

The NASA "Why?" Files
The Case of the Unknown Stink

Program 1 in the 2000-2001 Series



Educator's Guide

Teachers &
Students

Grades 3-5

EP-2000-09-20-LaRC

Production of the NASA "Why?" Files is made possible by the generous support provided by AIAA Foundation; Busch Gardens, Williamsburg; Hampton City Public Schools; and the NASA Langley Research Center's Learning Technology Project and Aerospace Vehicle Systems Technology Program Office.

The American Institute of Aeronautics and Astronautics (AIAA) provides classroom mentors to educators who register for the NASA "Why?" Files. Every effort will be made to match a teacher with an AIAA member who will mentor the teacher either in person or by e-mail. To request a mentor, e-mail nasawhyfiles@aiaa.org or call Lisa Bacon at (703) 264-7527.



Contact the AIAA to get a
classroom mentor at
nasconnect@aiaa.org.

The Series

The NASA "Why?" Files is a series of four 60-minute video (taped) programs with an accompanying web site. Each 60-minute video program is divided into four 15-minute segments. The series is designed to enhance the teaching of science and mathematics in grades 3-5.

Dear Educators,

Welcome to the NASA "Why?" Files our newest distance learning initiative. We are really excited about this series and hope that educators across the nation will use the NASA "Why?" Files to enhance and enrich the teaching of mathematics, science, and technology in grades 3-5. The 2000-2001 series of four 60-minute programs (1) supports the national mathematics, science, and technology standards, (2) uses scientific inquiry, including the scientific method and science process skills, and problem-based learning, and (3) introduces students to the excitement and exploration of real-world math, science, and technology. The NASA "Why?" Files includes a teacher guide, a video, and a web-based component.

The NASA "Why?" Files story line is based on the exploits of six ethnically diverse, inquisitive school children ages 8-12. The tree house detectives, as they are commonly known, meet in a tree house before and after school. The students and a retired science teacher, Dr. "D", use scientific inquiry to investigate a variety of issues and problems. In the 2000-2001 series, the tree house detectives investigate the "Case of the Unknown Stink," the "Case of the Barking Dogs," the "Case of the Electrical Mystery," and the "Case of the Challenging Flight."

The NASA "Why?" Files is FREE. All you have to do is visit the web site <http://whyfiles.larc.nasa.gov> and register. Off-air rights are granted in perpetuity. No fees or license agreements are required. Educators are granted unlimited rights of duplication, dubbing, broadcasting, cable casting, and web casting into perpetuity with the understanding that all materials associated with the NASA "Why?" Files are used for educational purposes. The lesson guides are in the public domain (i.e., not copyrighted). Neither the broadcast, the lesson guides, nor the web-based components may be used either in whole or in part, for commercial purposes without the expressed written consent of the Office of Education, NASA Langley Research Center.

Thank you for making the NASA "Why?" Files part of your classroom this year. If you have questions or comments, I would enjoy hearing from you. I can be reached by U.S. mail at the NASA Langley Research Center, Office of Education, Mail Stop 400, Hampton, VA 23681; by telephone at 757-864-2491; by fax at 757-864-8835; and by e-mail at t.e.pinelli@larc.nasa.gov

Sincerely,

Thomas E. Pinelli, Ph.D.
Educational Technology and Distance Learning Officer



The Series

Overview

The NASA “Why?” Files, offered by NASA Langley’s Office of Education as a distance learning initiative, is a series of four 60-minute video programs with an accompanying web site. The series is designed to enhance the teaching of science in grades 3-5. The program content is drawn from physical science, Earth science, life-biological space science, and computer science; is related to the National Science Teachers Association (NSTA) Standards; and reflects the National Council of Teachers of Mathematics (NCTM) Standards. The series implements problem-based learning and focuses on the application of the scientific method. Each video, the web site, and the supplemental materials are designed to model how children use the scientific method to solve problems and include such process skills as gathering and classifying data, establishing hypotheses, designing experiments, identifying variables, measuring, observing, predicting, and communicating results. Students simultaneously learn subject matter and develop process skills while engaging in solving real-world problems. The problem-based learning practices enable the students to become proactive and critical thinkers capable of self-guidance and assessment when involved in a problem-solving situation.

