Paramount Unified School District
Educational Services

ENGAGING IN INQUIRY:

Science and Engineering Practices

Preface

This curriculum supplement, modified from *The NIH Curriculum Supplement Series,* is aligned to the instructional shifts of the *Next Generation Science Standards for California Public Schools, Kindergarten through Grade Twelve*[1] *(CA NGSS).*

Though this curriculum supplement best complements Life Science curricula, the supplement was modified to incorporate and highlight the science and engineering practices used by professionals. This modification will provide students with an understanding for how scientific knowledge develops, pique their curiosity, and motivate their continued study.

The structure of this unit enables teachers to effectively facilitate learning and stimulate student interest by applying the practices of science and engineering to a real-world scenario. Design elements include a progression of lessons that are based on BSCS's 5E Instructional Model of Learning and promote active, collaborative learning for students to develop problem solving strategies and critical thinking skills.

This curriculum supplement contains a complete set of materials for both teachers and students, including lesson plans, student handouts, and activity resources. Student handouts and activity resources may be printed for student use.

The original curriculum developed by NIH included field tests to ensure that the supplement is both engaging and effective. The addition of the science and engineering practices components were incorporated by PUSD's Science Curriculum Specialist. Feedback by teacher users is welcome and should be submitted to mflores@paramount.k12.ca.us.

I hope you find this supplement a valuable resource, and I wish you a positive school year.

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[1] On September 4, 2013, the State Board of Education (SBE) adopted the Next Generation Science Standards for California Public Schools, Kindergarten through Grade Twelve (CA NGSS) as required by Education Code 60605.85. The NGSS Appendices A-M were also adopted to assist teachers in the implementation of the new science standards and to aid in the development of the new science curriculum framework.

Engaging in Investigation

Objective(s):	Focus Question(s):
• Show current understanding of the practices scientists engage in to investigate.	• How do scientists investigate the natural world?

Materials:

✓ 1 Mystery Box per student team (Boxes should be assembled and secured using transparent tape.)
✓ 1 Biological Box per student team (Boxes should be assembled and secured using transparent tape.)

Engagement: *Initiates the learning task, accesses prior knowledge, and organizes student thinking toward outcomes of current activities.*

- Before students take their seats, arrange the desks such that each team of students will be able to view their Mystery Box.
- Divide the class into teams of four and ask the class, "What is science?"
- Have students Think/Pair/Share and quickly generate a list of student responses on the board.
- Ask, "How do scientists go about their work? How do they investigate things to learn about the natural world?
- Have students Think/Pair/Share and quickly generate a list of student responses on the board.
    - Possible student answers: make observations, perform experiments

Exploration: *Common base of experiences within which concepts, processes, and skills are developed.*

- Announce that the student will perform an investigation of their own.
- Place a Mystery box at the center of each group. **Cubes should be placed on tables so that the side displaying the #2 is on the bottom. Instruct students not to touch the cube or move from their seats wile examining it.**
- Give the teams a few minutes and instruct students to record any questions and their observations.
- What questions do you have about the cube?
    - Each team should develop one or two questions.
    - Students' questions may include the following: What is on the bottom of the cube? What is inside the cube?

Explanation: *Students demonstrate their understanding. Teacher provides resources and information to support student learning. Formal definitions and scientists' details are provided.*

- Guide the discussion to focus on the question, "What is on the bottom of the cube?"
- Explain to students that they will develop an explanation of what is on the bottom of the cube and that their explanation must be based on evidence.
- Ask the teams, "What do we mean by evidence?"
- Instruct students to Think/Pair/Share.
    - Students often think that evidence is information acquired through personal experience or from people they know. Clarify for students that evidence refers to observations or the results of experiments.
- Ask the teams, "How do you think an explanation based on evidence is different from other explanations?"
- Instruct students to Think/Pair/Share.
    - Students may respond that an evidence-based explanation also supplies a reason for the explanation. Guide the discussion to bring out the idea that such a reason (evidence) is objective and does not merely reflect a personal preference.

Elaboration: *Students' understanding is challenged and extended, skills further developed. Application of knowledge to new situations.*

- Ask several student teams to share their answers to the question and to explain their reasoning.
    - Use this discussion as an opportunity to make the point that an explanation is strengthened by being supported by more than one type of observation or line of reasoning. For example, students may reason that the number 2 is on the bottom of the cube because that number is missing from the sequence 1, _, 3, 4, 5, 6. The observation that the numbers on opposite sides of the cube add up to seven (1+ 6, 3 + 4, and _ + 5 = 7) also supports the explanation that 2 is on the bottom of the cube. Additionally, students may suggest that the

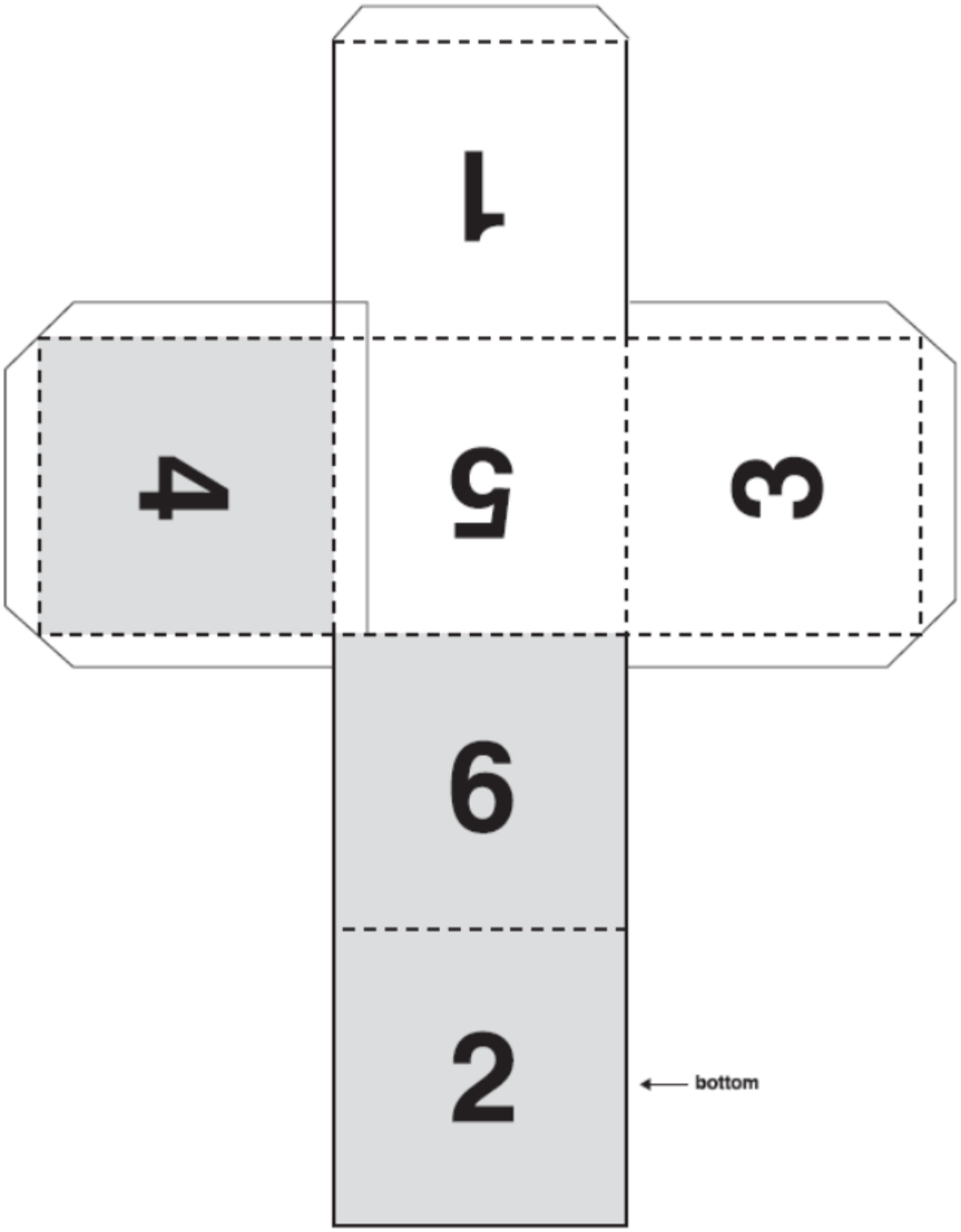
bottom of the cube is shaded, since 2 is an even number and the other even numbers, 4 and 6, are on shaded faces.

- Ask students whether they are convinced that their answer is correct and to explain why or why not. Emphasize that their answer should be consistent with all the evidence. You could also extend the discussion by asking whether they

Evaluation: *Teacher and students assess understanding and skills. Assessment is formal and informal, summative and formative.*

- Ask the teams how their investigation of the cube is similar to a scientific investigation.
    - Student answers will vary. Some may suggest that their investigation was scientific because it involved making observations and reaching explanations based on evidence. Others may point out that their investigation was not scientific because they were not able to conduct an experiment to see what was on the bottom of the cube.
- Conclude the activity by picking up the cubes without letting the students see the bottom face.
    - If students complain that they want to see the bottom of the cube, explain that the process of scientific inquiry often fails to provide a definite answer to a question. The results of the investigation provide a possible explanation that is consistent with the available evidence. The investigation may suggest additional questions that, when answered, may lead to a better explanation. You may also consider allowing the students to see the bottom of the Mystery Cube but not the bottom of the Biological Box used in the next activity.

