
- ☐ 9. To what extent does age affect the ability to learn?
- ☐ 10. How does a refracting telescope differ from a reflecting telescope?

Possible Score: 2 points for each correct answer



PI Assignment 2

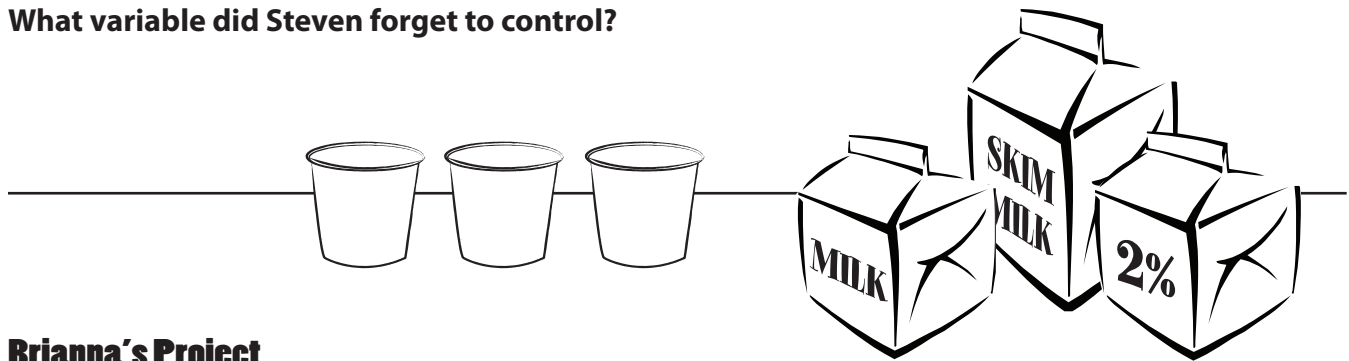
Controlling Variables

Steven's Project

One morning Steven took a spoonful of his favorite breakfast cereal and gagged. It had a horrible taste. His mom said the milk was spoiled and threw it out. Steven had to make another bowl of cereal and use some of his mom's low-fat (2%) milk. While he ate he wondered if one kind of milk spoils before another. He decided to use this problem for a science fair project. Since his milk went sour and his mom's didn't, he made the following hypothesis: Whole milk will go bad before other kinds of milk.

Method of Investigation: For his experiment Steven bought a carton of whole milk and a carton of skim milk, and used his mom's low-fat milk that was in the refrigerator. Next he got three paper cups. He put 200 ml of whole milk in one, 200 ml of low-fat milk in another, and 200 ml of skim milk in the last cup. He kept the cups in the refrigerator. Every day he smelled and tasted each kind of milk. He was surprised by the results. The low-fat milk was the first one to spoil.

What variable did Steven forget to control?



Brianna's Project

Brianna wanted to find the best kind of soil in which beans would grow. She collected four different soil samples: soil from her backyard, soil from school, sand, and an expensive potting soil that she purchased from a nursery. Her hypothesis was that the beans would grow best in the potting soil.

Each of the four soil samples was divided equally into two parts and each part was placed in a large paper cup. She now had eight cups. Two held soil from her backyard, two held school soil, two were filled with sand, and two held potting soil. Each cup had the same amount of soil. Brianna poked 1–5 holes in the bottom of each cup to allow for drainage, then she planted one bean seed 1-inch deep in the middle of each container and poured exactly 1 cup of water into each cup. They all received equal amounts of water and sunlight. She did not get the results she expected. Brianna was confused until she recognized her mistake.

What variable did Brianna forget to control?

Possible Score: 5 points



PI Assignment 3

Making Observations

Jared's Data

Soil Site 1		Soil Site 2	
Soil Site 3		Soil Site 4	

Tim's Data

Surface	Distance Traveled
wood	91 cm
sandpaper	46 cm
carpet	36 cm
cardboard	96 cm
linoleum	122 cm

1. Who made observations by counting?
2. Who made observations by measuring?
3. What kind of observation did neither student make?
4. What other observations could Jared make?
5. Jared started with 30 worms, but listed 28. Why?

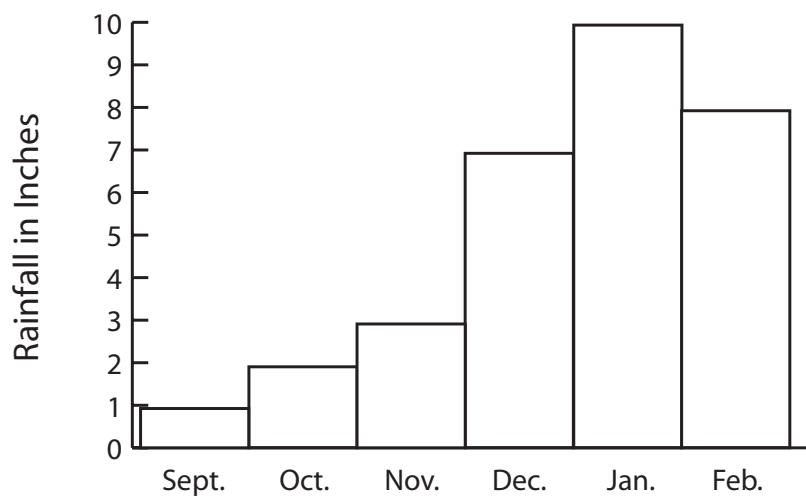
Possible Score: 1 point for each correct answer

PI Assignment 4

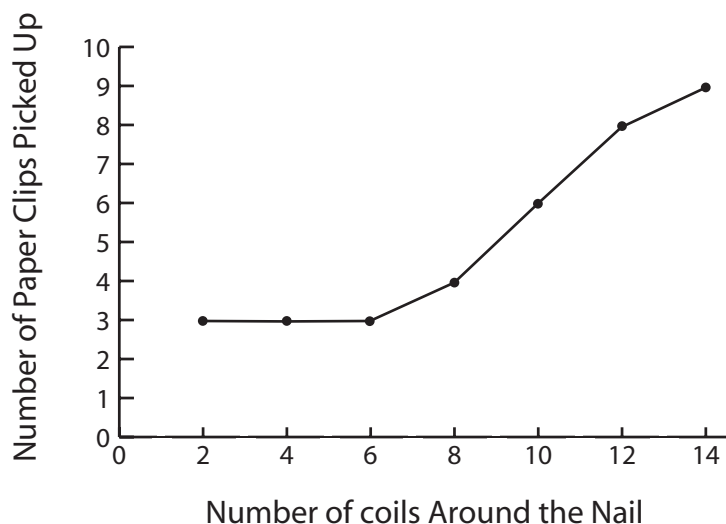
Analyzing Graphs

Directions: Study two graphs then answer the questions that your teacher asks. Write your answers on you PI Assignment Answer Sheets.

Jaime's Rainfall Graph



Miguel's Graph of an Electromagnet Experiment



Possible Score: 1 point for each correct answer

PI Assignment 5

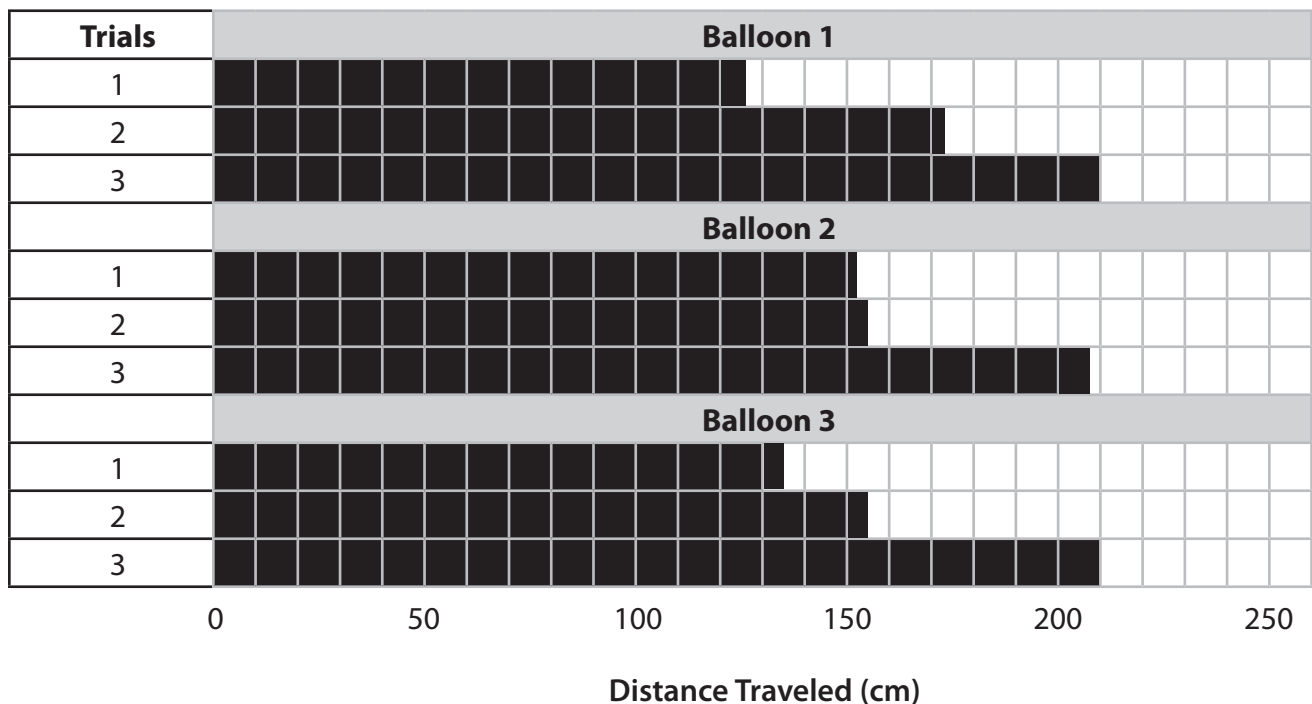
Writing a Conclusion

Ron's Hypothesis: The more times I re-use a balloon to propel my rocket, the shorter the distance it will travel.

Ron's Data

Distance Traveled (cm)			
	Trial 1	Trial 2	Trial 3
Balloon 1	127	173	221
Balloon 2	152	155	208
Balloon 3	135	147	211

Ron's Graph



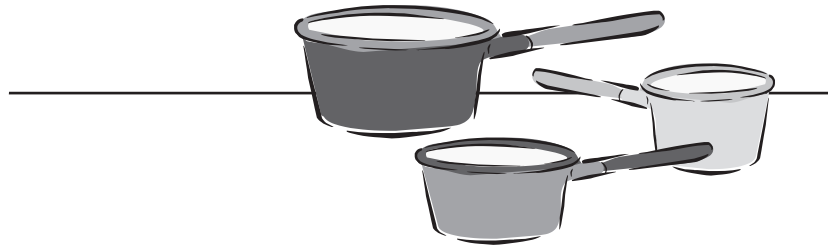
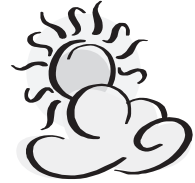
Possible Score: up to 5 points

PI Assignment 6

Understanding Repeated Experimentation

Ryan's Project

Ryan wanted to find out if the surface area speeded up evaporation. For his hypothesis he said: The greater the surface area the faster the rate of evaporation. To test his hypothesis he used three aluminum pans and labeled them A, B, and C. The pans were the same shape, but different sizes. Pan A had a surface area of 120 cm^2 , pan B's surface area was 200 cm^2 , and pan C's surface area was 400 cm^2 . He put 250 ml of water in each pan and set them in the sun for five hours. Then he measured the amount of water left in each pan. From this experiment he wrote his conclusion.