The video programs are fast paced, include animation, have a musical opening and closing, and are planned to appeal to children aged 8-10. The story line has six ethnically diverse, inquisitive school children (ages 10, 11, and 12; three males and three females), who are friends that meet in a tree house belonging to one of the children. They investigate the solution to a particular problem, and the NASA “Why?” Files series follows them through the

steps of their investigation and final conclusion. A companion teacher guide is available for each video program in the series. Each guide includes the program overview, related science and mathematics concepts, key vocabulary, and program discussion. In addition, the guide includes extension activities and web site information designed for classroom or home/family enrichment.

The NASA “Why?” Files web site technology components provide a learner-centered environment in which the educator monitors, questions, and challenges, while students construct meaning and direction that will lead to a solution.

To reach a solution, students go through the following stages: understanding the problem, learning about the problem, solving the problem, and reflecting on the process used to solve the problem. This process helps students develop crucial problem-solving skills to become life-long learners.

The NASA “Why?” Files will be delivered to school districts and educators by PBS instructional television. The teacher guides and the videos are free for educators. Copies of the teacher guide may be downloaded at the NASA “Why?” Files web site <http://whyfiles.larc.nasa.gov>



The Series

Program Preparations

To generate student interest and to enhance the educational value of the program series, introduce each tape as you would any video or literature selection. Use the program summary for introductory ideas. List the key vocabulary words on the chalkboard or on a chart. Either go over the words and the meanings before presenting the video or remind the students to listen carefully for the words as they view the video so that the words and their meanings can be discussed after viewing.

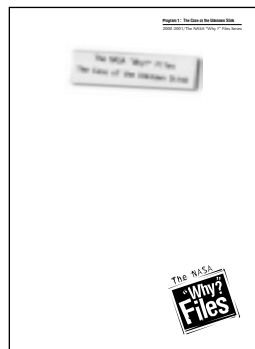
Keep the following in mind:

- (1) The series may be used, with the appropriate teacher follow-up instruction, to introduce the scientific method or to supplement/culminate previous classroom instruction and materials relative to the scientific method.
- (2) What's the Stink? (Program 1) should be used first since the story characters, the problem to be solved, and the scientific method will be introduced.
- (3) The remaining programs should be used as they relate to the teacher's curriculum.
- (4) The discussion questions and extension activities should be selected and/or adapted as appropriate for the developmental level of the students.

Each teacher guide reflects the content of a particular 15-minute segment of the 1-hour per program series. Adjust the information and activities in the guide according to the program segments used at a given time.

Encourage the students to use the NASA "Why?" Files web site for enrichment and technology application. The web site should generate student interest in exploring the use of the technology independently, rather than as a classroom instructional activity to obtain specific scientific information. The web page also contains some activities that families can enjoy together at home.

Program Components



The teacher guide for each of the four videos in the program series contains the following:

- *Series Overview*
- *Program Preparation*
- *Program Overview*
- *Science Concepts*
- *Mathematics Concepts*
- *Key Science Vocabulary*
- *Program Discussion*
 - *Before Viewing*
 - *After Viewing*
- *Program Extensions*
- *NASA "Why?" Files Web Site Information*

The Series

Preparations for Using the Program

Research has shown that when technologies such as video and the Internet are integrated into the curriculum, a student-centered and interactive learning environment can be achieved. By integrating technology with existing curriculum, technology tools become an effective educational resource rather than one more component to fit into an already packed agenda. The design of the NASA “Why?” Files video and web site promotes a “marriage” of the two technologies. The video and web site are developed to address the national standards and provide students with an opportunity to enhance their science, mathematics, and educational technology skills.

Suggestions for Effective Use of the Video

To generate student interest and to enhance the educational value of the series, introduce each 15-minute program segment by using the Program Discussion to generate introductory ideas. Display the key vocabulary words and discuss the definitions. Remind the students to listen carefully for the words as they view the instructional program and to be prepared to discuss the vocabulary definitions after viewing.

The series can be used to introduce the scientific method and to supplement previous classroom instruction. Discussion questions and extension activities provided in the teacher guide can be adapted to the developmental level of the students. The teacher guide supports the instructional content of each 15-minute segment by providing a variety of related educational experiences for the students. Programs and their segments may be videotaped and shown at times that enhance instruction of a particular concept or topic.