Mystery Box Template



Engaging in the Practices of Science

Objective(s):	Focus Question(s):
• Recognize the practices by which scientists learn about the natural world.	• What practices do scientists engage in to learn about the natural world?

Materials:

✓ 1 Biological Box per student team (Boxes should be assembled and secured using transparent tape.)

Engagement: *Initiates the learning task, accesses prior knowledge, and organizes student thinking toward outcomes of current activities.*

- Before students take their seats, arrange the desks such that each team of students will be able to view their Biological Box.
- Divide the class into teams of four and ask the class, "What did you do to go about investigating the mystery cube?"
- Have students Think/Pair/Share and quickly generate a list of student responses on the board.

Exploration: *Common base of experiences within which concepts, processes, and skills are developed.*

- Announce that the student will perform another investigation of their own.
- Place a Biological box at the center of each group. **Cubes should be placed on tables so that the sides displaying the grass, question mark, and lion is on the bottom. Instruct students not to touch the cube or move from their seats wile examining it.**
- Instruct teams to make and share observations about the box and develop an answer to the question: What is on the bottom of the box?
- Give the teams a few minutes and instruct students to record their observations.
    - Possible student answers: The box has six sides. The box has five exposed sides. Three exposed sides depict an environment arctic, savanna, and forest). Two exposed sides display three images (acorn, squirrel, and hawk; fish, seal, and polar bear). Environments and the organisms that live in them are found on opposite sides. The exposed faces with three images on them represent food chains.
- Ask a member of each team to share the team's answer to the question and to explain its reasoning.
    - Possible student answers: The patterns on the exposed box faces should allow students to propose that the bottom face shows three images that together depict a food chain found in a savanna.
- Ask the teams, "What investigation could you perform to determine what is on the bottom of the cube?"
    - Students may suggest simply picking up the cube and looking at the bottom.
- Ask a member of each team to share the team's answer to the question and to explain its reasoning.
    - Possible student answers: The patterns on the exposed box faces should allow students to propose that the bottom face shows three images that together depict a food chain found in a savanna.

Explanation: *Students demonstrate their understanding. Teacher provides resources and information to support student learning. Formal definitions and scientists' details are provided.*

- Explain that each team will be able to perform one "investigation" to learn more about what is on the bottom of the cube.
- Ask teams to select one corner of the bottom face they would like to see.
- Designate one student from each team to slide the cube toward the edge of the table until the corner they selected extends no more than 2 centimeters off the edge of the table.
- Instruct another student to glance up at the exposed corner and share his or her observation with teammates.
- Students should be able to explain why they chose the corner that they did. Explain that sliding the cube along the table represents an investigation being performed that produces evidence needed to help them answer the question, "What is on the bottom of the cube?"
- After teams have performed their experiment, ask them to share the evidence they collected with the rest of the class.
- Can they now conclude what is on the bottom of the cube?

- Depending on which corner of the cube they exposed, students will report that they see nothing, a clump of grass, or a lion. The image at the center of the bottom face should not be visible.
- Students should conclude that the bottom face contains three images that depict a food chain found on the savanna. The first organism of the food chain is grass, and the third organism is a lion.
- Students can only guess at the identity of the middle member of the food chain. Animals eaten by lions include zebras, wildebeests, impalas, gazelles, antelopes, and warthogs. They should reason that it must be an animal that eats grass and is itself eaten by lions. Students may suggest animals such as zebras or antelopes.
    - The cube actually displays a question mark. This, too, relates to the nature of science, where an investigation may point to more than one equally correct, evidence-based answer.

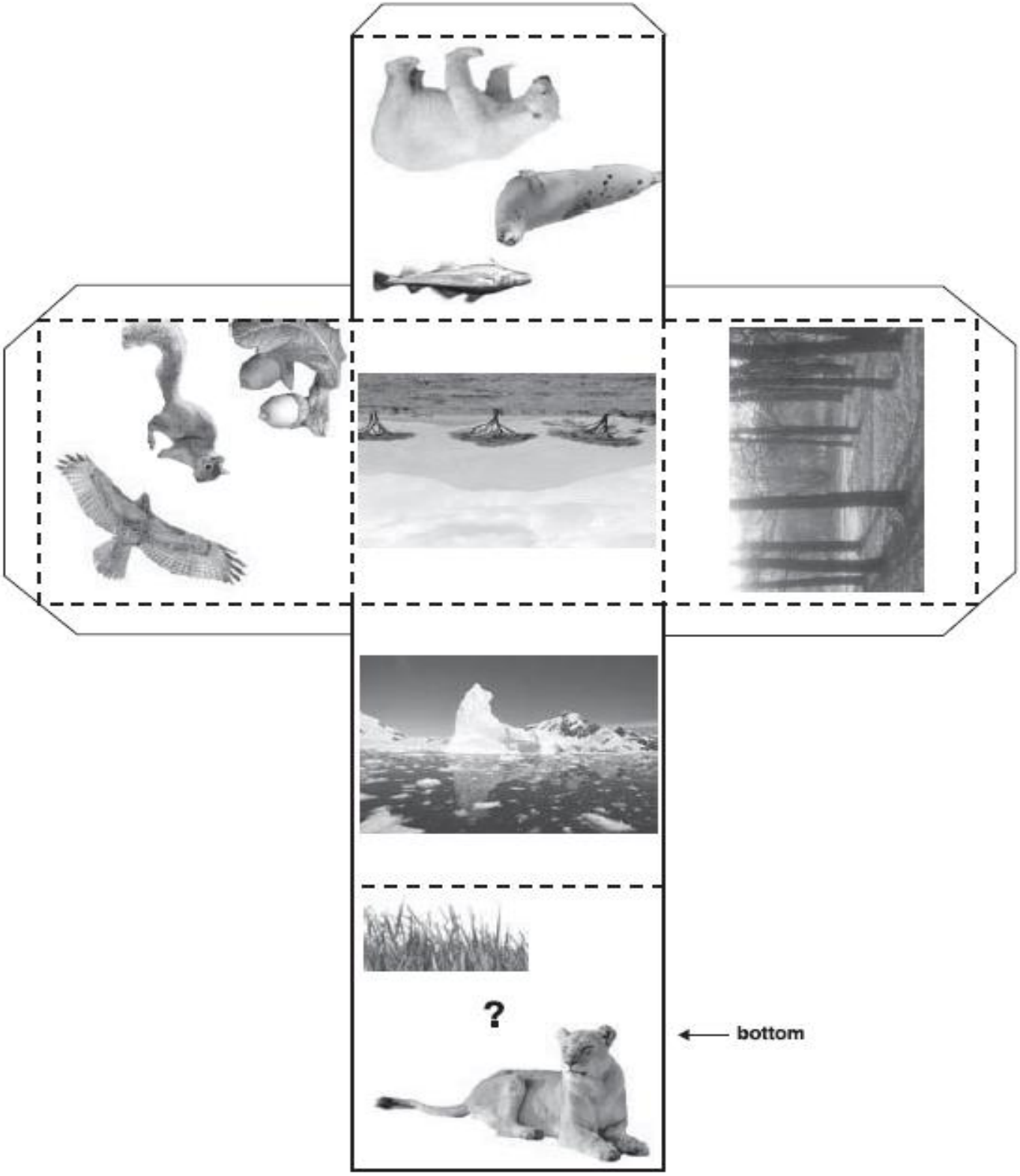
Elaboration: *Students' understanding is challenged and extended, skills further developed. Application of knowledge to new situations.*

- Conclude the activity by asking the teams to consider how their experience with the cubes is similar to how scientists learn about the natural world.
- Instruct student to complete the Thinking About Inquiry worksheet.

Evaluation: *Teacher and students assess understanding and skills. Assessment is formal and informal, summative and formative.*

- Have students Think/Pair/Share.

Biological Cube Template



Thinking About Inquiry

Name: _____ Date: _____ Period: _____

The following table lists parts of the process you went through to investigate the Mystery and Biological Boxes. Think back to your work with the boxes. On the right side of the table, provide an example of what you did in each activity that models the practices scientists use to learn about the natural world.

Practice	Mystery Box	Biological Box Activity
Ask a scientific question		
Use a model		
Carryout investigations		
Analyze data		
Use mathematical/ computational thinking		
Construct explanations		
Engage in argument from evidence		
Communicate information		

Asking Questions

Objective(s):	Focus Question(s):
• Identify and ask questions that can be answered through investigations; and identify the type of evidence needed to answer those questions.	• What is a scientific question?

Materials:

- ✓ *Working with Questions* worksheet per student
- ✓ *Letters to the Editor* handout per student
- ✓ *Question and Investigation Form* per student

Engagement: *Initiates the learning task, accesses prior knowledge, and organizes student thinking toward outcomes of current activities.*

- Remind students that they asked questions about cubes in the prior lessons.
- Ask students, "Why do you ask questions?"
- Students likely will respond, "To get answers or to get more information."
- Explain that scientists also ask questions to get answers, but they must ask their questions in ways that can be tested through a scientific investigation. This means that some questions are more easily answered than others.
- Ask students, "To a scientist, what makes a question a good question?"
    - Accept all answers. Write student responses on the board. Some students may believe that good questions do not ask about something really obvious, ask only about things that are real, or allow us to gain necessary information. The objective is not to be overly critical, but rather to engage student thinking about questions.
- Explain that scientists continually ask questions and that they try to ask questions that can be answered through investigations. Challenge students to describe some questions that are not suitable for a scientific investigation.
    - Students' answers will vary. Write some of their responses on the board.
        - Try to elicit the following characteristics of questions that are not scientifically testable: Their answers depend on personal preference. Their answers depend on moral values. They relate to the supernatural. They relate to phenomena that cannot be measured.