Shane's Project

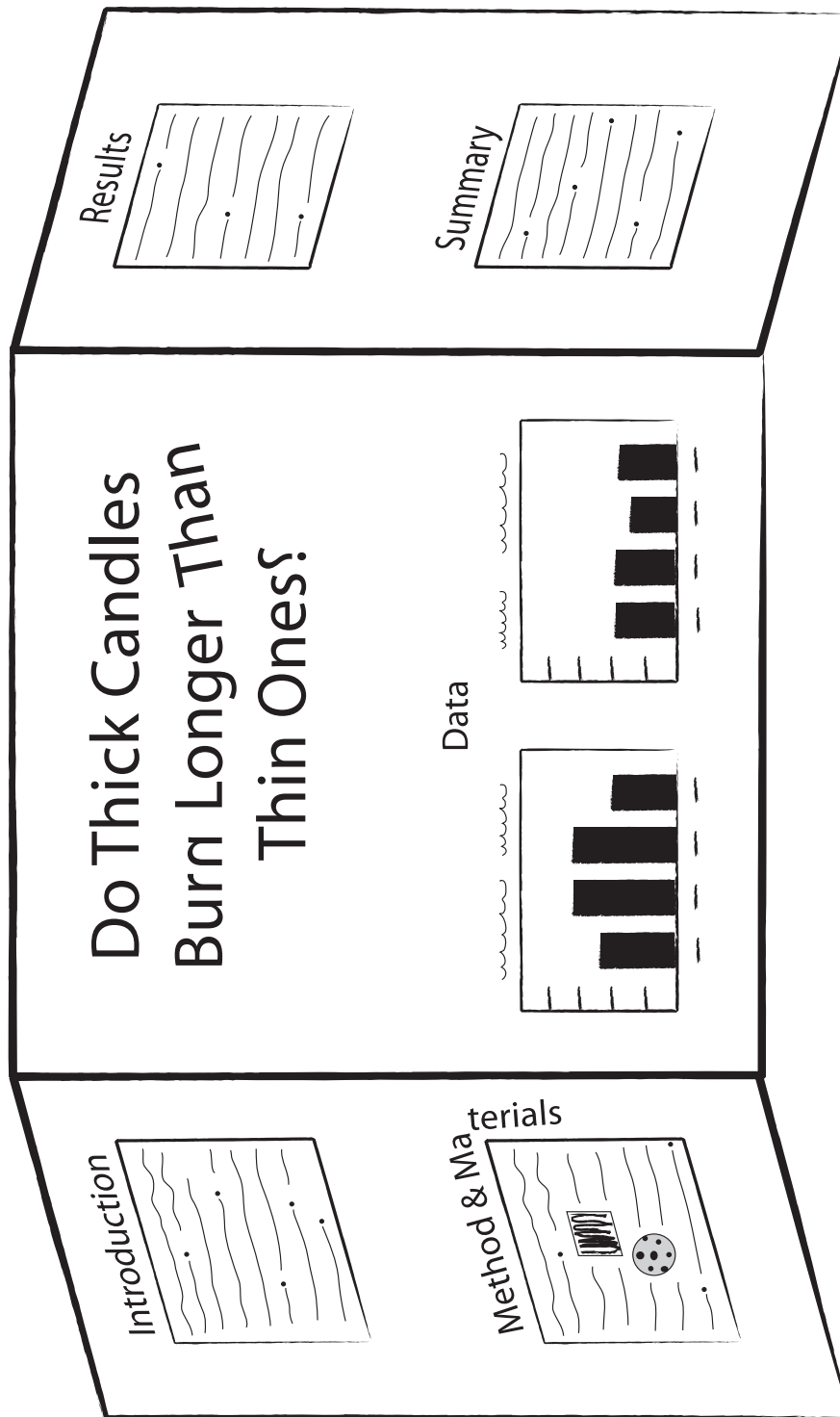
Shane knew that polar bears have a thick layer of fat, black skin, and clear fur that appears white. He made a hypothesis that black skin helped keep them warm. To test his hypothesis he took two 1-liter plastic water bottles and wrapped them with cotton padding. Next, he wrapped one bottle with black paper and another with white paper. Shane then put five layers of plastic wrap around each bottle. The bottles represented the polar bear. The cotton padding was the fat, the paper was the skin, and the plastic wrap was the fur. Shane filled the bottles with water heated to 37°C (98.6°F), which is the polar bear's normal body temperature. He placed both bottles in the sun. He measured the water temperature every hour for three hours. Based on this experiment he wrote his conclusion.



Possible Score: up to 5 points

PI Assignment 7

Evaluating a Science Fair Display Board



Possible Score: up to 5 points

Teacher Transparency 1

Practice Sheet

Directions: Use the information shown below to find out who stole Shelly's science fair project, and where the display board and materials are hidden.

Location Clues

1. Classrooms A and B are exactly the same except Classroom A does not have a sink.
2. The display board is too large to be hidden in Classroom A.
3. The materials are hidden in a classroom with a sink.

School Campus Locations		
Room	Display Boards	Materials
Classroom A		
Classroom B		
Library		

Eyewitness Evidence

Evidence A: The person who hid Shelly's project did not do an experiment with a living organism.

Evidence B: The person who hid Shelly's project did not go to soccer camp after school.

Eyewitness Evidence Log		
Evidence	Where Found	When Received

Student Clues

Clue A: Lindsay did a project on goldfish.

Clue B: Mark went to soccer camp with a person who did a project on crystals.

Clue C: Only one other person, besides Tami, went to soccer camp.

Student Data Sheet						
Name	Science Project	Project Data Source	After School Activity	Proof of Activity	X—Not a Suspect	Proof
Jeff						
Lindsay						
Mark						
Tami						

Teacher Transparency 2

Deja's Project

Problem: Does the temperature of water effect how fast water boils?

Hypothesis: I believe hot water will boil faster than cold water.

Experiment: For my experiment I used a one-quart saucepan and three 1-cup containers of water. I labeled the cups X, Y, and Z.

Cup X was filled with ice water. Its temperature was 40°F.

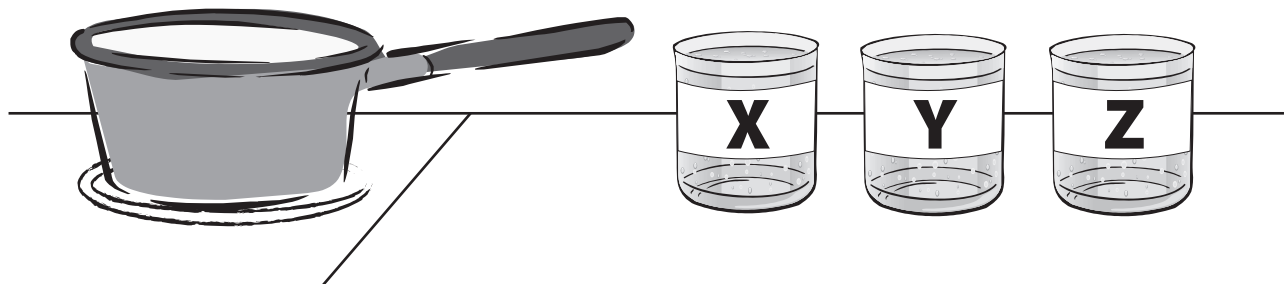
Cup Y was filled with tap water. Its temperature was 70°F.

Cup Z was filled with hot tap water. Its temperature was 120°F.

I heated the pot by boiling water and then pouring it out. Then I poured the water from cup X into the saucepan and placed it on the highest setting on the stove. I timed the number of minutes it took to begin boiling. I repeated this procedure with the water in cups Y and Z.

Cup	Time to heat to boiling
X	62
Y	43
Z	24

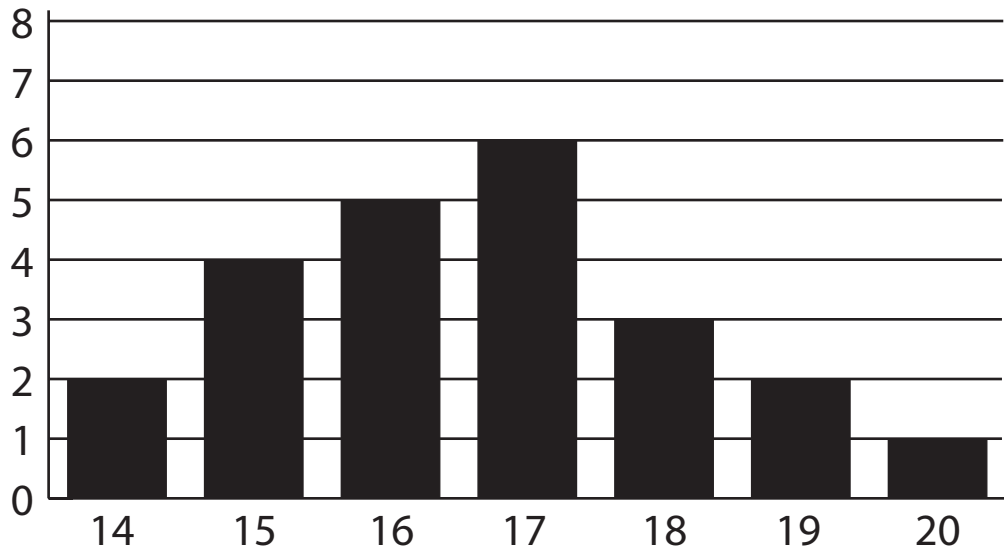
Conclusion: Based on my observations I conclude that hot water boils faster than cold water. My hypothesis is correct.