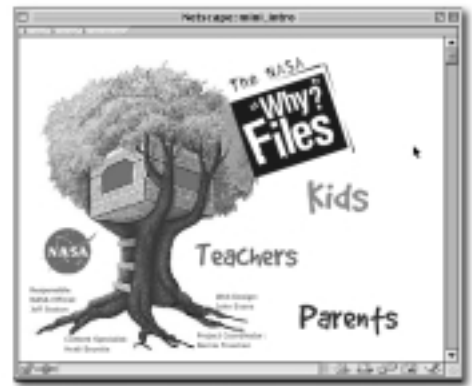
Some Approaches for Using the Program in the Classroom

- View one 15-minute segment and incorporate the lesson guide worksheets, on-line activities/experiments, and home activities/experiments.
- View all four segments of the video sequentially and then follow up with the lesson guide worksheets, on-line activities/experiments, and home activities/experiments according to each student's needs.
- View an individual segment to help introduce or reinforce a particular content area/concept that you are currently teaching in an existing unit.

The Series

The NASA “Why” Files Web Site

Encourage students to use the NASA “Why?” Files web site for enrichment and additional instructional enhancement. The web site should generate student interest in exploring the topics presented in the programs and develop technology skills. The web site also contains activities students can share at home.



<http://whyfiles.larc.nasa.gov>

Web Site Components

Research Rack

- Facilitates internet searches on specific content.
- Is an access point for summary information and glossary terms about the show's topic.
- Is a point of reference for NASA research and missions.

Dr. D's Lab

- Is a resource for assignments and exploration for each section of the video.
- Offers a family or classroom resource for experiments and exploration activities.

Problem Board

- Collection of interactive activities where students apply their technology skills and science inquiry skills.

NASA “Why?” Files Club

- Incorporates technology skills.
- Contains the tree house detectives' biographies.

Feedback

- Has on-line evaluation of the NASA “Why?” Files.
- Encourages students to create their own web evaluation form they can use at home to ensure their on-line time is spent on quality sites.

Media Zone

- A resource for sound clips, animation, and screen savers to enhance on-line electronic presentations.

Experts' Corner

- Encourages career exploration.
- Inspires students to define their roles within the school or community and to share an experience of how someone motivated them to pursue a hobby, sport, or practice.
- Provides practice using spreadsheets to catalog professional information that can be used as a resource for career week, writing biographies, or writing a paper that compares and contrasts various professions.

The Series

Effective Integration of the Video and the Web Site

Suggestions for effective integration of the NASA “Why?” Files video, the *Case of the Unknown Stink* and the NASA “Why?” Files web site:

- Worksheets will be located in the teacher and parent portions under Resources.
- Home activities will be located in Dr. D’s Lab area inside the tree house.
- Problem-based learning and video enrichment on-line activities will be located in the tree house at the Problem Board.

Video Segments (Parts 1-4)

Part 1: What's the Stink?

- Students can take notes during the segment by using the on-line worksheet Question and Answer Data Collection Table found in the teacher resource portion of the web site.
- Students can complete the on-line worksheet, *Can We Make Sense of Our Senses*, as a cooperative activity with another student. This activity may be used as a warm-up activity prior to the video or as a closure activity as part of the learning extensions.
- Students can complete the home activities *Where’s the Odor?* and/or *Sweet Smells 101* as a home work assignment, as extra credit, or as a classroom activity.
- Students can visit the Internet Resources inside the Research Rack and read a news article by NASA that highlights a technological invention, the “Electronic Nose.” An image of the “Electronic Nose” is also available from JPL at <http://www.jpl.nasa.gov/news>
See NASA’s Jet Propulsion Lab News Release of June 6, 2000 at <http://www.jpl.nasa.gov/pictures/tech/enose/> (Electronic Nose picture and caption)