Exploration: *Common base of experiences within which concepts, processes, and skills are developed.*

- Say, "In this activity, you will investigate how to ask questions in the ways that scientists do."
- Divide the class into teams of three.
- Give each student one copy of *Working with Questions*.
- Read the list of questions with the students.
    - Each question defines a general problem. As written, none of the questions is directly testable. Two of the questions (3 and 6) are not appropriate for a scientific investigation because they involve personal preference (Question 3) and moral values (Question 6). The other questions are appropriate to scientific investigation but need to be rephrased in a more specific form.
- Explain that scientists may ask questions that have to be rephrased in the form of specific questions that can be tested through investigation.
    - To get students started, give them one example of a testable question such as, "Does what you eat influence the appearance of pimples?" or, "Does eating chocolate contribute to acne?"
- Assign each team a question from *Working with Questions*. Ask the teams to do the following:
    - Decide whether their question can be answered through a scientific investigation.
    - If their question can be answered through an investigation, come up with two testable questions that relate to the problem described in their assigned question.
    - If their question cannot be answered through an investigation, be able to explain why not and come up with two testable questions that relate to their question's topic.
- Give student teams 5 to 10 minutes to work with their questions.

- Students probably do not have the background to generate questions that show insight into each of the scientific problems. Students working with the same question may ask different testable questions. The purpose of this step is to develop critical-thinking skills and to give students practice writing testable questions. Focus on the students' ability to phrase a question in a way that makes it testable. Look for questions that focus on the natural world, scientific ideas, and quantitative relationships.

- Reconvene the class. Ask teams first to state whether or not their question can be answered through a scientific investigation. If they determined that their question can be answered through an investigation, what two testable questions did they ask?
  - Write the teams' questions on the board. As questions are put on the board, ask students if they agree that the question is testable.
    - If they do not agree, ask that they restate the question so that it is testable.

Explanation: *Students demonstrate their understanding. Teacher provides resources and information to support student learning. Formal definitions and scientists' details are provided.*

- Lead a discussion asking students to list characteristics that distinguish testable questions from questions that cannot be tested.
- Guide the discussion to focus on the following criteria: Testable questions ask about objects, organisms, and events in the natural world. Testable questions can be answered through investigations that involve experiments, observations, or surveys. Testable questions are answered by collecting and analyzing evidence that is measurable. Testable questions relate to scientific ideas rather than personal preference or moral values. Testable questions do not relate to the supernatural or to non-measurable phenomena.

Elaboration: *Students' understanding is challenged and extended, skills further developed. Application of knowledge to new situations.*

- Give each student one copy of *Letters to the Editor* and *Question and Investigation Form*.
- Explain that each of the three letters on *Letters to the Editor* features an individual expressing a different point of view about the same topic.
- Instruct students to read each of the three letters, select one letter and develop two scientific questions that relate to the point of view expressed in the letter, and for each question, describe an investigation and the evidence that could be used to answer it.
  - Look for questions that are worded in a way that suggests that they can be answered through investigations. Questions should not be based on opinions or personal beliefs.
  - Students may include:
  - **Fast Food and Cancer?** Example Question: Does food served at Quick and Tasty contain chemicals that can lead to cancer? Example Investigation: Test food from Quick and Tasty for chemicals that are associated with cancer. Example Question: Is cancer more common today than in the past? Example Investigation: Compare the incidences of several types of cancer today and 20 or 50 years ago.
  - **Healthy Diet? It's Up to You!** Example Question: Do obese people select different food items at Quick and Tasty compared with people of normal weights? Example Investigation: Observe and record the food choices at Quick and Tasty of obese and normal-weight people. Example Question: Are the salads served at Quick and Tasty as nutritious as similar salads served at more expensive restaurants? Example Investigation: Obtain comparable salads from Quick and Tasty and several more expensive restaurants. Analyze them for their nutritive content.
  - **Weight a Minute!** Example Question: Does a typical meal at Quick and Tasty contain more calories than recommended for an average person? Example Investigation: Determine the number of calories in several of the Quick and Tasty meals and compare this with recommended calorie intakes. Example Question: Are the food portions served at Quick and Tasty larger than those recommended for a healthy diet? Example Investigation: Obtain various food items from Quick and Tasty. Compare their portion sizes with the recommended ones.

Evaluation: *Teacher and students assess understanding and skills. Assessment is formal and informal, summative and formative.*

• Observe as students demonstrate their understanding of scientific questions.
  ○ Students need to come away with the understanding that scientifically testable questions are centered on objects and phenomena in the natural world. These objects and phenomena can be described and explained by scientific investigations. Testable questions do not relate to the supernatural. Testable questions lead to scientific investigations that gather measurable evidence.
  ○ Mention to students that different kinds of investigations may be appropriate depending on the question. Some questions lead to observations, while others lead to experiments.

Working with Questions

Name: _____ Date: _____ Period: _____

1. How is bug blood different from human blood?

2. Why do your fingers wrinkle after you take a bath?

3. Is rock music better than hip-hop music?

4. Why does bright light cause some people to sneeze?

5. Do smells affect people's moods?

6. Is vegetarianism better than eating meat?

Working with Questions

Answer Key

1. How is bug blood different from human blood?
    - Do all bugs have blood? Does bug blood contain white blood cells and red blood cells? What is the composition of bug blood?
2. Why do your fingers wrinkle after you take a bath?
    - What happens to your fingers if you soak them in other liquids, such as dish-washing detergents? Do fingers wrinkle faster in hot or cold water? How long do you have to soak your fingers before they wrinkle?
3. Is rock music better than hip-hop music?
    - Does rock music make more money than hip-hop music? How do music sales vary by geographical distribution and by type of music? How do music sales vary by age and gender of the buyer and by type of music?
4. Why does bright light cause some people to sneeze?
    - What physiological changes trigger sneezing? Do sunglasses prevent sneezing? Does breathing through your mouth versus breathing through your nose make a difference in sneezing when you are exposed to bright light?
5. Do smells affect people's moods?
    - Are septic workers unhappy? (subjective) Changed to: Do results of psychological tests designed to measure happiness show that sanitation workers score lower than other types of workers? Do people who work in florist shops have fewer psychological problems than those who work in less pleasantly fragrant environments?
6. Is vegetarianism better than eating meat?
    - Do vegetarians experience fewer heart attacks than meat eaters do? Does a vegetarian diet contain the same vitamins and minerals as a meat-containing diet? How do vegetarian and meat-containing diets compare nutritionally?

Letters to the Editor

Name: _____ Date: _____ Period: _____

The Daily Bugle Newspaper: **Readers Sound Off About Proposed Quick and Tasty Restaurant:**

Fast Food and Cancer?

When are Americans going to wake up to the dangers of restaurants like Quick and Tasty? The food they serve contains many chemicals known to cause cancer. It is no coincidence that as more people eat at these restaurants, more cases of cancer are being reported. Americans need to learn that organic foods are better than processed foods.

Signed, A Health-Conscious Reader

Healthy Diet? It's Up to You!

I for one will welcome Quick and Tasty to our neighborhood. Their food tastes great, is reasonably priced, and is good for you. People who say otherwise just eat too much or pick the wrong items. Their salads are just as good as those served at fancy restaurants but are much less expensive. I regularly eat at the Quick and Tasty near my business, and I'm in great shape.

Signed, Marathon Man

Weight a Minute!

Quick and Tasty is the last thing our community needs. The nation is in the midst of an epidemic of obesity, and fast-food restaurants are the biggest reason why. The food they serve has too many calories, and their portions are way too large. Society must be protected from companies like Quick and Tasty. They are more interested in making money than in the health of their customers.

Signed, Lean and Mean

Question and Investigation Form

Name: _____ Date: _____ Period: _____

Select one of the letters from *Letters to the Editor*. Develop two scientific questions related to the letter. Then describe an investigation and the evidence you could gather to answer each question.

Letter you chose: _____

Question 1: Investigation:
Question 1: Investigation:

Conducting Investigations

Objective(s):	Focus Question(s):
• Formulate scientific questions. • Use graphs and data table to analyze and interpret data. • Develop explanations based on evidence	• How do scientists engage in practices to learn about the natural world?