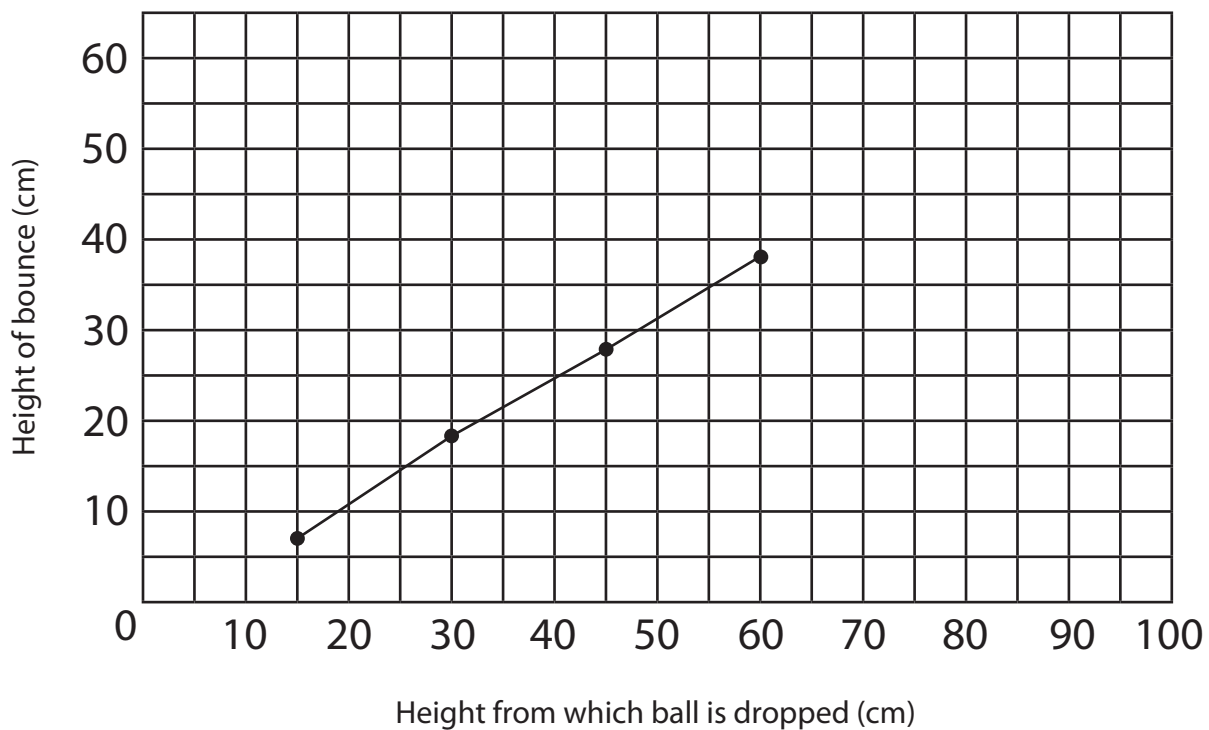
Teacher Transparency 3

Graphing and Analyzing Data

Hand Span Graph



Ping-Pong Ball Bounce Graph



Teacher Transparency 4

A Science Fair Display Board

The display board is shown in a 3D perspective view, revealing its top and front faces. The top face contains two sections: "Conclusion" on the left and "Summary" on the right, each with a rectangular box. The front face is divided into three main sections. On the left is a large "Title" section. To the right of the title are two smaller sections: "Data" and "Results". The "Data" section contains a bar graph with four vertical bars of increasing height from left to right. The "Results" section contains a rectangular box. Below the "Title" section are two more sections: "Introduction" on the left and "Method and Materials" on the right, each with a rectangular box.

Conclusion

Summary

Title

Results

Data

Introduction

Method and Materials

Teacher Transparency 5

Notebook 1

Cindy's Paramecia Experiment

Introduction of Problem: Paramecia are small single-celled animals that live in fresh water. The purpose of this project is to find out what effects different substances have on paramecia. For my hypothesis I believe that any changes to the water will kill the paramecia.

Methods and Materials: This project was divided into two parts. First, I collected paramecia by mixing water, dirt, and leaves in a jar and letting it stand uncovered for three weeks. After three weeks the water was examined under a microscope, and paramecia were seen.

For the experiment, I divided the water with the paramecia evenly among five jars. One jar labeled "A" was set aside as a control. The other four jars had substances added to them. One jar labeled "B" had salt water added; another jar labeled "C" had soap added; a third jar labeled "D" had vinegar added; and the fourth jar labeled "E" had hot water added. The paramecia from each jar were examined in one-hour intervals.

Results and Data:

Jar	First Hour	Second Hour	Third Hour
A	look normal	look normal	look normal
B	moving slowly	died	
C	moving slowly	died	
D	died		
E	moving rapidly	moving slowly	died

Conclusion: The experiment shows that my hypothesis is correct and that paramecia can only survive in fresh water.

Summary: The purpose of this project was to find how different stimuli affected paramecia. When environments were changed by adding different substances, the paramecia died. They survived only in fresh water.



Teacher Transparency 6

Notebook 2

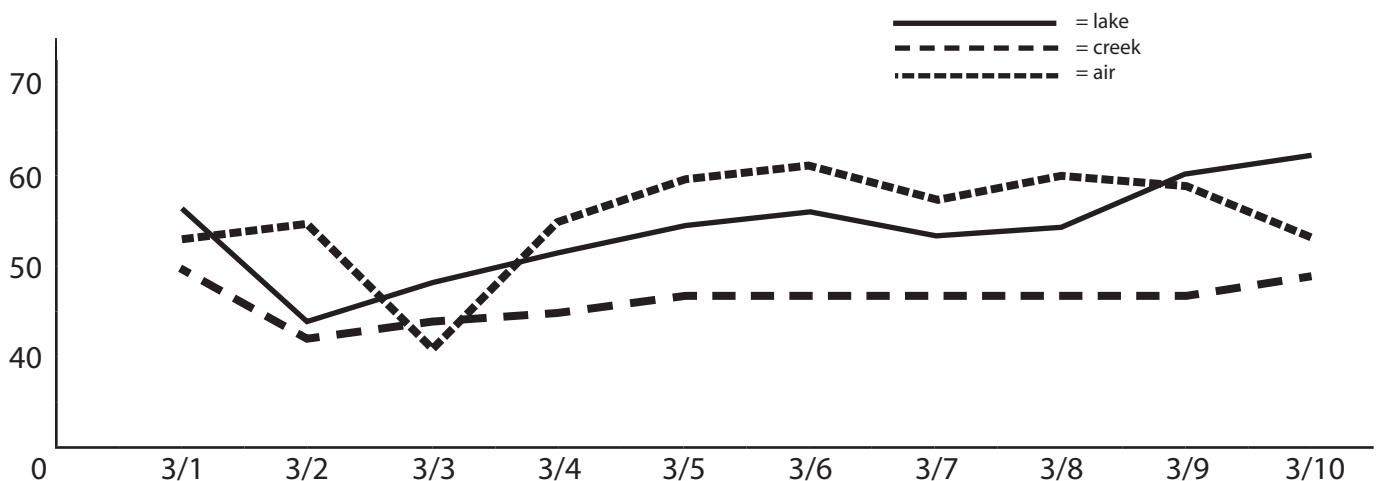
Susan's Water Temperature Experiment

Introduction of Problem: Does the temperature of water change as air temperature changes? My hypothesis is that the water temperature will increase as the air temperature increases.

Method and Materials: First, I went to Horseshoe Lake with a thermometer. I held up the thermometer in the air and recorded the temperature. Then I put the thermometer in the lake and waited 30 seconds. After 30 seconds I took it out and recorded the temperature. Next I went to the creek and put the thermometer in the water for 30 seconds. After time was up, I took it out and recorded the temperature. I did these measurements for 10 days.

Results and Data: The results I collected were hard to study; therefore, I decided to make a graph of the data. This is the graph.

Lake	Temperature of Creek	Air	Weather	Time of Day
58	50	52	Sunny	4:00
47	44	52	Rain	6:00
50	47	44	Rain	5:35
52	46	52	Sunny	5:15
56	48	60	Sunny	6:00
58	60	62	Sunny	5:30
54	50	58	Sunny	3:54
57	50	60	Sunny	6:11
62	50	60	Sunny	6:02
63	51	55	Sunny	6:30



Conclusion: The temperature of the lake changed as the air temperature changed, but the creek temperature stayed the same. My hypothesis was not entirely correct.

Summary: I wanted to find out if the air temperature effected the temperatures of lake water and creek water. By measuring these temperatures each day for ten days, I found that the lake temperature and air temperature are related, but the creek temperature stays about the same.

Further Research: I believe it is possible to predict the temperature of the air based on water temperature of the lake. This will be my hypothesis for next year's science fair project.

Teacher Transparency 7

Notebook 3

Andy's Anemometer Experiment

Introduction of Problem: It seems to me that it always gets more windy in the afternoon so I wondered what time of day the wind blows the hardest. My hypothesis is that wind blows hardest in the afternoon.

Methods and Materials: I built a Robinson type of anemometer using materials from a tinker toy set and an egg carton. I painted one of the four parts of my anemometer red. As my anemometer moved in the wind I counted each time the red marker went by me to get the wind speed. So I measured the wind speed by counting the number of times the red marker went around in two minutes.

I measured the wind speed three times a day. I measured in the morning, in the afternoon, and at night. I did this for 10 days.

Results and Data:

Wind Speed			
Date	Morning	Afternoon	Evening
3/26	3	32	3
3/27	1	14	0
3/28	2	17	50
3/29	12	4	20
3/30	7	15	86
4/1	2	3	10
4/2	0	3	6
4/3	1	25	35
4/4	7	0	15
4/5	12	31	1
Totals	62	154	230

Conclusion: The data clearly shows my hypothesis is correct. The wind blows hardest in the evening.

Summary: I wanted to find out what time of day the wind blew the hardest. Through careful measurement, I found the wind blew hardest in the evening.