Part 2: Search for the Stink

- Students can take notes during the video by using the on-line worksheet, *Using the Scientific Process*. After each segment, pause and discuss the scientific process steps students took or task them with completing the worksheet in small groups after viewing the video segments.
- Students can complete the on-line worksheet, *Writing a Hypothesis*, as a classroom activity or as homework.
- Students can complete the home activity, *Eye on the Environment*, as a homework assignment or an extra credit activity.
- Students can implement the Science Journal Writing home activity in the classroom or at home. It may also be placed in their student portfolios for later growth assessment.
Note: By emphasizing journal writing in the classroom, students will develop an understanding of the importance of continuing the practice at home.
- Students can visit an internet resource found at the Research Rack that pertains to animals and their sensing abilities to gain additional information about how animals use their sense of smell.
<http://www.faculty.washington.edu/chudler/amaze.html>

Video Segments “Continued”

Part 3: We're Almost There

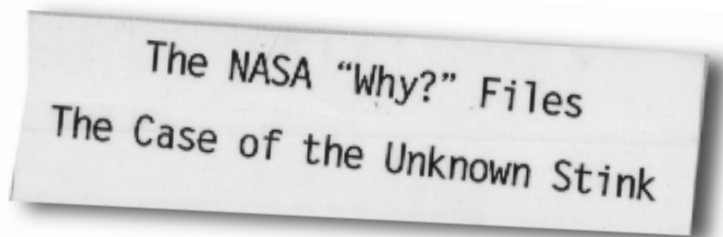
- Students can extend the concept of variables by completing the *Identifying Variables* on-line worksheet. The worksheets will help students make the connection between variables and other real world situations.
- Students can complete the home activity, *Designing a Wind Vane*, and use the wind vane to collect and record data over a period of time. The data can then be organized and communicated in graph form as part of an extension activity for the unit or another unit dealing with weather.
- Students can complete the home activity, *Smelly Traveler*, in class, as an investigation for a lab activity/grade, or as a homework assignment.

Students can visit two internet resources found at the Research Rack. Each pertains to kids' health and how human beings smell.
<http://faculty.washington.edu/chudler/chsmell.html>
http://kidshealth.org/kid/body/nose_SW.html

Part 4: This Is It!

- Students can complete the on-line worksheet, *Environmental Discussion*, as a small group activity to further extend the application of environmental awareness and to develop communication skills.
- Students can complete the home activity Environmental Awareness Contract as a homework assignment that provides an elapsed amount of time before it is due. The final product may be presented in poster format, as an oral report, or as a Power Point presentation.

The Case



*In this program, students are invited to actively join the tree house detectives as they investigate the **Case of the Unknown Stink**. The tree house detectives accept the challenge of trying to find the source of an unpleasant odor that is invading the surrounding neighborhoods.*

To determine the source of the stink, our detectives learn about the sense of smell: what it is, how people and animals smell, and how wind speed and direction influence the movement of odor. They also learn how NASA's Atmospheric Science research can help solve the case. While investigating, the tree house detectives learn that the source of the "unknown stink" is "right under their very noses."

Part 1	What's the Stink?
Part 2	Search for the Stink
Part 3	We're Almost There
Part 4	This is it!

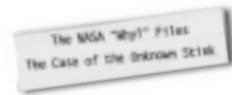
The NASA "Why?" Files
The Case of the Unknown Stink

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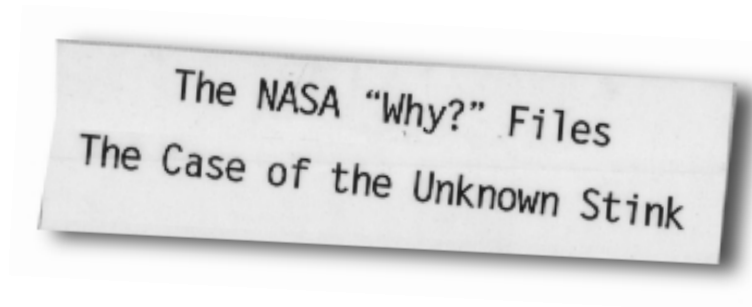
The Case