Materials:

One per Class	One per Team	One per Student
✓ *Letter from Principal* ✓ *First Memo from Director* ✓ *Second Memo from Director* ✓ *Third Memo from Director*	✓ *Interview Summary* ✓ *Quotes from Interviews* ✓ *School Calendars* ✓ *Activity Tables* ✓ *Activity Maps*	✓ *Investigative Report Form* ✓ *Attendance Data*

Engagement: *Initiates the learning task, accesses prior knowledge, and organizes student thinking toward outcomes of current activities.*

- Explain to the class that they are about to carry out a scientific investigation. In this investigation, they will be working as members of an investigative team from the local community health department.
- Divide students into teams of three students. Explain that they will investigate a possible health problem in the community.
- Give each student one copy of *Investigative Report Form*. Explain that students will use this form to record the progress of their investigation.
- Display *Letter from Principal*. Read the letter aloud to the class.
    - The letter is from the principal of a local middle school. She states that this past week, there was an unusual number of student absences from the band class. She is concerned that the school may be facing an outbreak of flu.
- Display *First Memo from Director*. Read the letter aloud to the class.
    - The memo from the director of the health department asks the investigative team to look into the matter and see if a health problem exists at the school.
- Instruct students to discuss with their teammates what scientific questions they can ask to help them determine whether a health problem exists.
    - Students should record their scientific questions on their *Investigative Report Form* and be prepared to share them with the class.
        - Circulate among the teams as they work to develop their scientific questions. Remind students of the aspects of scientific questions listed on the board. Students should ask questions that will help them determine whether the school absences indicate a health problem.
        - Examples: Is the number of absences in the last week more than in the previous weeks? Are there more absences in one school than the others?

Exploration: *Common base of experiences within which concepts, processes, and skills are developed.*

- Give each team one copy of *Attendance Data*.
- Students should record their findings on their Investigative Report Form under "Evidence collected."
- Instruct teams to analyze and explain their findings. Explain that they will share their results with the class later.
- Facilitate a class discussion to summarize the findings from all the teams.
    - Students answers may include: There were an unusually high number of absences during the last week among students in band classes at both Alondra and Jackson middle schools. Absences among students in art and PE classes, as well as for the entire seventh grade, were not higher during the last week for both

Alondra and Jackson middle schools. Paramount Park and Zamboni middle schools had fairly constant numbers of absences throughout the last month in every category.

- Instruct students to add anything from the class summary that they feel may have a bearing on their investigation now or in the future under "Evidence Collected."
- Tell students to consider which steps the investigation should take and prompt them to phrase these steps as questions.
    - Students should write their questions under "Next Questions."
- Instruct students to Think/Pair/Share.
    - Students questions may include: What is the reason for the higher number of absences among students in band class at Alondra and Jackson middle schools? If these absences are due to an illness, do band members from the two affected schools share the same symptoms? Have band members from the two schools been in recent contact with each other?

Explanation: *Students demonstrate their understanding. Teacher provides resources and information to support student learning. Formal definitions and scientists' details are provided.*

- Display *Second Memo from Director*. Read the memo aloud to the class.
- Give each team one copy of *Interview Summary and Quotes from Interviews*. Instruct students to review the information and record their findings under "Evidence Collected" in their *Investigative Report Form.*
    - Student answers may include:
    - The table for Alondra Middle School shows that there were 10 students from band class absent during the past week. One student was away on a family vacation. The other nine students all have an illness that displays stomach-related symptoms.
    - The table for Jackson Middle School lists eight absent students. One student has a broken leg. The remaining seven students have an illness that presents stomach-related symptoms.
    - The quotes from the parent interviews report the same symptoms listed in the tables.
        - Point out that the reasons given by the parents are opinions and not diagnoses from a doctor, which are derived from medical evidence.
- Give each team one copy of *School Calendars*. Make sure that students understand that they are looking at the school calendars because an illness is involved. If there are contacts between students from the two schools, then such contacts may help explain how an illness was contracted or passed from student to student.
- Have students compare the two school calendars and record their findings under "Evidence Collected." Tell students that they are to find evidence that will help them develop better explanations about the cause of the health problem.
- Facilitate a class discussion to summarize the findings from all the teams.
    - Students answers may include: A comparison of the Alondra and Jackson middle school calendars reveals that the seventh-grade bands from both schools were together three times in the past month: On May 5, both bands performed at a May Day parade. Students should note that May 5 was likely too long ago to be associated with the current illness. It is interesting that the band from Roosevelt Middle School was also at the parade and yet its band members did not become ill. Students from the two bands were together on May 15 for a planning meeting about the upcoming Battle of the Bands. The bands competed at the Battle of the Bands event on May 19.
- Guide the analysis of the evidence collected and develop a class explanation by focusing on the following questions: Is there a common reason for the absences of the band students at Alondra and Jackson middle schools? What are possible causes for the student illnesses?
- Encourage students to ask questions about the activities the band members might have participated in during the planning meeting and at the Battle of the Bands. Students should be concerned about activities the sick band members have in common.
    - If not brought out by a student, call attention to the fact that people become sick about five days after being exposed to a stomach virus, while they become sick the next day or two after eating contaminated food.

- Tell students to consider which steps the investigation should take and prompt them to phrase these steps as questions.
    - Students should write their questions under "Next Questions."
- Instruct students to Think/Pair/Share.
    - Students questions may include: How could students from both bands be exposed to a disease-causing organism at the same time? Assuming that the students from the two bands are suffering from the same illness, when were they most likely exposed to the disease-causing organism?

Elaboration: *Students' understanding is challenged and extended, skills further developed. Application of knowledge to new situations.*

- Display *Third Memo from Director*. Read the memo aloud to the class.
    - The memo informs the teams that a nearby community has reported that its water supply may be contaminated by bacteria that cause a stomach-related illness.
        - The students' knowledge about disease transmission is limited. Make sure that they understand that food poisoning and illness from contaminated water are not contagious. However, a stomach virus can be passed from one person to another.
- Give each team one copy of *Activity Tables*. Ask students to review the information and record their findings on their *Investigative Report Form*.
    - The *Activity Tables* provide information about the activities that band members from both schools participated in on the day of the Battle of the Bands event. The tables include information about activity participation by band members who became ill and those who did not become ill.
- Give each team one copy of *Activity Maps*. Ask students to review the information and record their findings on their *Investigative Report Form*.
    - The Activity Maps show the street locations for the various student activities. The maps depict students from Alondra Middle School who became ill and the activities in which they participated, students from Jackson Middle School who became ill and the activities in which they participated, and students from both Alondra and Jackson middle schools who became ill and the activities in which they participated.
- Instruct students to complete the "Analysis and Explanation of Evidence" for their findings.
- Prompt teams to share with the class.
    - Possible team responses: Analysis of the activity data suggests that either eating at the Cheep Chicken Hut restaurant or swimming in the lake made the band members ill.
- Instruct teams to review their entire collection of evidence. Instruct student to write a conclusion to explain how they think the band members became ill. Ask the teams to explain their reasoning using their evidence.
    - Students should conclude from their analyses of the activity tables that two possibilities exist: 1) students got food poisoning at the Cheep Chicken Hut and 2) students were infected while swimming in the lake. Without additional information, it is not possible to eliminate either possibility from suspicion. A third possibility also exists. Students could have contracted a stomach virus while attending the planning meeting on May 15.
- Explain to students that the process they followed is similar to that used by scientists conducting an investigation. Investigations do not always reach a single conclusion. They often raise more questions that need to be investigated.
- Ask students to consider what next steps they would take to reach a firm conclusion about the cause of the student illnesses. What evidence would they like to collect?
- Instruct students to Think/Pair/Share.
    - Students' suggestions may include: visit the various restaurants and take food samples for testing, visit the lake and take water samples for testing, have the illnesses of the sick students diagnosed by a doctor, investigate activities (such as eating) that took place during the planning meeting, and survey other people (not students) who ate at the Cheep Chicken Hut or swam in the lake to see whether they also became sick.

Evaluation: *Teacher and students assess understanding and skills. Assessment is formal and informal, summative and formative.*

- Conclude the activity by asking the teams to consider how their experience with the community health department investigation is similar to how scientists learn about the natural world.
- Instruct student to complete the Science Practices worksheet.
- Instruct students to Think/Pair/Share.

Investigative Report Form

Name: _____ Date: _____ Period: _____

Complete the Health Department investigation by recording your notes on the form below.

1. Scientific Question:
2. *Attendance Data* - Evidence Collected:
3. Analysis and Explanation of Evidence:
4. Next Questions:
5. *Interview Summary and Quotes from Interviews* - Evidence Collected:
6. *School Calendars* – Evidence Collected:
7. Analysis and Explanation of Evidence:

8. Next Questions:
9. *Activity Tables* - Evidence Collected:
10. *Activity Maps* - Evidence Collected:
11. Analysis and Explanation of Evidence:
12. Conclusion:
13. Next Steps:

Letter from Principal

Alondra Middle School Where Knowledge Is Good

Director Community Health Department

Dear Director:

I want to alert you to a possible health problem affecting students at the Alondra Middle School. I just had a discussion with the director of our student band. He told me that in his class on Wednesday, May 20, fully one-third of his students were absent.
This situation reminds me of last year when we had a widespread outbreak of the flu. Can you help us determine if we should be concerned? If there is a problem, can you suggest measures we might take to prevent or contain the disease?

Thank you for your attention to this matter.