Teacher Transparency 8

Student Data Sheet Answer Key

Name	Science Project	Project Data Source	After School Activity	Proof of After School Activity	X—Not a Suspect	Proof
Aaron	no project	Clues 8b, 9c	baseball	Clue 2b	X	E3, 4
Ahmed	no project	Clue 6c			X	E3
Amy	plants	CCA 2			X	E9
Andy	wind speed	TT 7			X	E3
Angela	fabrics	Clues 9a, 9b			X	E3
Ashley	no project	Clues 4b, 5a	day care	Clue 5a	X	E3, Clue 4b
Ben	batteries	CCA 8			X	E3
Bobby	earthquakes	Clue 4c, school tour	baseball	Clue 4c	X	E4
Brianna	beans	PIA 2 E 3			X	E9
Brian	paper towels	Clue 8a	gym	Clue 2c	X	E4
Carol	volcano	Clue 7b				only girl left
Cindy	paramecia	TT 5			X	E9
Deja	boiling water	TT 2			X	E3
Holly	no project	Clues 5b, 5c	home	Clue 1a	X	E3
Jamie	rainfall	PIA 4			X	E3
Jared	worms	PIA 3			X	E9
Jia	no project	Clue 6a	music	Clue 2a	X	E3, 4
Kim	air pressure	Clue 3b			X	E3
Lee	no project	Clues 1c, 6c	baseball	Clue 1c	X	E4
Matt	snails	Clue 10c			X	E9
Michelle	Ping-Pong	Day 4			X	E3
Miguel	electromagnets	PIA 4			X	E9
Natalie	no project	Clues 8b, 9c	gym	Clue 3a	X	E3, 4
Reyna	no project	Clues 5b, 5c	dentist	Clue 1b	X	E3
Richard	candles	CCA 7			X	E3
Ron	rockets	PIA 5	baseball	Clue 1c	X	E4
Ryan	evaporation	PIA 6	home	Clues 10a, 10b	X	E3
Shane	temperature	Clue 10a, PIA 6	friend's house	Clue 10a	X	E3
Steven	milk	PIA 2	gym	Clue 2c	X	E4
Susan	water temperature	TT 6			X	E3
Tim	cars	PIA 3			X	E3
Tommy	telescope	Clue 7a				only boy left
Wayne	cups	CCA 2			X	E3

Key: E Eyewitness Evidence CCA Clue Card Activity PIA PI Assignments TT Teacher Transparency

Teacher Transparency 9

Student Data Sheet

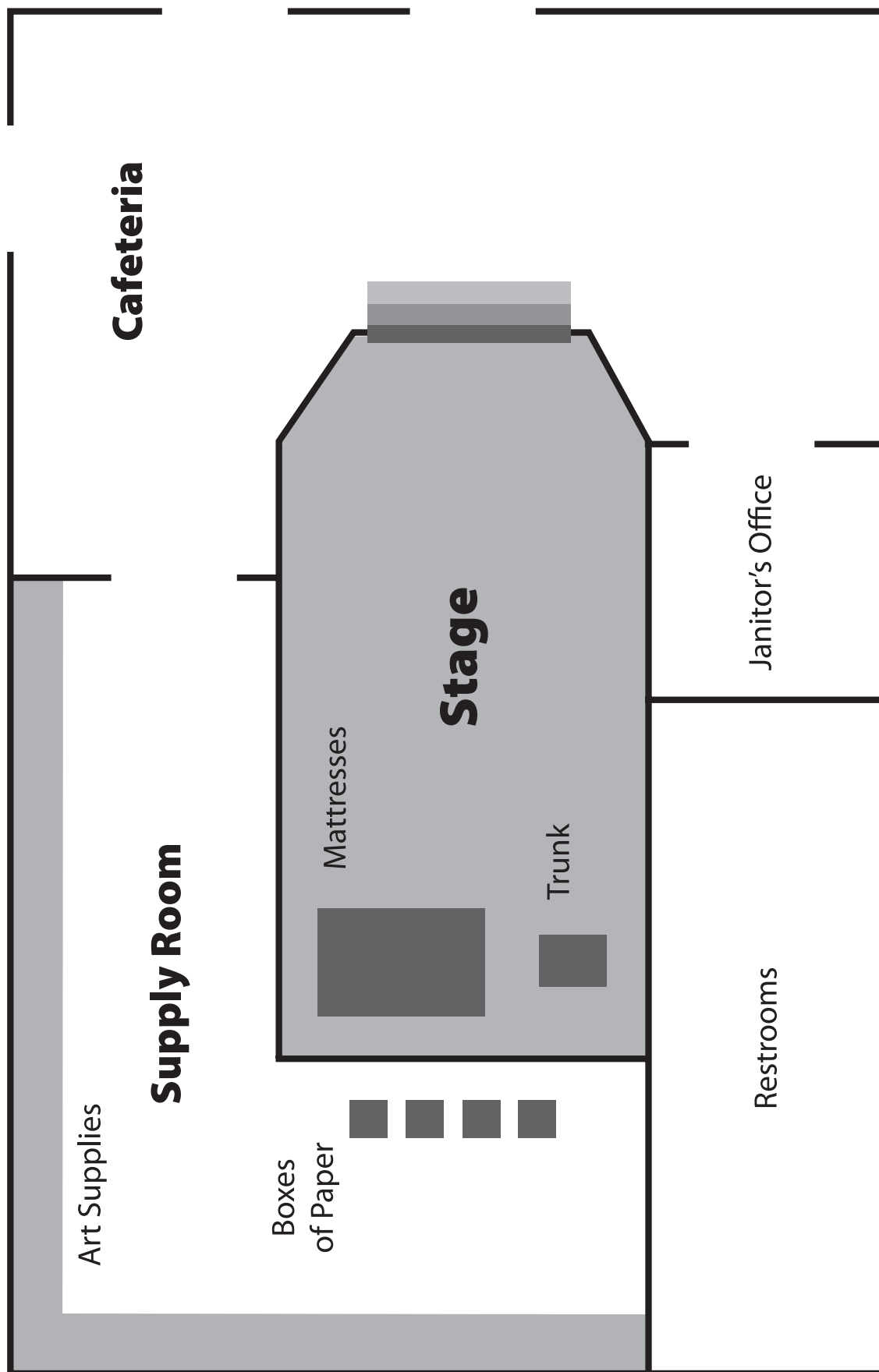
Name	Science Project	Project Data Source	After-School Activity	Proof of After School Activity	X—Not a Suspect	Proof
Aaron						
Ahmed						
Amy						
Andy						
Angela						
Ashley						
Ben						
Bobby						
Brianna						
Brian						
Carol						
Cindy						
Deja						
Holly						
Jamie						
Jared						
Jia						
Kim						
Lee						
Matt						
Michelle						
Miguel						
Natalie						
Reyna						
Richard						
Ron						
Ryan						
Shane						
Steven						
Susan						
Tim						
Tommy						
Wayne						

Key: **E** Eye Witness Evidence **CCA** Clue Card Activity **PIA** PI Assignments **TT** Teacher Transparency

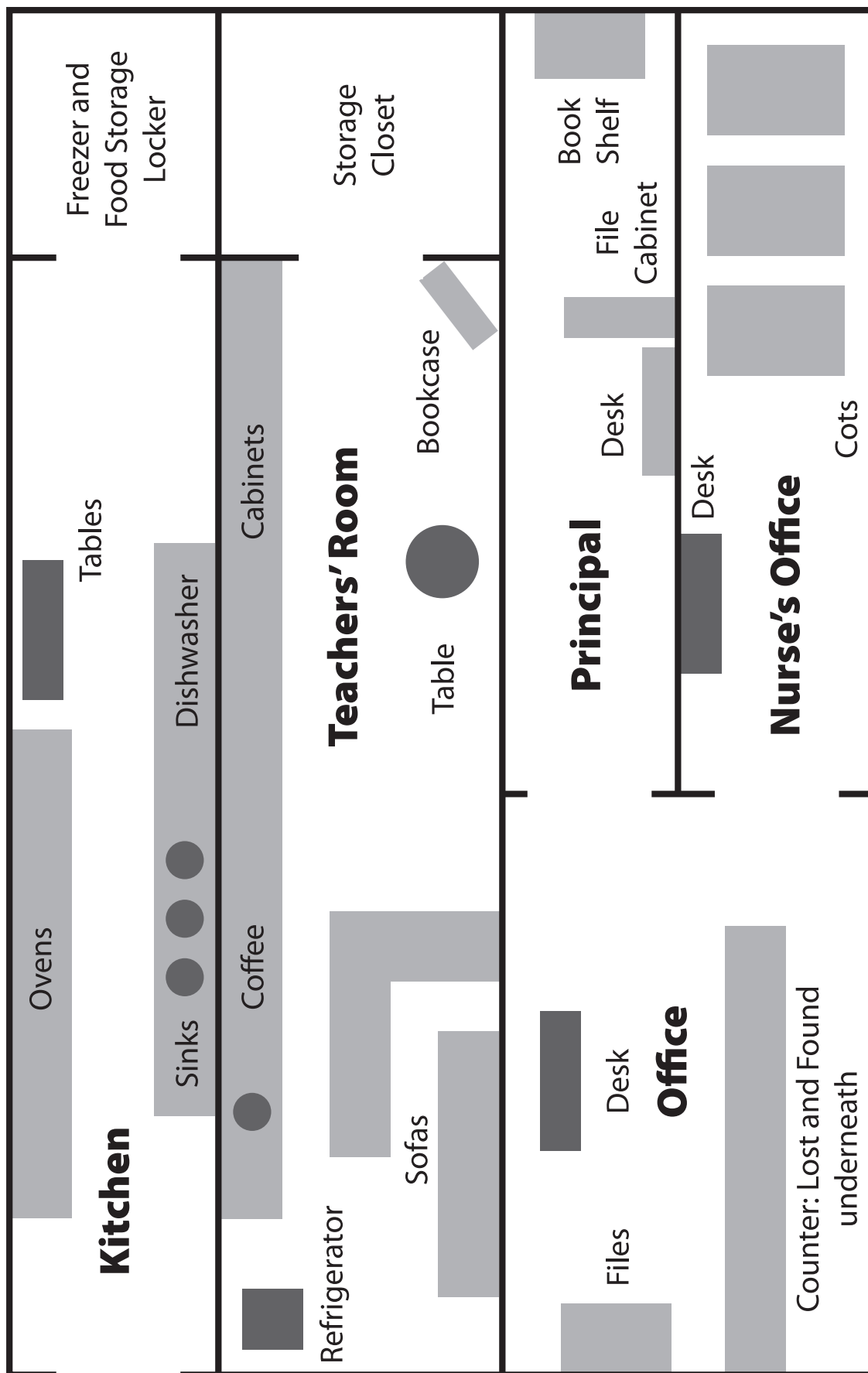
Eyewitness Evidence

- 1** *The places where you find our evidence are just as important as the clues themselves. Record the location of the evidence in the order you find it.*
- 2** *Your science fair projects are hidden in two different rooms, but they are not hidden in a room where you find our evidence.*
- 3** *In addition to this mystery we made, we each entered a science fair project, but our projects do not use any kind of measuring instruments.*
- 4** *Neither of us participates in music or after-school sports.*
- 5** *Most of you walk by your projects every school day.*
- 6** *The two places where your projects are hidden share a common wall.*
- 7** *Everything we took is hidden in objects that have the shape of rectangular prisms.*
- 8** *The display boards are hidden in a place where children are seen more than adults, but the materials you had on display are in a room where children are not allowed to enter.*
- 9** *Our individual science fair projects do not involve living organisms or electricity.*
- 10** *The science fair projects are not hidden in a room where food is cooked or eaten, nor is it in a room where medicine is stored.*