National Standards



National Science Education Standards	National Educational Technology Standards	National Mathematics Standards	National Geography Standards
The student will develop abilities necessary to do scientific inquiry.	The student will understand and use basic operations and concepts of technology.	The student will apply a variety of techniques, tools, and formulas for determining measurement.	The student will understand how to use maps and other geographical representations, tools, and technologies to acquire, process, and report information from a spatial perspective.
The student will develop an understanding about scientific inquiry.	The student will use technology tools productively.	The student will pose questions and collect, organize, and represent data to answer those questions.	The student will understand how to analyze the spatial organization of people, places, and environments on Earth's surface.
The student will develop an understanding of personal health.	The student will use technology as a communication tool.	The student will interpret data using methods of exploratory data analysis.	
The student will develop an understanding of changes in the Earth and sky.	The student will use technology as a research tool.	The students will organize and consolidate student mathematical thinking to communicate with others.	
The student will develop an understanding about science and technology.	The student will use technology resources in problem solving and decision making.	The student will recognize, use, and learn about mathematics in contexts outside mathematics.	
The student will develop an understanding of changes in the environment.		The student will create and use representations to organize, record, and communicate mathematical ideas.	
The student will develop an understanding of science as a human endeavor.			

Part 1



Part 1 | What's the Stink?

Age Range
Ages 8-10

Duration
15 Minutes

Science Concepts

Science as Inquiry
Science and
Technology
Science in
Personal and Social
Perspectives
History and
Nature of Science

**Mathematics
Concepts**

Measurement
Data Analysis,
Statistics, and
Probability
Connections
Representation

**Key Science
Vocabulary**

Data
Experts
Internet
Scientific Method
Science by Inquiry
Hypothesis
Observation
Scientist
Engineer
Variables

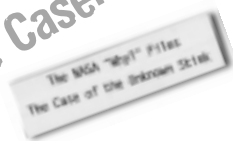
Program Overview

Part 1: What's the Stink?



Three friends (ages 8, 9, and 10) meet after school in a tree house that belongs to one of the children to watch the TV program, NASA's Kids Science News Network (KSNN). The children learn from the program that a nearby town is being bothered by an unpleasant odor, and viewers are invited to assist with solving the problem of the unknown source of the odor. The three friends decide to try to solve the problem. A neighbor, a retired science professor, assists them with suggestions for informational resources and introduces them to the scientific method.

They learn the necessity of identifying the problem, gathering data, forming a hypothesis, testing the hypothesis, controlling the variables, analyzing the data, and reaching a conclusion. To begin their problem solving, the three investigators search for information about smells by using the tree house computer, the Internet, and a web browser. They visit a NASA Langley electronics engineer to learn about conducting experiments and the role variables play in scientific research.



Science as Inquiry
Science and
Technology
Science in
Personal and Social
Perspectives
History and
Nature of Science

Science Concepts

Part 1: What's the Stink?

National Science Teachers Association (NSTA) Standards

Science as Inquiry

Students develop abilities necessary to do/to understand scientific inquiry.

- Observe and ask questions to identify problems.
- Plan and conduct a simple scientific investigation.
- Use tools and equipment to gather data.
- Compare evidence and what is already known.

Science and Technology

Students develop abilities to understand how technological systems work to help solve problems.

- Use technological designs/tools to gather information.

Science in Personal and Social Perspectives

Students understand how the environment affects personal health.

- Be aware that pollution can influence health and the quality of life.

History and Nature of Science

Students understand that science is a human endeavor.

- Recognize that people of all backgrounds engage in various science career activities.

Measurement
Data Analysis,
Statistics, and
Probability
Connections
Representation

Mathematics Concepts

Part 1: What's the Stink?

National Council of Teachers of Mathematics (NCTM) Standards

Measurement

Students understand systems of measurement and apply a variety to techniques, tools, and formulas for determining measurements.

- Produce simple scale drawings.

Data Analysis, Statistics, and Probability

Students pose questions and collect, organize, and represent data to answer those questions.

- Organize data by using tables and graphs.

Connections

Students recognize, use, and learn about mathematics in contexts outside of mathematics.

- Observe the mathematics and science connections in problem solving and experiments.

Representation

Students create and use representations to organize, record, interpret, and communicate mathematical ideas.

- Use graphs to mathematically represent a written image/response to a question or problem.

Key Science Vocabulary

Part 1: What's the Stink?