Sincerely,

Lynn Butler

Lynn Butler, Principal, Alondra Middle School

First Memo from Director

MEMO

To: Members of the Health Department Investigative Staff

From: Director of the Community Health Department

About: School Absences

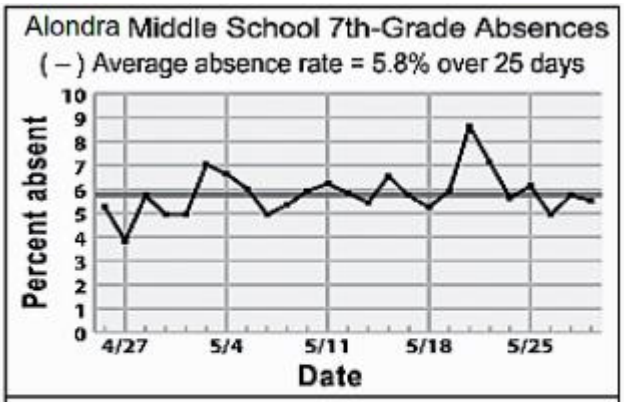
Principal Butler at Alondra Middle School has alerted me to a possible health problem among her students (see accompanying letter). I need your staff to investigate the situation and determine if a health problem exists in our community. To get you started, I have arranged to give you access to the attendance data for each of our community's four middle schools.

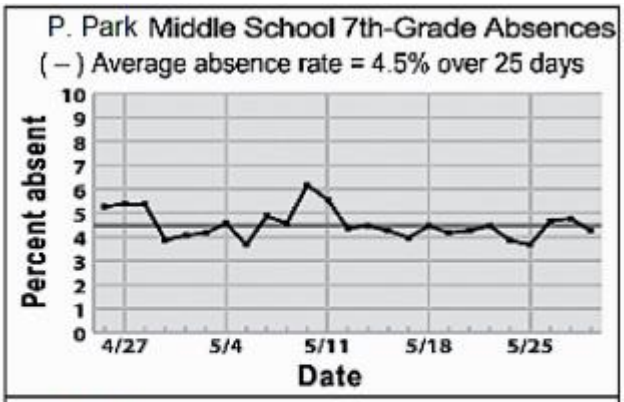
Please remember to take notes about your investigation. You should write your notes on the *Investigative Report Form*. The headings for our new *Investigative Report Forms* are

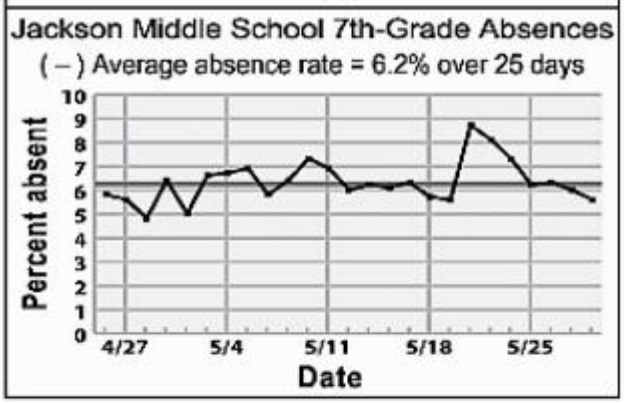
1. Scientific Question
2. Evidence Collected
3. Analysis and Explanation of Evidence
4. Next Questions

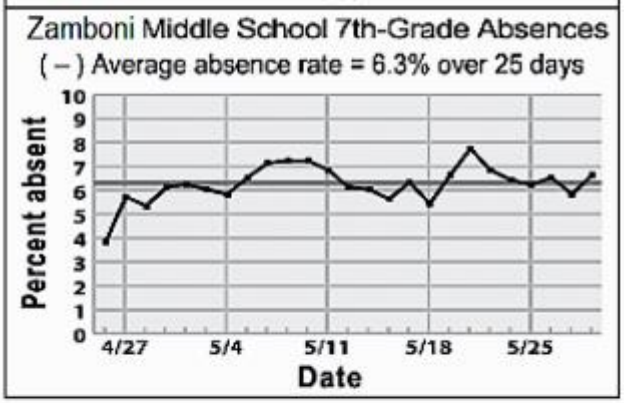
For your first investigation to determine if a health problem exists, you will need to ask a scientific question that can be answered by analyzing school attendance data.