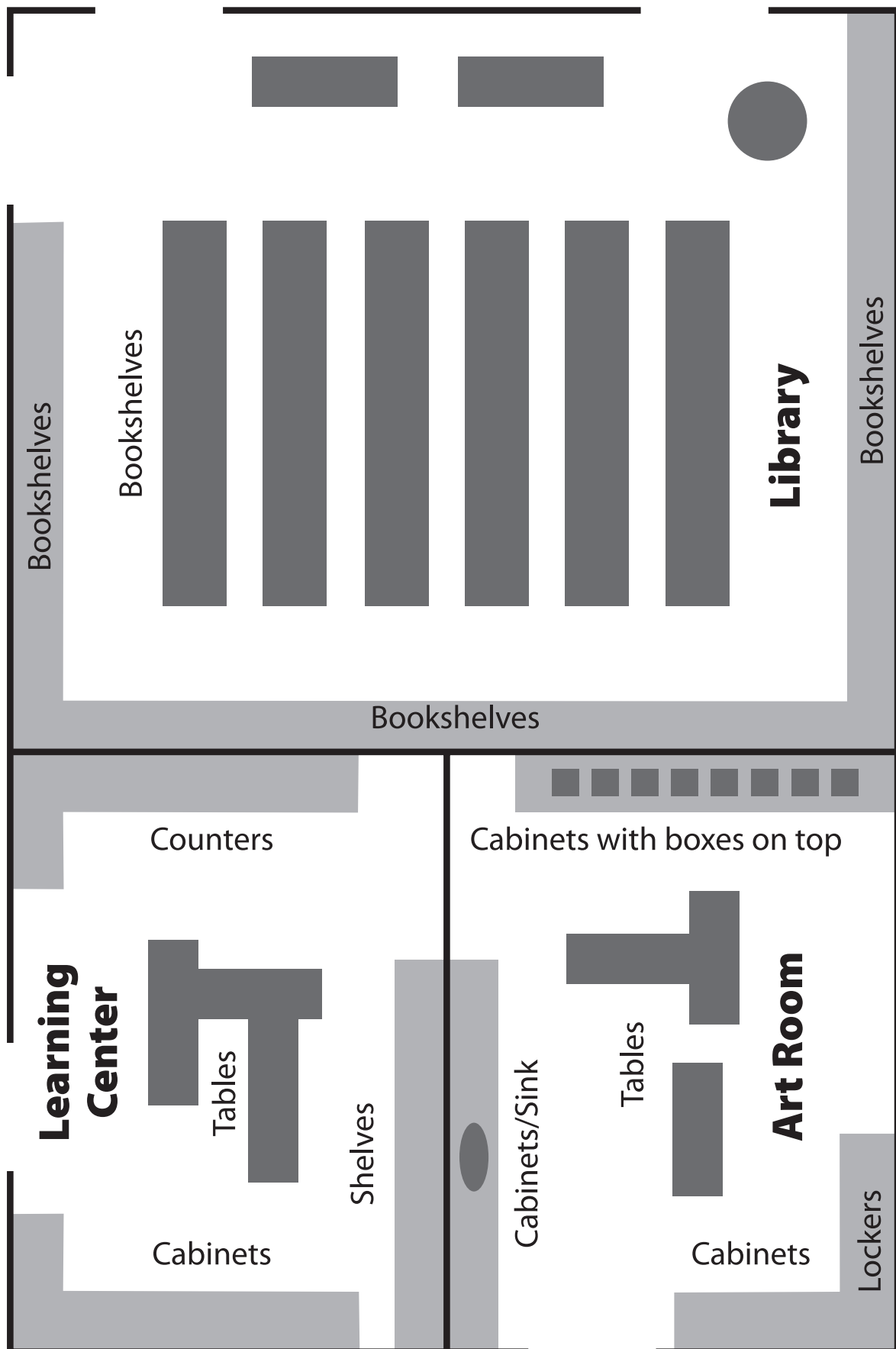
A Wing Map



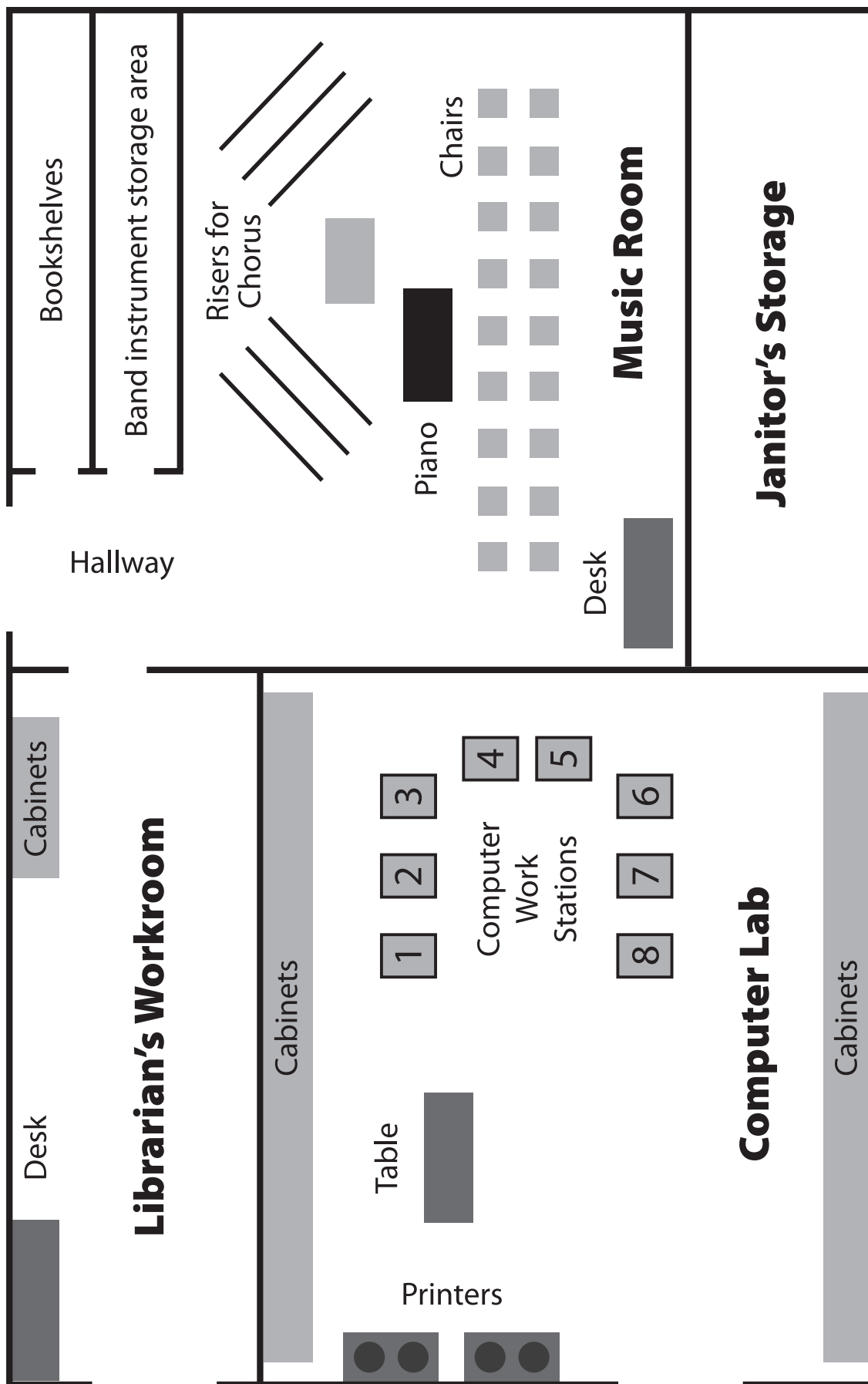
B Wing Map



E Wing Map



F Wing Map



Wing Descriptions

A Wing Description

Supply Room: The shelves opposite the boxes are packed tight with paper. The shelves with art supplies are mostly empty. The locked door can be opened from the inside without a key. A grocery store shopping cart, used by Mrs. Lorimyer to deliver supplies, is against the back wall.

Stage: Upon closer examination you notice that the top two mattresses are on a raised platform. The area under the mattresses is empty. The trunk at the foot of the bed is welded shut.

Janitor's Office: This room is too small to hide anything, but you notice the keys to all of the rooms are hanging on the back wall.

Cafeteria: The tables fold up into the walls when not in use. One of the tables is stuck and never folds down.

B Wing Description

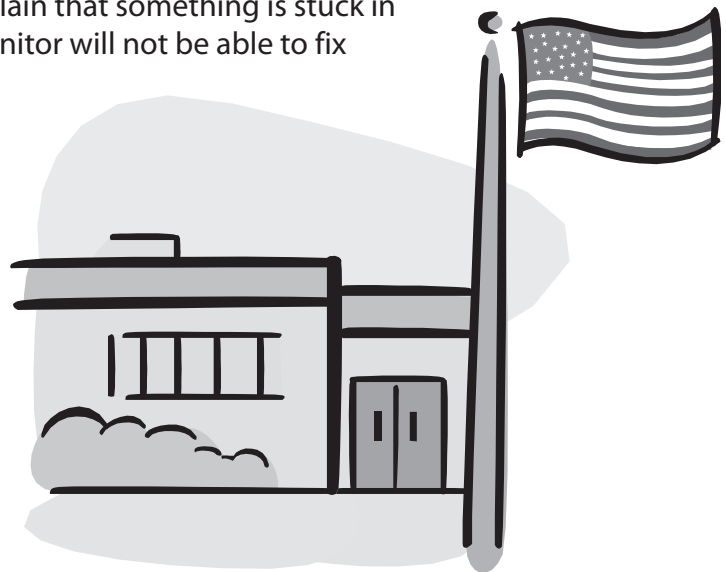
Kitchen: The freezer and food locker are locked with large padlocks anytime a Cafeteria worker is not in the Kitchen.

Teachers' Room: The bookcase in the corner is six feet high. It is permanently mounted to the walls, creating a large empty space in the corner. The door leading to the Cafeteria cannot be locked.

Office: The lost and found bin is filled with jackets, sweaters, and coats that no one claims. The bins are emptied just before winter vacation and on the last day of school. It is very unusual to see anyone go through the lost and found bin.

Principal's Office: Not much to see except a bookshelf, desk, and file cabinet.

Nurse's Office: You overhear the nurse complain that something is stuck in the keyhole to her closet door and that the janitor will not be able to fix it for a week.



E Wing Description

Art Room: Cabinets are built above the sink area. At the back of the room are six lockers that are the size of small closets. These lockers are used by sixth graders to store their art projects. Students using a locker must provide their own locks.

Learning Center: The shelves against the Art Room wall are three feet high and are completely filled with math and reading materials. The cabinets on the opposite wall are never locked and are filled with books and paper.

Library: This is all open space. There is no place to hide things in this room unless someone hides them in the teachers' boxes on top of the bookshelves that are against the wall.

F Wing Description

Librarian's Workroom: The cabinets store boxes of new books that need to be catalogued and boxes of books that need to be repaired. Other parts of the room are too small to hide things as big as science fair projects.

Music Room: The instrument storage area has many instruments, like tubas in heavy protective bags. These instruments are seldom used. Many of them are broken, and the school can't afford to have them fixed. During the school year most instruments are loaned to students.