Data	factual information, especially information organized for analysis or used to make decisions
Experts	persons who are highly skilled or knowledgeable in a certain subject or area
Internet	a worldwide information system in which computers are connected so that computer users can communicate and/or obtain information
Scientific Method	there is no one scientific method, rather methods or science: a set of interrelated processes of posing questions and investigating phenomena
Science by Inquiry	process through which science content is learned where the student is the facilitator of the learning
Hypothesis	an estimate or "educated guess" for solving a problem based on facts, observations, and available data
Observation	the act of systematically observing or paying careful attention to something and noting or recording what was observed
Scientist	a person who has special training and expertise/knowledge in the observation, identification, description, experimental investigation, and explanation of scientific facts or occurrences
Engineer	a person who has special training and practice in applying scientific principles to the practical design, manufacture, and operation of structures and machines
Variables	changes which can be controlled by the experimenter when doing an experiment

Before Viewing
(Questions 1-2)

After Viewing
(Questions 3-9)

Program Discussion

Part 1: What's the Stink?

Before Viewing

1) Ask the students to predict from the title (*What's the Stink?*) what they think the content of the video program will be.

After the students offer their suggestions about the video's content, record 5 or 6 of the ideas and have the class vote on the one they feel may be the most accurate prediction. Help the students graph the voting outcome. (The graphing can be done now or later as a class or independent extension activity.)

2) Encourage the students to brainstorm the processes of the scientific method. List the suggested processes on the chalkboard or chart. Tell the students that a comparison will be made after they view the video to see if all the processes have been included or if revisions are needed.

Accept whatever the students suggest prior to viewing the program. After they view the program, give the students an opportunity to revise the list according to the information learned. The revised list should include identifying the problem, asking questions about the problem, observing and gathering data or helpful information, forming a hypothesis, testing the hypothesis, trying again if the data does not support the hypothesis, reaching a reasonable conclusion or explanation, and communicating the results. (Initially, third graders may be able to comply only by naming a specific question to be answered, finding out information about the question, answering the question based on the findings, and presenting the results to others.

After Viewing

3) Ask the students why Phewsville is an appropriate name for the town with the bad odor.

“Phew” is an expressive sound often used to describe something unpleasant, such as an offensive odor.

4) Have the students identify the problem the tree house detectives will be trying to solve. Have the students explain why this problem needs to be solved.

The problem is, “What is the odor or stink and what is causing it?” The problem needs to be solved because the odor is unpleasant for the residents of Phewsville, it causes air pollution, and it may have an adverse or negative effect on people with certain health conditions such as asthma and other respiratory illnesses.

5) Ask the students to name the resources and the steps taken by the video investigators thus far in trying to solve the problem of the odor/stink.

The tree house detectives have identified the problem, begun an informational chart, used the Internet, asked their neighbor for help, and visited an expert (NASA electronics engineer).

6) Ask the students to name the three basic informational resources suggested by Dr. D. Question the students as to why Dr. D cautioned the children to “look at everything you read with a critical eye.”

The basic resources suggested by Dr. D are books, the Internet (computer), and experts.

Anyone can write something for publication or on the Internet without the information being accurate or carefully researched. Therefore, it is best to check several sources to be sure that the information is correct.

7) Work with the students to create, on the chalkboard or on a chart, Need to Know Board similar to the one the tree house detectives prepared to help them with the problem. (*You may prefer to give the students the headings and then have them complete the chart as a summary activity.*)

Need to Know Board

What we know	What we need to know	Where to go for help
Health Department has given a warning	What’s in a smell	Dr. D (science expert)
People in Phewsville smelled something bad	How a smell moves	Computer/Internet
No one knows where the smell is coming from	How to experiment	NASA electronics engineer

8) Refer to any recent class experiment; have the students define the term variable and name the variables in that experiment. (*Answers will vary.*)

9) Explain that the title of the next video in the series is *The Search for the Stink*. Encourage the students to predict what they think the three friends will do next in trying to solve the problem.

Accept all suggestions; however, to promote the students’ logical thinking and problem-solving skills, ask the students to explain why the suggested steps would be helpful.

NOTE:
The extensions can be class or individual enrichment activities and should be selected and/or adapted according to student developmental levels.

Program Extensions

Part 1: What's the Stink?