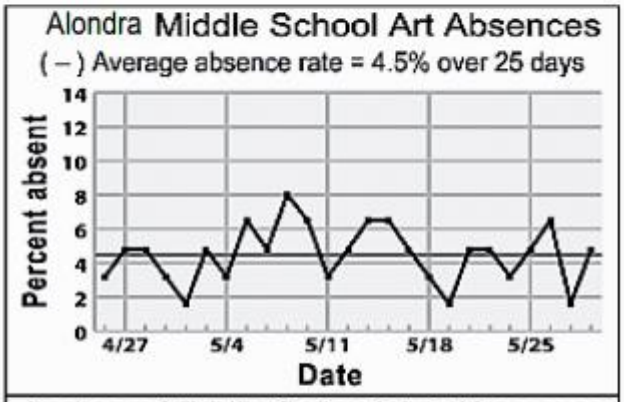
Attendance Data

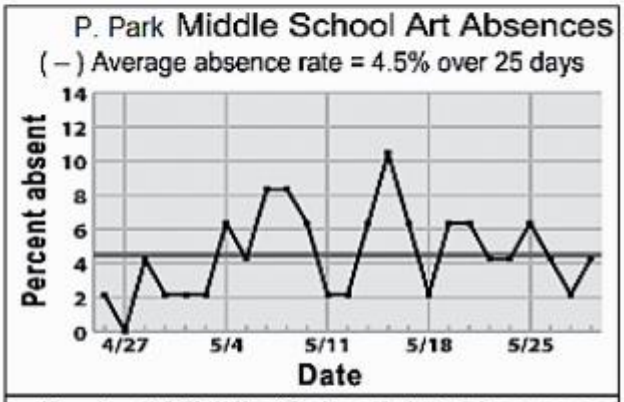


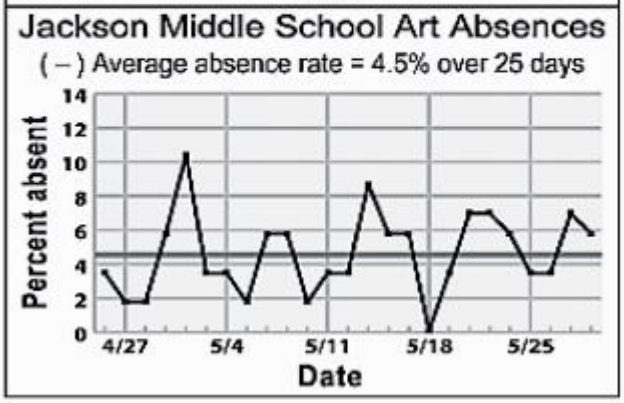


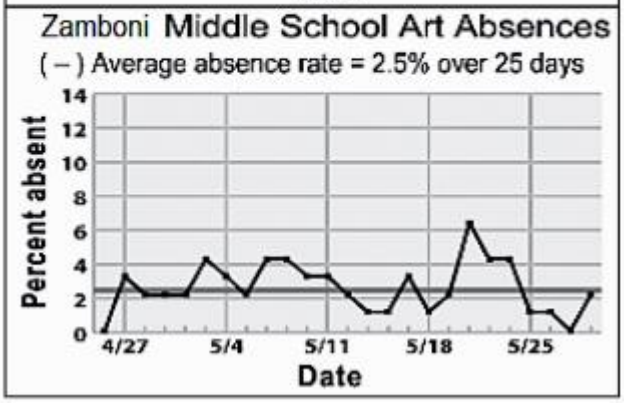




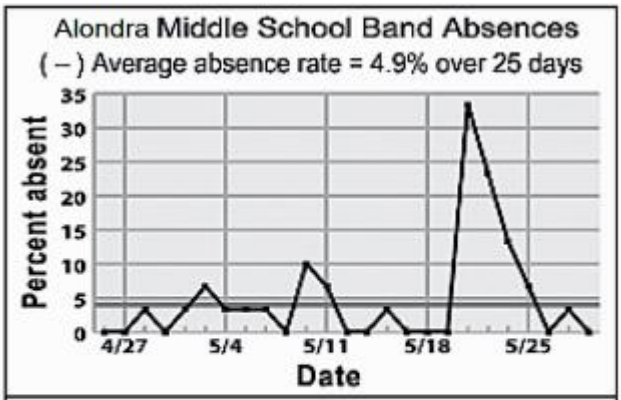


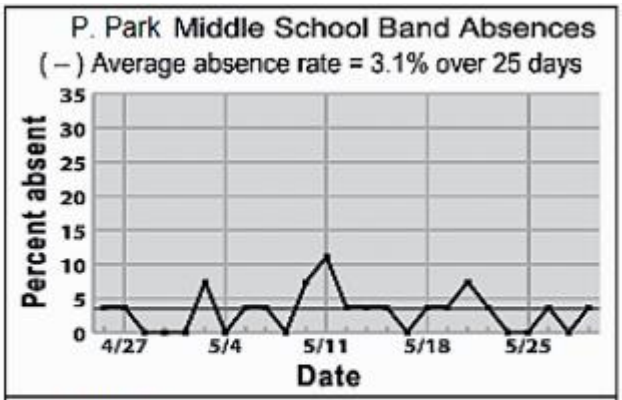


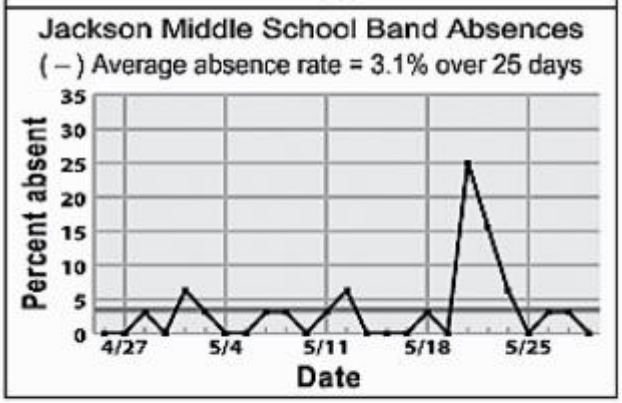


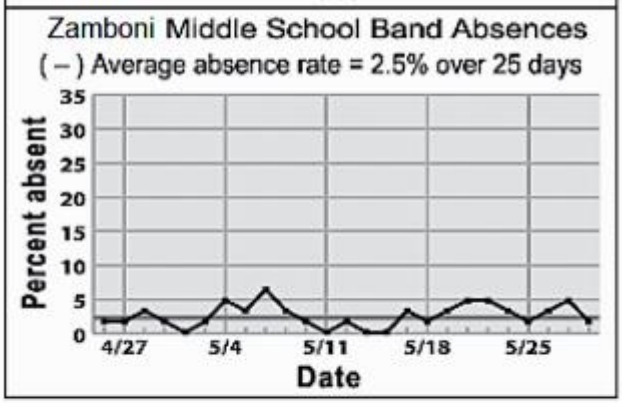


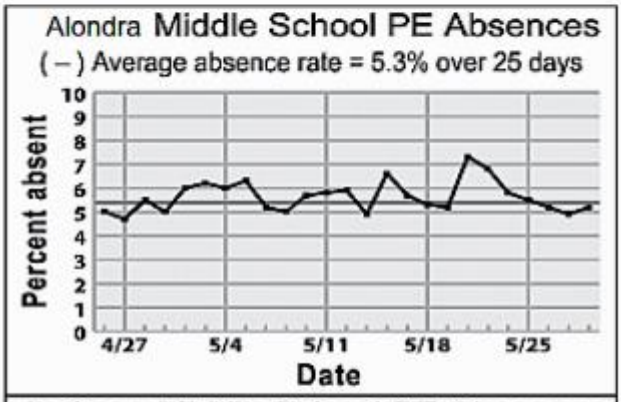
Attendance Data

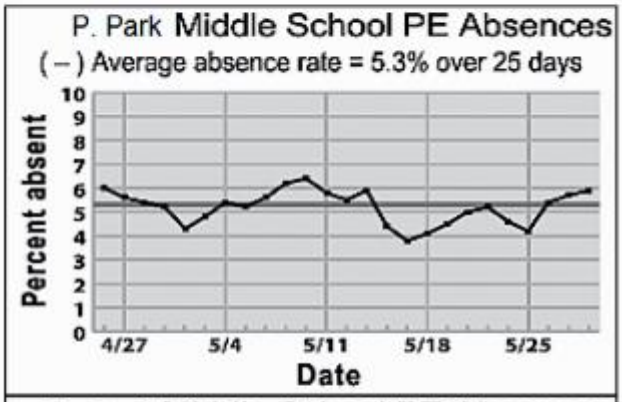


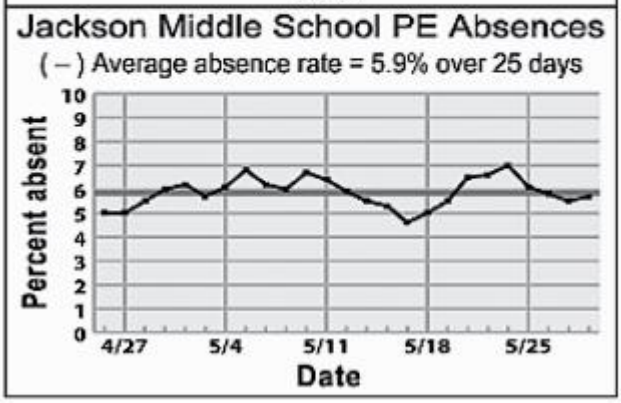


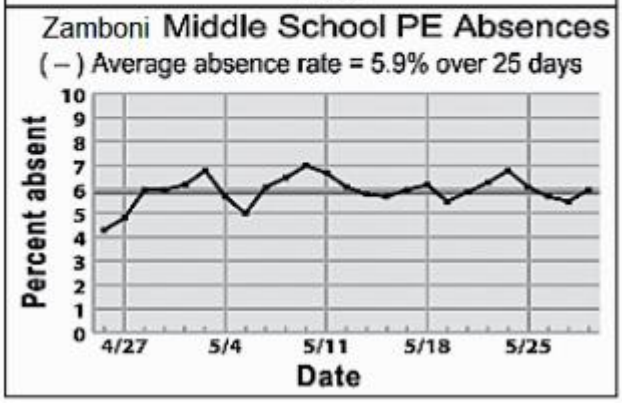












Second Memo from Director

MEMO

To: Members of the Health Department Investigative Staff

From: Director of the Community Health Department

About: Band Student Absences at Alondra and Jackson Middle Schools

Thank you for your hard work. You have established that a potential health problem exists at Alondra and Jackson middle schools. I have informed the principal at each school that you will continue your investigation and keep them informed of your progress.

Staff members have interviewed the parents of the absent students. The results of their interviews are summarized in the accompanying tables (one for each middle school). The tables provide a reason for each student's absence. If a student is sick, the symptoms are reported in the table. You also can read quotes from the parent interviews that are available as of today.

The principals from Alondra and Jackson middle schools have sent school calendars that provide information about the activities of band-class students over the past two months.

Keep up the good work. I look forward to learning the results of your investigation.

Interview Summary
Results of Interviews with Parents of Absent Students

Alondra Middle School Band Class

Student	Reason for absence	Symptoms	Parent interview available?
T1	Sick	Stomachache, headache, fever	No
T2	Sick	Stomachache, vomiting, fever	No
T3	Sick	Stomachache, headache, vomiting	No
T4	Sick	Stomachache, diarrhea	Yes
T5	Sick	Stomachache, diarrhea, fever	No
T6	Sick	Stomachache, vomiting, diarrhea	Yes
T7	Family vacation	None	No
T8	Sick	Stomachache, headache, diarrhea	No
T9	Sick	Stomachache, diarrhea, fever	No
T10	Sick	Stomachache, vomiting, diarrhea, fever	Yes

Jackson Middle School Band Class

Student	Reason for absence	Symptoms	Parent interview available?
J1	Broken leg	Broken leg	No
J2	Sick	Stomachache, diarrhea, vomiting, fever	Yes
J3	Sick	Stomachache, headache, diarrhea, fever	No
J4	Sick	Stomachache, diarrhea, fever	No
J5	Sick	Stomachache, headache, diarrhea	No
J6	Sick	Stomachache, vomiting, diarrhea, fever, headache	Yes
J7	Sick	Stomachache, headache	No
J8	Sick	Stomachache, headache, diarrhea	No

Quotes from Interviews

Interview with Parent of Student T4

Health worker: I understand that your daughter missed school on May 20 and 21. Can you tell me why she was absent?

Parent: She woke up before her alarm clock went off and complained that she felt sick to her stomach. About an hour later she threw up and so I kept her home.

Health worker: I see. How is she doing now?

Parent: She is better. She missed two days of school, though, and is busy getting caught up.

Interview with Parent of Student T6

Health worker: Can you tell me why your son missed school on May 20 and 21?

Parent: Yes, he had the flu.

Health worker: Did you take him to the doctor?

Parent: No, but I'm pretty sure it was just the flu. He probably caught it from his friend who was also sick at the same time.

Health worker: Maybe. After being exposed to the flu, it generally takes three to five days for symptoms to show up.

Interview with Parent of Student T10

Health worker: Why was your son absent from school on May 20 and 21?

Parent: He came home from the band competition and complained that his stomach hurt. The next day he felt worse. I took his temperature and found that he had a fever, so I kept him home. I think he had food poisoning. You should check out the restaurant that they went to.

Health worker: I suppose it could be food poisoning. Symptoms of food poisoning usually appear in the next day or two after eating contaminated food.

Interview with Parent of Student J2

Health worker: Why did your son miss school on May 20 and 21?

Parent: He had a bad stomachache and diarrhea. I took his temperature and it was a little high. I was going to take him to the doctor, but he started getting better, so I canceled the appointment.

Health worker: Well, I'm glad he's doing better!

Interview with Parent of Student J6

Health worker: Can you tell me why your daughter missed school on May 20 and 21?

Parent: She woke up with a stomachache and spent the whole morning in the bathroom. Later, she developed a fever and a headache. Do you think it is anything serious?

Health worker: We're concerned that the absent students may all have the same illness. I'll be sure and let you know what our investigation turns up.