Computer Lab: In the corners, between computers 3 and 4 and computers 5 and 6 are two empty spaces.

Janitor's Storage: The back of this room is filled with desks stacked on top of each other. The ones against the wall are broken, and the ones closest to the door are extras for new students. The desks, especially the ones in back, are very dusty.

Planning a Science Fair Project

A Step-by-Step Guide

1. Start early because many things come up that can delay your project.
2. At the first opportunity, get a copy of the science fair guidelines and judging standards. Be sure to follow these guidelines.
3. Choose a topic that interests you and begin researching it. Start with the easiest books first. Go to the children's section of the library and read books written for children younger than you. This will help build your background knowledge on the topic. As you build this knowledge you can move on to more difficult books and magazine articles. Search the Internet for information and read everything you can about your topic. This will take several weeks.
4. After studying your topic, find a problem to solve. This is often the most difficult part. It can take a long time. Here are three models you may use to help you get started.

Model 1

How does _____ effect _____ ?

Examples of Model 1 type questions:

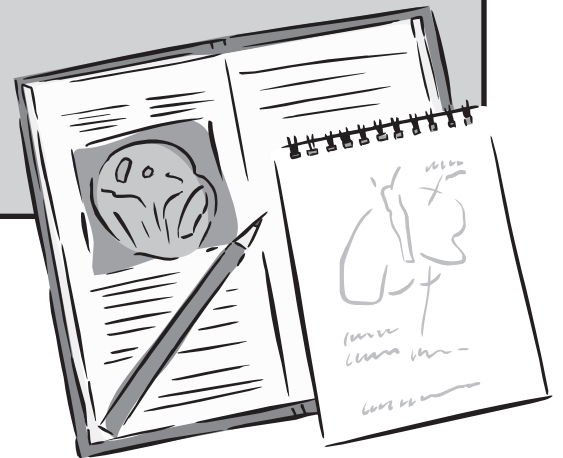
- How does water temperature effect plant growth?
- How does the amount of glue effect the strength of glue?

Model 2

What is the effect of _____ on _____ ?

Examples of Model 2 type questions:

- What is the effect of fences on wind speed?
- What is the effect of liquid fertilizer on houseplants?



Model 3

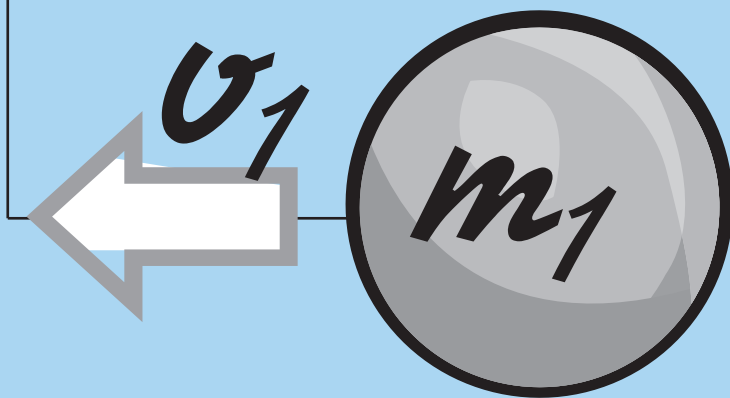
Which _____ is _____?
consumer product strongest ... lasts longest ... is best, etc.

Examples of Model 3 type questions:

- Which brand of white glue is the strongest?
- Which brand of popcorn pops the fastest?

5. Form a hypothesis and design an experiment to test your hypothesis.
6. Collect all of the materials you need for conducting the experiment. This may be more difficult than expected. Science books and Internet Web sites describe materials to use for experiments, but sometimes these are hard to find. You may even have to order your supplies online which will delay the start of your experiments for a few weeks.
7. Conduct your experiments. Keep a record of all observations and data. Be sure to take pictures of your experiment at regular intervals. These pictures can later be used in your notebook and on your display board.
8. Repeat the experiment several times.
9. Purchase a display board well before the science fair. You can buy them in office supply stores. They are called presentation boards. Shop early. The supply may be limited or gone as the date of the science fair approaches.
10. Write the science fair notebook using the recommended guidelines for your science fair. Be sure it is neat and correct, and accurately represents your experiment. Have several people look it over to catch any errors.
11. A few weeks before the science fair, make your display board. Arrange all of the parts in an attractive manner. It usually takes longer than expected so leave yourself plenty of time to complete this step.

Science Fair



Paper Towel
Testing:
Whole-Class
Science Fair Project

Paper Towel Testing

A Science Fair Project for the Whole Class

Before you have students work on individual science fair projects, it is a good idea to do a project with the whole class. One such project is paper towel testing. Working in groups, students conduct several experiments in which they test paper towels for strength and absorbency. They combine the data from their experiments, graph it, analyze it, and are able to determine the best brand of paper towel. Each student makes a science fair notebook based on the results of the group work. All teams combine their data and work as a class to create a large science fair display board. This project puts into practice most of the skills learned in *Science Fair*. It is motivational, fun, easy to do, and gives your students a good idea of what a science fair project is like.

Preparation and Setup

Read all of the directions and familiarize yourself with each of the experiments and all of the materials you will need.

1. Group Students

Divide students into small groups of 4–6. You may use the same groups used in *Science Fair* or form new groups.

2. Make Copies

- **Science Fair Notebook**—one per student

Insert pages into folders or a piece of large construction paper folded in half. Staple the pages inside the cover.

Note: Although it is best for each student to make a notebook, you can make one science fair notebook for each team instead and grade the group rather than the individual.

- **Group Results**—one per group and one transparency
- **Display Board Job Assignments**

3. Collect Materials

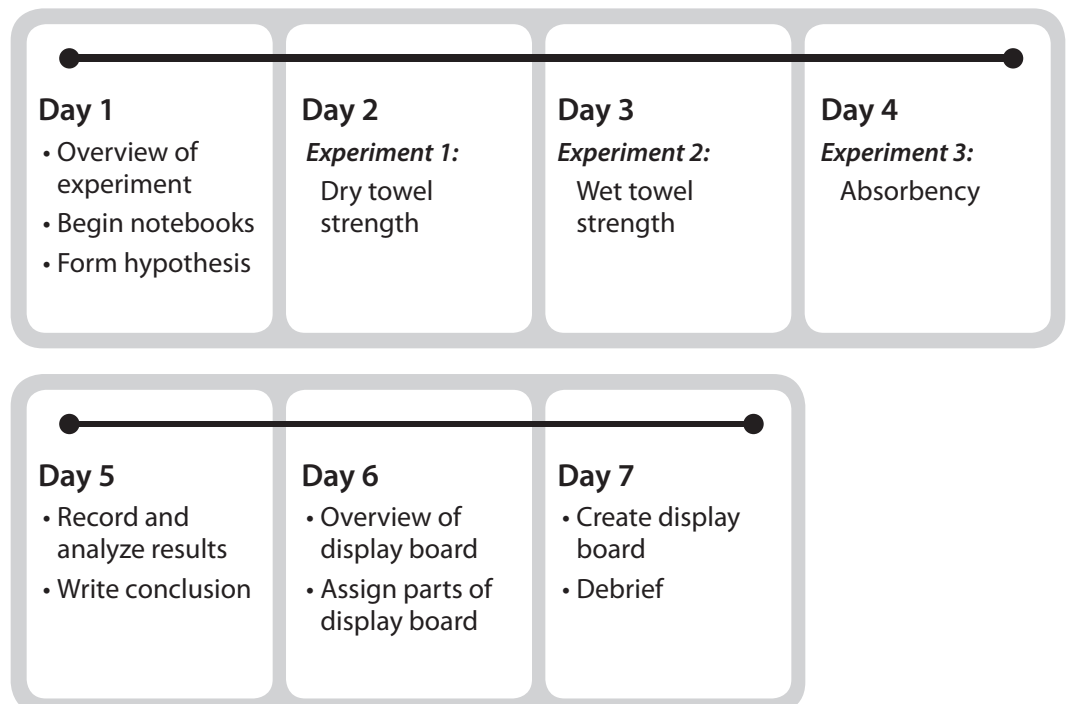
- four brands of paper towels with same size sheets (one expensive, one very inexpensive, and two in-between)
- spring scale (measures 50 grams to 250 grams)—one per group
- eye dropper—one per group
- small container of water—one per group
- 250 ml graduated cup (divided with lines to show the ml)—one per group

- large presentation board
- theme paper and graph paper
- craft supplies: scissors, markers, adhesive
- **Teacher Transparency 4: A Science Fair Display Board**

Prepare Materials

Write down the name of each brand and how much it costs per roll. Write down the number of sheets per roll. Then calculate the price per sheet by dividing the number of sheets per roll into the cost of the roll. Tear off one sheet from each roll. At the top of each sheet write the brand name and the cost per sheet. Put these on a bulletin board or in a convenient place where you can get to them at a later time. You will need these to identify the paper towels (if you get them mixed up) and to help with writing the conclusion. Second, you need to get the paper towels ready for testing. First, you need three sheets of paper towels of each brand for each experiment (12 in all). Have some extras ready just in case students need to redo their experiments. For the two experiments on strength you need to use a hole punch to make a hole one inch from the bottom of each sheet that is being tested. When you are done, you will have three sheets of each brand of paper towel with a hole punched one inch from the bottom of each sheet available for each group. For the absorbency experiment you need three sheets of each brand for each team.

Unit Time Chart



Day 1

Objective: Explain paper towel testing to your students and have them complete the first part of their science fair notebook.

MATERIALS

- four brands of paper towels
- **Science Fair Notebook** for each student

Directions:

1. Review what students learned in Science Fair and introduce the Whole-Class Science Fair Project.

For the last few weeks you have been reading about the scientific method and science fairs. You have formed hypotheses, conducted experiments, made observations, and written conclusions. Today your teams begin a science fair project that investigates the strength and absorbency of paper towels.

Although you will be working in groups, you will each have to write your own science fair notebook, form your own hypothesis, record your results, make graphs, analyze the data, and write your own conclusion. Then, when the notebooks are finished, all of the groups will work together on a science fair display board. Let's get started.

2. Hand out the science fair notebooks. Have them print their names on the cover about a third of the way up from the bottom and again on the title page.
3. Have your students open their notebooks to "Paper Towel Testing" and read aloud the Introduction of the Problem. Discuss with your students possible hypotheses that could be made. Here are a few to consider:
 - My hypothesis is that all of the brands will be about the same.
 - My hypothesis is that the most expensive brand will be the strongest and most absorbent.
 - My hypothesis is that the expensive towels will be better than the least expensive ones.



Read or say

Paper Towel Testing

Day 1

- My hypothesis is that the least expensive will be the strongest and most absorbent.

Do not have students write their hypothesis just yet.