1. Language Arts

Students suggest what they think would be a good name for the tree house and write a paragraph to explain why they selected that name.

2. Mathematics and Language Arts

Students draw a design, similar to a simple blueprint, for a tree house. Ask them to draw the design to scale and label the dimensions. Have them list or write in narrative form how they would furnish a tree house and what things they would include if they built a tree house (See "My Tree House" page 22.)

3. Science and Language Arts

Direct the students to copy the informational chart (prepared as a class or summary activity) in their science notes so they can refer to and add data as they work with the subsequent tapes in the series.

4. Science, Technology, and Language Arts

Students explain (orally or in writing) the experiment that is being conducted by NASA concerning safer landings on airport runways during inclement weather and tell why this experiment is important to air travelers and air transportation. Include a description of how NASA uses computers in the experiment and ask them to identify the four variables in the experiment.

5. Science and Language Arts

Encourage interested students to design and share their own experiments showing how an object moves on both a dry and a wet surface. Have them state their conclusions.

6. Science and Language Arts

Students make a list of their favorite smells and a list

of their least favorite smells. Compare lists with partners or in small groups. Additionally, have them choose a favorite and a least favorite smell from their lists and write why they made the particular selections (*See "What's That Smell?" page 23.*)

7. Science, Technology, and Language Arts

Students search the topic "smells" on the Internet as the "tree house detectives" did to see what other interesting facts can be found. Let the students share some of their findings with the class orally or in writing.

8. Science, Technology, and Language Arts

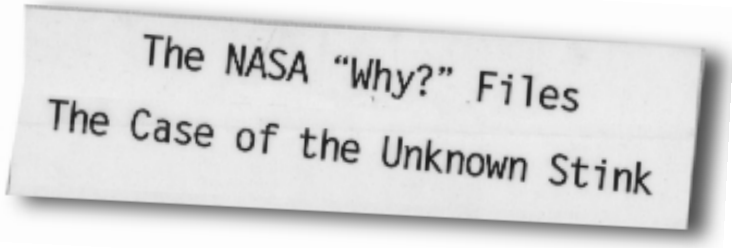
Students use the Internet or available print materials to learn more about snakes' and sharks' sense of smell. Write and/or report orally the findings to the class.

Options for further research topics: air pollution; respiratory diseases; the NASA Boeing 757 airplane; and an environmental, aeronautics, or computer scientist or invention.

9. Science and Technology

Encourage the use of the NASA "Why?" Files web site.
<http://whyfiles.larc.nasa.gov>

Exercises



The NASA "Why?" Files
The Case of the Unknown Stink

Part 1 : What's the Stink?