School Calendars

Alondra Middle School Band Calendar

April

Sun	Mon	Tue	Wed	Thu	Fri	Sat
29	30	31	**1**	**2** Parent Teacher Conferences	**3** No School— Teacher Work Day	4
5	**6** No School— Spring Break	**7** No School— Spring Break	**8** No School— Spring Break	**9** No School— Spring Break	**10** No School— Spring Break	11
12	**13** Band practice	**14**	**15** Band practice	**16**	**17** Band practice	18 Band Concert
19	**20** Band practice	**21**	**22** Band practice	**23**	**24** Band practice	25
26	**27** Band practice	**28**	**29** Band practice	**30**	1	2

School Calendars

Alondra Middle School Band Calendar

May

Sun	Mon	Tue	Wed	Thu	Fri	Sat
26	27	28	29	30	**1** Band practice	2 Bake Sale Fundraiser
3	**4** Band practice	**5** May Day Parade with bands from Jackson and Roosevelt	**6** Band practice	**7**	**8** Band practice	9
10	**11** Band practice	**12**	**13** Band practice	**14**	**15** student planning meeting for battle of bands with Jackson	16
17	**18** Band practice	**19** Battle of the Bands with Jackson	**20** Band practice	**21**	**22** Band practice	23
24	**25**	**26**	**27** Band practice	**28**	**29** Band practice	30
31	1	2	3	4	5	6

School Calendars
Jackson Middle School Band Calendar

April						
Sun	**Mon**	**Tue**	**Wed**	**Thu**	**Fri**	**Sat**
29	30	31	**1**	**2** Parent Teacher Conferences	**3** No School—Teacher Work Day	4
5	**6** No School—Spring Break	**7** No School—Spring Break	**8** No School—Spring Break	**9** No School—Spring Break	**10** No School—Spring Break	11
12	**13**	**14** Band practice	**15**	**16** Band practice	**17**	18
19	**20**	**21** Band practice	**22**	**23** Band practice	**24**	25
26	**27** Band Concert	**28** Band practice	**29**	**30** Band practice	1	2

School Calendars
Jackson Middle School Band Calendar

May						
Sun	**Mon**	**Tue**	**Wed**	**Thu**	**Fri**	**Sat**
26	27	28	29	30	**1**	2
3	**4**	**5** May Day Parade with bands from Truman and Roosevelt	**6**	**7** Band practice	**8**	9
10	**11**	**12** Band practice	**13**	**14** Band practice	**15** student planning meeting for battle of bands with Truman	16
17	**18**	**19** Battle of the Bands with Truman	**20**	**21** Field Trip to Band Concert at State College	**22**	23
24	**25**	**26** Band practice	**27**	**28** Band practice	**29**	30
31	1	2	3	4	5	6

Third Memo from Director

MEMO

To: Members of the Health Department Investigative Staff

From: Director of the Community Health Department

About: WATER ALERT

I need to alert you to a new situation that may or may not relate to your investigation. A neighboring community has discovered a problem that may affect us and other communities in the region. Bacteria that cause stomach illness have been detected in its water supply. The health department in that community reports a sharp increase in illnesses that have symptoms similar to food poisoning and a stomach virus (stomachache, vomiting, nausea, and diarrhea). We're taking the necessary steps to watch for problems in our community.

By the way, I'm pleased to hear of the progress you are making with your investigation. As requested by your team supervisor, our staff has collected information about the activities that students participated in during the Battle of the Bands event. This information is available in a table and displayed as a series of maps.

Keep up the hard work. I look forward to learning the results of your investigations.

Activity Tables

Activities in which Students Participated Alondra Middle School[a, b]

Student	Biff's French Restaurant	Cheep Chicken Hut	Volleyball	Soccer	Swimming
T1		X			X
T2	X			X	
T3		X			X
T4		X			X
T5		X			X
T6		X			X
T8		X			X
T9		X			X
T10	X				X
T11	X				X
T12		X			X
T13	X		X		
T14	X			X	
T15		X			X
T16		X		X	
T17	X				X
T18	X		X		
T19	X		X		
T20	X			X	
T21	X			X	
T22	X		X		
T23		X		X	
T24	X			X	
T25		X		X	
T26	X		X		
T27	X			X	
T28		X			X
T29	X		X		
T30		X			X

[a]Student T7 was on vacation and did not attend the Battle of the Bands event. [b]The shaded area indicates students who did not become sick.

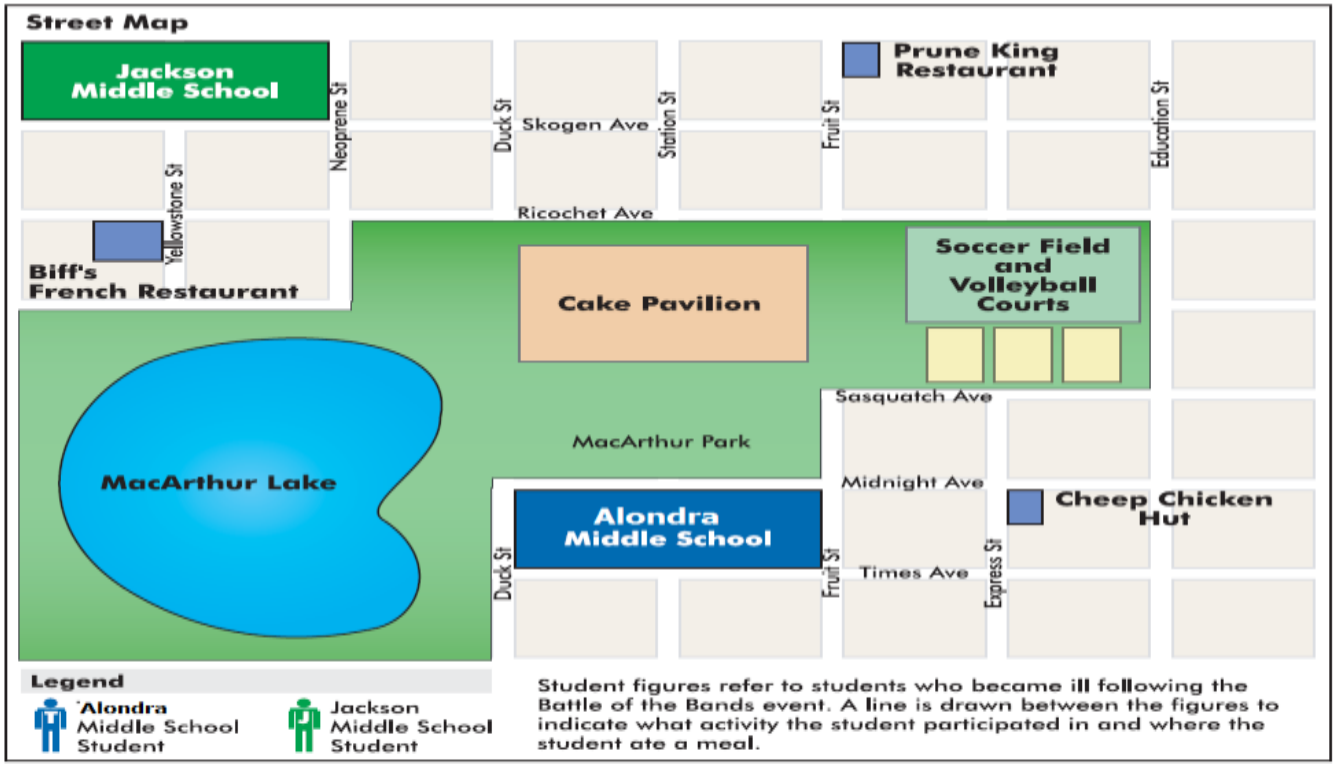
Activity Tables

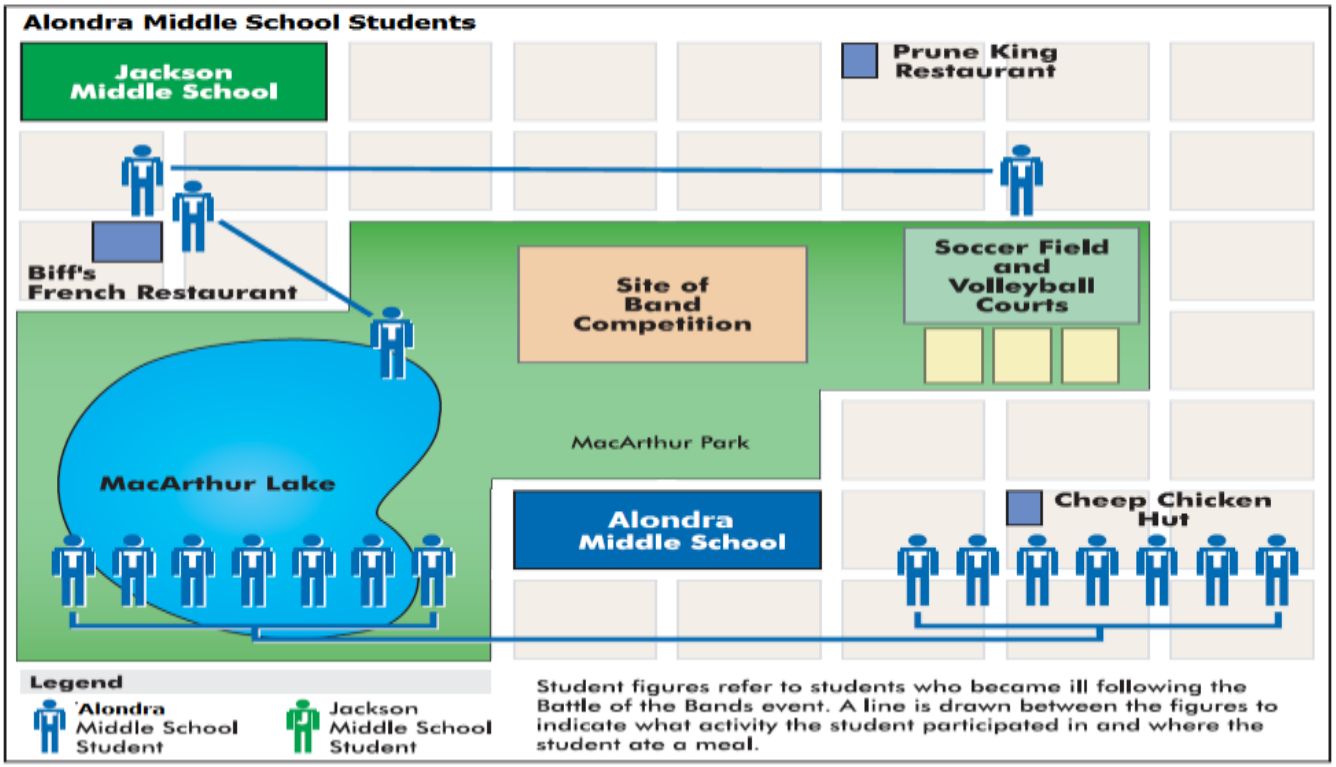
Activities in which Students Participated Jackson Middle School[a, b]