4. Write the names and cost per sheet of each brand of paper towel on the white board or overhead projector and have the students copy this information in the Methods and Materials section of their science fair notebook.
5. Now talk about the various brands of paper towels. Ask your students if they look familiar? Do they use any of them? Do you think they are different? When you have finished go back and see if your students can come up with another hypothesis. For example:
 - My hypothesis is that Bounty is the strongest and most absorbent paper towel.

Now have your students write their hypotheses in the space provided. Have them share what they have written. Remind them that they will be testing these hypotheses over the next three days.

6. Explain to your students that the rest of this page and the next one will be filled out after all of the experiments have been completed. At that time it will all make sense and help them to see if their hypothesis is correct.

Day 2

Objective: Teams test the strength of the dry paper towels and record the data in their science fair notebooks.

MATERIALS

- 3 sheets of each brand of paper towel for each team
- spring scale for each team
- **Science Fair Notebook** for each student

Directions:

1. Have your students open their science fair notebooks to the first experiment, "Dry Paper Towel Strength." Read and discuss the experiment then have the students write their hypothesis. In most cases the hypothesis will be the same as the previous day, but as they move to the second and third tests their hypothesis may change.
2. Demonstrate how to conduct the experiment, then give each team a sample of each brand of paper towel and have them conduct the first test and write their results under Test 1. When all teams have finished go on to Test 2 and Test 3.
3. Show the teams how to average their scores by adding the results of the three tests and dividing by three. Then have the teams share their results. There may be quite a discrepancy between teams because the scales of each team may be slightly different. This should not matter as long as the each test is done with the same scale.
4. Next, have the students graph the average score. Another option would be to have the students graph all of the scores.
5. Have the students study the data and write their analysis. Students should share what they wrote.
6. Have each student write his or her conclusion. Remind students to base their conclusion on the data and to state if their hypothesis was correct.

Day 3

Objective: Teams test the strength of the wet paper towels and record the data in their science fair notebooks.

MATERIALS

- 3 sheets of each brand of paper towel for each team
- spring scale for each team
- eyedropper and water for each team
- **Science Fair Notebook** for each student

Directions:

1. The procedures for today are they same as yesterday except as noted.
2. Have your students open their science fair notebooks to the second experiment, "Wet Paper Towel Strength." Read and discuss the experiment then have the students write their hypothesis. Some students may change their hypothesis based on yesterday's results. This is acceptable, but they cannot change the original hypothesis they made at the beginning of the project.
3. Demonstrate how to conduct the experiment then give each team a spring scale, an eyedropper a small cup of water, and a sample of each brand of paper towel and have them conduct the first test and write their results under Test 1. When all teams have finished go on to Test 2 and Test 3.
4. Have the teams average the scores, graph the average, analyze the data, and write a conclusion.
5. Let the teams share their results, analyses, and conclusions.

Day 4

Objective: Teams test the absorbency of the paper towels and record the data in their science fair notebooks.

MATERIALS

- 4 brands of paper towels
- **Science Fair Notebook** for each student
- graduated 250 ml cup

Directions:

1. Have your students open their science fair notebooks to the third experiment, "Paper Towel Absorbency." Read and discuss the experiment then have the students write their hypotheses.
2. Demonstrate how to conduct the experiment. Give each team a 250ml cup of water and a sheet of each brand of paper towel, then have them conduct the first test. They write their results under Test 1. When all teams have finished they go on to Test 2 and Test 3.
3. Have the teams average the scores, graph the averages, analyze the data, and write a conclusion
4. Let the teams share their results, analyses, and conclusions.

Day 5

Objective: Students combine the results of all three tests, graph the results, analyze them, and finish the science fair project by writing a conclusion and summary.

MATERIALS

- **Science Fair Notebook** for each student

Directions:

1. Have your students open their notebooks to “Paper Towel Testing” and reread the first page. Explain to them that today they will combine the data from all three experiments, graph it, analyze it, and then write a conclusion and summary.
2. Have them turn to the next page and look at the table titled “Experiments” and tell them they are now going to fill out the table.

First, write the names of the paper towels that were tested. Second, look at the results of the first experiment, “Dry Strength Test,” and find the name of the paper towel that did the best. Next to this name, under the heading “Dry Strength” write 4. The paper towel that comes in first always gets a 4. Now go back and find the name of the paper towel that came in second. Next to its name, under “Dry Strength” write 3. Write 2 next to the paper towel that came in third and 1 next to the towel that came in fourth.

3. Check to see that students are doing this correctly.
4. Have the students do the same thing with tests for wet strength and absorbency. Then have them find the totals and graph the results.
5. Next, students analyze the data and write a conclusion. The conclusion should refer back to the original hypothesis. For example: My hypothesis that the most expensive brand of paper towel would be the strongest and most absorbent was wrong. Instead I found out that most paper towels are about the same.
6. Have students share their hypotheses.



Read or say

7. Explain to the students that the summary briefly explains how the science fair project was conducted and what the results were. Then have them write and share their summaries. Here is a sample:

For my science fair project I hypothesized that the most expensive brand of paper towel would be the strongest and most absorbent. I tested the most expensive brand, the least expensive brand, and two others for strength, both wet and dry, and for absorbency. The results of these experiments show my hypothesis was wrong and that the brands were all about the same.

Day 6

Objective: The teams will combine their data from the paper towel experiments and will review how to make a display board.

MATERIALS

- **Science Fair Notebook** for each student.
- one copy per team of the **Group Results**
- transparency of the **Group Results** (or copy it onto the board)
- **Teacher Transparency 4**

Directions:

1. Introduce creating a group display board.

Last week you did a science fair project on paper towels. Each group conducted three experiments and each person made a science fair notebook. If you were going to enter this project in a science fair you would also have to make a display board. Rather than have each of you make one we are going to combine the data you collected and make one display board for the entire class.

2. Hand out the **Group Results**.
3. Use an overhead projector to show the **Group Results** or copy it on the white board (chalkboard).
4. Together, you and your students will fill in the results. First, have each team go to the Dry Strength Test and list the names of each brand of paper towel. Second, ask each team to look up the results they got for this experiment in their science fair notebooks. Third, assign each team a number. Then go from team to team and have them tell you the points they gave each paper towel in the Dry Strength Test. As the teams report, write this information on the board or transparency. Each team will also copy this information on their **Group Results** sheet. Here's an example:

Team 1 looks in a **science fair notebook** and sees that it gave Brand D paper towel 4 points for coming in first, Brand B 3 points for second, Brand A 2 points for third, and Brand C 1 point for fourth. This is how it would look on the **Group Results** sheet.



Read or say

Dry Strength Test

Brand of Paper Towel	Team Score						Total
	1	2	3	4	5	6	
Brand A	2						
Brand B	3						
Brand C	1						
Brand D	4						

Continue to record the data until all teams have reported, then total the amount of points for each brand.

- Fill in the results the same way for the "Wet Strength Test" and the "Absorbency Test."

- Next, go to the "Summary of all Tests" and fill in as follows:

First, list the names of the paper towels. Second, have your students look at the data of the "Dry Strength Test" on the **Group Results** sheet and determine how each paper towel placed. Then next to each paper towel, write the points it receives: 4 for first, 3 for second, 2 for third, and 1 for fourth. Do the same thing for the remaining two tests.

- Once the data is entered, total the results. The group results may differ from individual team results. Discuss what variable may not have been accounted for in the experiment. Use one or more of the following questions:

Are all of the measuring devices the same?

Did you accurately read the measuring devices the same way each time you measured?

Did you accurately write down your results?

Can different sheets of the same brand of paper towel be different in strength and absorbency?

Should there be more repeated experimentation?

Is there a better way to measure strength and absorbency?

Are the differences you noted significant?

Can we form a conclusion based on the averages of each team?

8. Project Teacher **Transparency 4** and review the parts of a display board. Tell your students that tomorrow they will be assigned one of six jobs that must be done to complete the science fair display board. The six jobs are:

Job 1: Make the title and all headings.

Job 2: Write the introduction.

Job 3: Display the paper towels used in the experiments.

Job 4: Explain the methods and materials.

Job 5: Put up the results and make graphs .

Job 6: Write the conclusion and summary.

9. Before students begin work tomorrow you need to assign them jobs. You may assign the jobs by teams or by individuals. You do not need the same number of students per job.

Day 7

Objective: Complete the science fair display board for paper towel testing.

MATERIALS

- **Science Fair Notebook** for each student
- presentation or display board
- theme paper and graph paper
- scissors, glue, glue sticks, marking pens, tape
- 6 copies of **Display Board Job Assignments**
- access to a computer or large letters to trace
- **Teacher Transparency 4**

Directions:

1. Discuss beginning work the display board. Offer students a list of activities they can do when they've completed their work and are waiting for others to finish.

Today you are going to make a science fair display board. Each of you will be assigned a job. When your job is done raise your hand so I can check your work. Do not attach anything to the display board just yet. You will do this later when everyone has finished.

2. Give each group a copy of the **Display Board Job Assignments** and project **Teacher Transparency 4**. Read and discuss the jobs with your students referring to the display board shown on the transparency when necessary. Here is some additional information you can use while discussing the jobs.

Job 1: Print letters out on the computer then glue them on color construction paper. Lay out the letters on the display board to be sure they fit, but do not attach them.

Job 2: Write a rough draft first. Make revisions and check for correctness then copy it on theme paper. Do not write in cursive. The neatest printer in the group should make the final copy or use a computer and print it out.

Job 3: It may take several attempts to print neatly on the paper towels so have extra sheets available.



Read or say

Job 4: Talk about all of the experiments and remind students to refer to their science fair notebooks. See Job 2 for writing directions.

Job 5: To make this job easier have students first make a graph of each test. Then use the neatest copy of the **Group Results** sheet that students filled in earlier and cut apart each test. The test and corresponding graph will go next to each other on the display board.

Job 6: Discuss with your class what would be a good conclusion. The students doing this job will use what the class decides should be the conclusion. In writing the conclusion and summary follow the directions in Step 2.

3. Have the students begin. As they finish their jobs collect their work and set it aside. When all of the jobs are completed have the students lay out their work on the display board. Use the display board shown in **Teacher Transparency 4** to guide you, but together with your students use your judgment to make the most attractive display. When you and your students are satisfied, glue or tape everything in place.
4. Have a discussion about the paper towel science fair project. Among the topics to discuss are:
 - What did you like about this project?
 - What did you dislike?
 - What did you learn about making a science fair notebook?
 - What did you learn about making a science fair display board?
 - How would it be different if you did this project by yourself?
 - What would you do different if you did this project by yourself?
 - What other experiments could you do with paper towels?
5. Put up the display board in your classroom or the school library where it can be seen by others.
6. Save the science fair notebooks and the display board so you can put them out at Open House.

Group Results

Paper Towel Testing

Dry Strength Test

Brand of Paper Towel	Team Score						Total
	1	2	3	4	5	6	

Wet Strength Test

Brand of Paper Towel	Team Score						Total
	1	2	3	4	5	6	



Absorbency Test

Brand of Paper Towel	Team Score						Total
	1	2	3	4	5	6	

Summary of all Tests

Brand of Paper Towel	Total Dry Strength Score	Total Wet Strength Score	Total Absorbency Score	Total Score



Display Board Job Assignments

Job 1

Make the title and all headings.

The title is "Paper Towel Strength and Absorbency." Make it larger than the other headings. The other headings include: Introduction, Method and Materials, Data and Results, Conclusion, and Summary. If you have access to a computer you may use it to make the titles and headings. If not, you may make titles by using stencils, tracing preformed letters, or printing them neatly.

Job 2

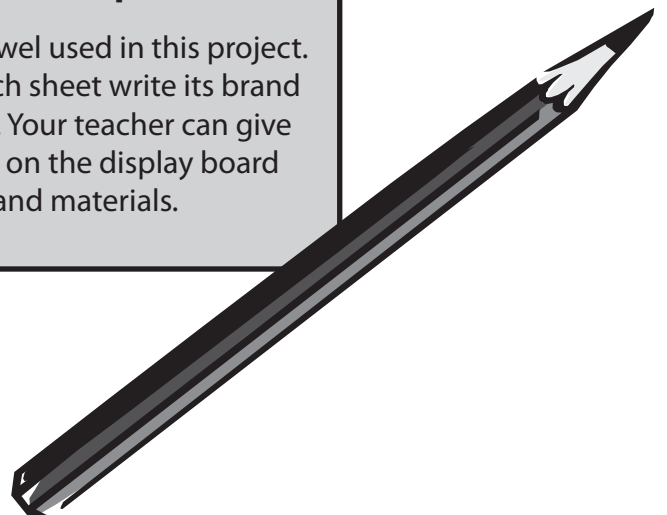
Write the introduction.

In the introduction you want to explain the problem and write a hypothesis. Use the following as a hypothesis: "For our hypothesis we state that the most expensive brand of paper towel will be the strongest and most absorbent." You may use the introduction used in your science fair notebook as a guide.

Job 3

Display the paper towels used in the experiments.

Take one sheet of each brand of paper towel used in this project. Cut each one into a 6" x 6" square. On each sheet write its brand name and how much it costs per sheet. Your teacher can give you this information. You will put these on the display board under the section on methods and materials.



Explain the methods and materials.

Briefly describe the three experiments. You may summarize the methods and materials used in your science fair notebooks. Also describe how the results of each group were combined.

Job 4**Put up the results and make graphs.**

For this job you will make a graph for each of the four tables listed on the **Group Results** sheet. On the display board you will mount the graph along with the table.

Job 5**Write the conclusion and summary.**

Look at the hypothesis (see Job 2) and at the results shown in the "Summary of all Tests" on the **Group Results** sheet and write a conclusion. Then go back and summarize the problem, experiments, and final results.

Job 6

Paper Towel

Strength and Absorbency



A Science Fair Notebook by:

Paper Towel Testing

Introduction of Problem: Paper towels are a common household item. Stores carry many different brands and there is a big price difference between them. They are used mainly to dry hands, but they are also used to clean up around the house. The purpose of this investigation is to find out what brand of paper of towel is the strongest and most absorbent. My hypothesis is:

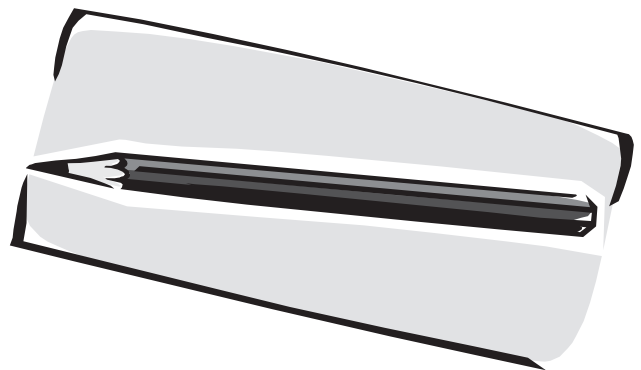
Methods and Materials: For this project I purchased four brands of paper towels. I bought the most expensive one, the least expensive one, and two priced in between. The brands I purchased are:

Brand of Paper Towel	Cost Per Sheet
1. _____	
2. _____	
3. _____	
4. _____	

I conducted three experiments on each brand of paper towel. I tested the towels for strength while dry, strength while wet, and absorbency. For each experiment the towels were tested three times. The results of these experiments are summarized below. The rest of this notebook contains the description and results of each experiment.

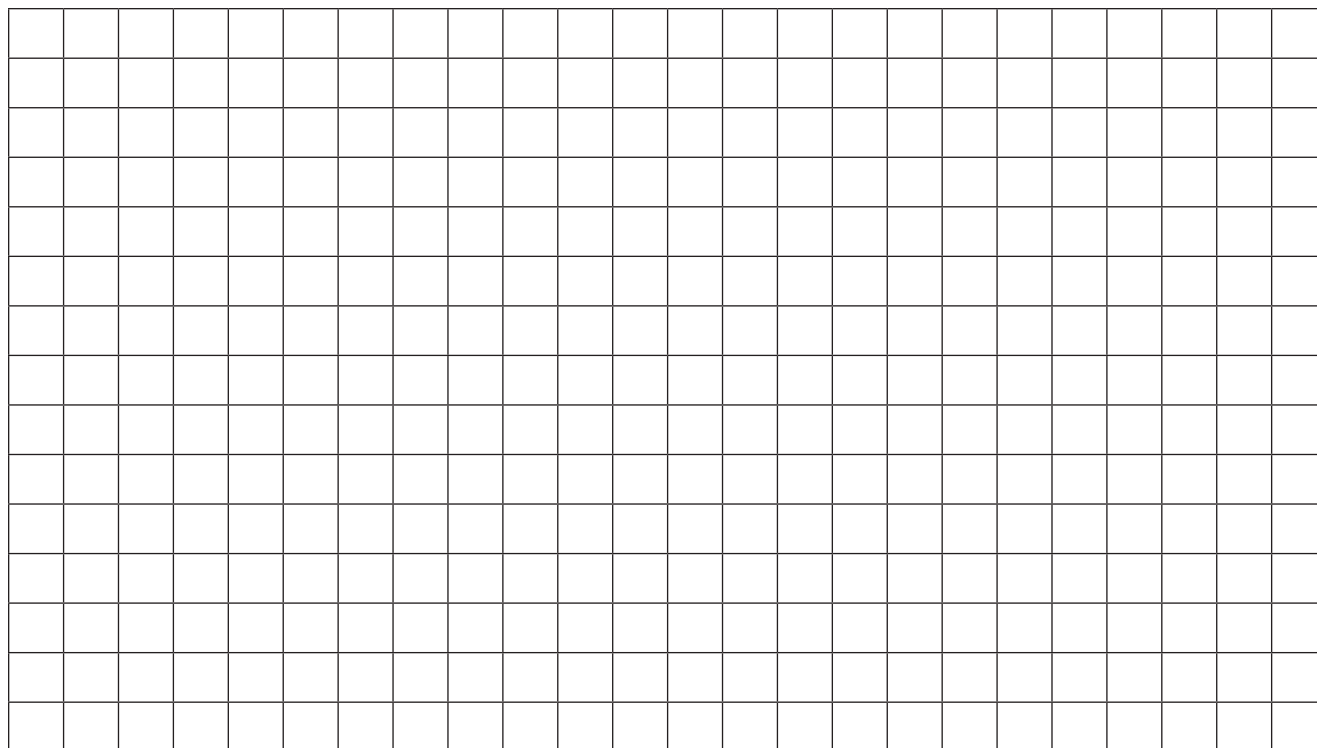
Results and Data

The following table shows how the paper towels compared to each other in terms of strength and absorbency. The towels were awarded points by how well they performed: 1st = 4 points, 2nd = 3 points, 3rd = 2 points, and 4th = 1 point. The final number shows the total number of points earned for all of the tests.



Brand of Paper Towel	Experiments			
	Dry Strength	Wet Strength	Absorbency	Total

Graph



Conclusion: _____

Summary: _____

Problem: Do the different brands of dry paper towels vary in strength?

Hypothesis: _____

Results

Brand of Paper Towel	Test 1	Test 2	Test 3	Average

[illegible]

Analysis of Data: _____

Conclusion: _____

Analysis of Data: _____

Conclusion: _____

Analysis of Data: _____

Conclusion: _____

How to Organize a Science Fair

1. Start early!
2. If you are planning a school-wide science fair form a committee to help you.
3. Choose a date, time, and location for your science fair. Check to see that there are not conflicts with other school or community activities. A classroom science fair can be held in your classroom; school science fairs can be held in cafeterias, libraries, gyms, or at off campus locations.
4. Get organized. Read over the following list of jobs that need to be done, make a time line to set completion dates, and assign committee members to complete them.
 - Make the science fair rules. This would include kinds of projects, categories of projects, size requirements, safety, and entry deadlines.
 - Make judging guidelines that judges use to score the science fair projects.
 - Get judges. You need at least one judge for every 10–20 projects. Judges may be teachers from other schools, retired teachers, or community members with a science background.
 - Determine the prizes you want to award. Do you want to give out 1st, 2nd, and 3rd place ribbons in each category? In each grade? Or do you want to have three grand prizes and participation ribbons for the rest of the entrants?
 - Order the prizes, ribbons, or trophies, you plan to give out at least six weeks before the science fair. Get enough extras in case of ties. Also consider getting thank you gifts for the judges.
 - Teach students how to do a science fair project. Have sample projects on display before students work on their science fair projects.
 - Have a list of science fair projects available to students.
 - If space is limited and/or you have too many projects for the number of judges you will need to have a preliminary screening of projects. This can be done at the classroom level where each teacher chooses a selected number of projects to move on to the school science fair.
 - Make entry forms and plan to register all projects.
 - Prepare reminder notes and thank you notes for judges.
 - Have scoring sheets, clip boards, pencils, and refreshments ready for judges.



- Plan times:
 - To set up the science fair area
 - For students to bring up their projects
 - For judging (2–3 hours)
 - To place ribbons on projects
 - To open and close the science fair
 - To remove the projects and clean up
- 5. Consider having refreshments for sale during the science fair. The proceeds can be used to offset some of the costs.
- 6. Have an awards assembly to recognize and award the science fair winners.

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Release Form for Photographic Images

To Teachers:

To help illustrate to others the experiential activities involved and to promote the use of simulations, we like to get photographs and videos of classes participating in the simulation. Please send photos of students actively engaged so we can publish them in our promotional material. Be aware that we can only use images of students for whom a release form has been submitted.

To Parents:

I give permission for photographs or videos of my child to appear in catalogs of educational materials published by Interact.

Name of Student: _____ (print)

Age of Student: _____ (print)

Parent or Guardian: _____ (print)

Signature: _____ Date: _____

Address:

Phone: _____

Interact

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