Student	Cheep Chicken Hut	Prune King Restaurant	Volleyball	Soccer	Swimming
J2	X				X
J3	X			X	
J4		X			X
J5	X		X		
J6	X				X
J7	X				X
J8	X				X
J9		X	X		
J10		X	X		
J11		X		X	
J12	X				X
J13		X			X
J14		X	X		
J15		X		X	
J16	X				X
J17		X		X	
J18	X			X	
J19		X	X		
J20		X			X
J21		X	X		
J22		X		X	
J23		X		X	
J24	X		X		
J25	X				X
J26		X		X	
J27		X		X	
J28		X	X		
J29		X		X	
J30	X			X	
J31		X			X
J32	X				X

[a] Student J1 has a broken leg and did not attend the Battle of the Bands event. [b] The shaded area indicates students who did not become sick.

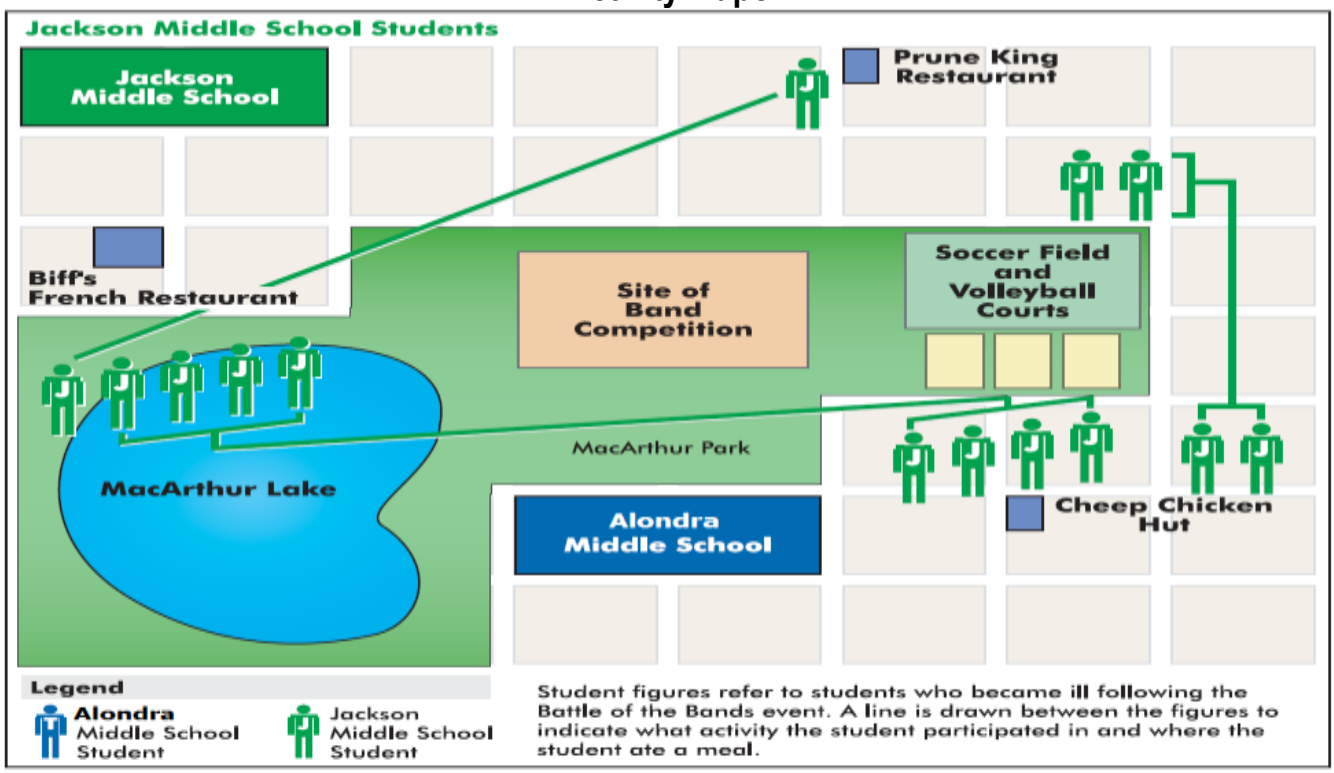
Activity Maps

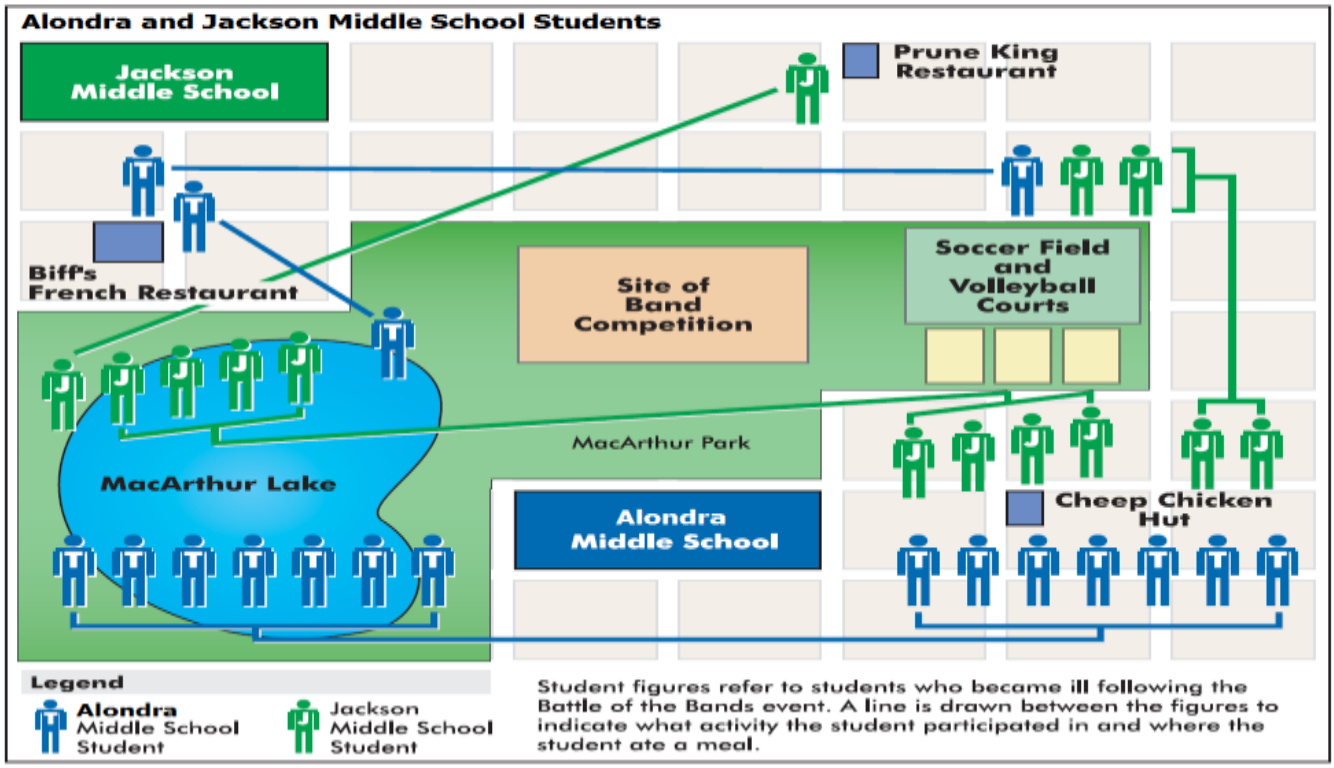




For each student, a line is drawn between two figures to indicate what activity the student participated in and where the student ate a meal on May 19.

Activity Maps





For each student, a line is drawn between two figures to indicate what activity the student participated in and where the student ate a meal on May 19.

Science Practices

Name: _____ Date: _____ Period: _____

The following table lists the science practices you engaged in to investigate the Health Department Investigation. Reflect on your work and on the right side of the table, provide an example of what you did in the investigation that models the practices scientists use to learn about the natural world.

Practice	Health Department Investigation
Ask a scientific question	
Use a model	
Carryout investigations	
Analyze data	
Use mathematical/ computational thinking	
Construct explanations	
Engage in argument from evidence	
Communicate information	