Need to Know Board

The MDA "dog" #11111
The Case of the Unknown Stink

WHAT WE KNOW	WHAT WE NEED TO KNOW	WHERE TO GO FOR HELP

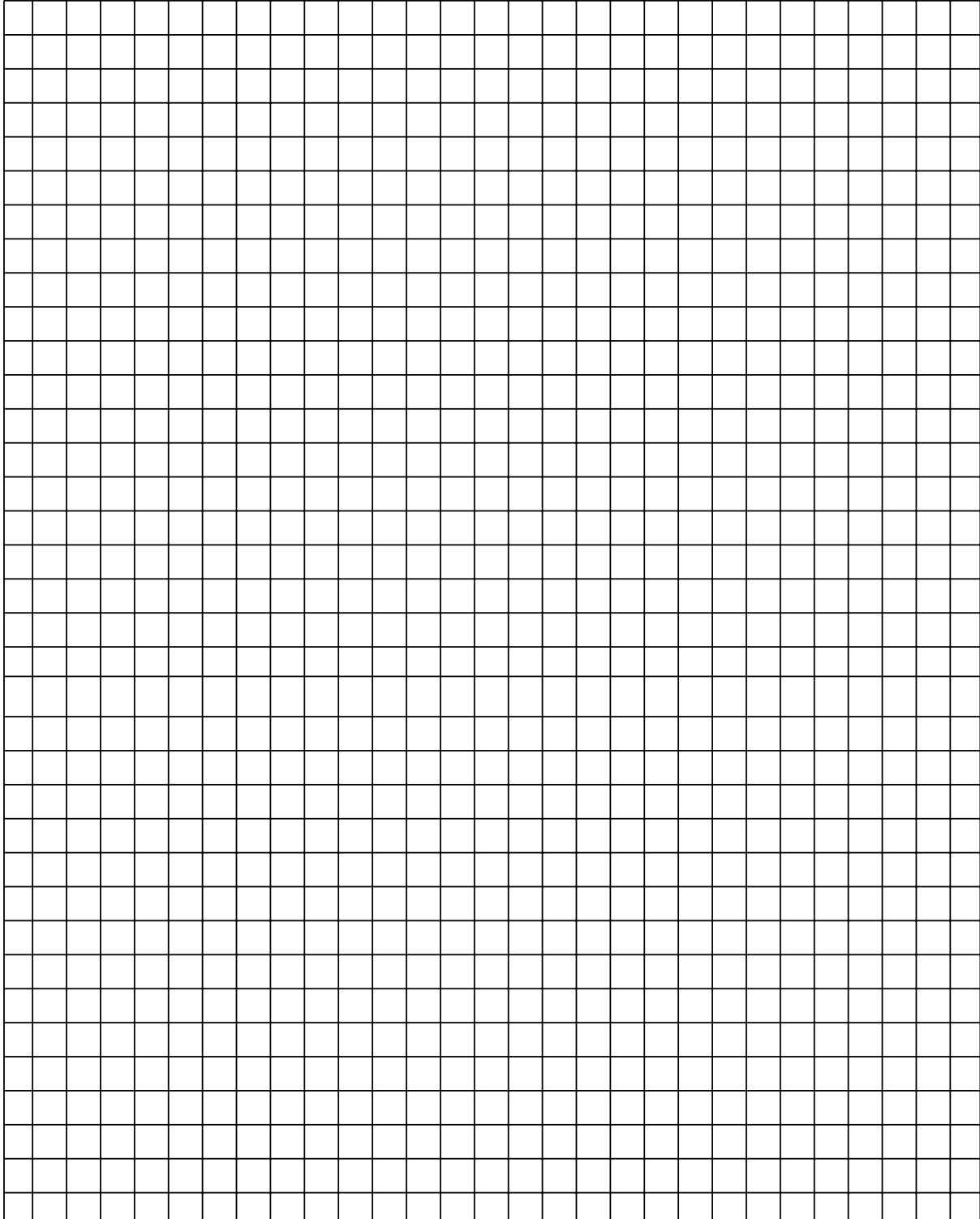
My Tree House

Design a blueprint of your tree house. Use the graph below and determine an appropriate scale.

The Case of the Unknown Stink

Part 1: What's the Stink?
Exercise 2

Key: 1 square unit = _____



Problem

What is that smell?

Materials

1. 10 black plastic film canisters with lids that have 4-5 holes punched in the top of each
2. 10 cotton balls
3. 5 different scents (suggestions: vanilla, peppermint, perfume scents, and cooking scents)
4. Permanent marker
5. Blindfold
6. Scent Control Chart (this page)
7. Student Data Chart (page 25)

Procedure

1. Place a few drops of a scent on two cotton balls.
2. Place each cotton ball in a film canister and replace the lid.
3. Using the permanent marker on the top of both lids, label them both canister "A." The other canisters will be labeled in pairs as "B," "C," "D," and "E."
4. Write the scent in the control chart.
5. Repeat Steps 1-4 with the other four canisters, putting a different scent for each pair.
6. Now you are ready to test your partners.
7. Have all partners waft the smell in canister A toward their noses. To waft, hold the container a short distance from your nose and using your other hand, wave the smell towards yourself. You never want to directly smell an unknown substance.
8. Partners will then try to guess the smell.
9. They will write their guesses on the data sheets.
10. Compare the correct answers to each partner's responses.
11. Blindfold your partners.
12. Choose one of the scents and let each partner waft it towards himself/herself.
13. Let partners smell the other scents until they find the matching scent.
14. Repeat until all scents are matched.
15. Take the blindfold off and let your partners see if they were correct!
16. Now it is your turn. Repeat the second part of the experiment, steps 11-15.

Data

Scent Control Chart

Canister A	Canister B	Canister C	Canister D	Canister E

Student Data Chart

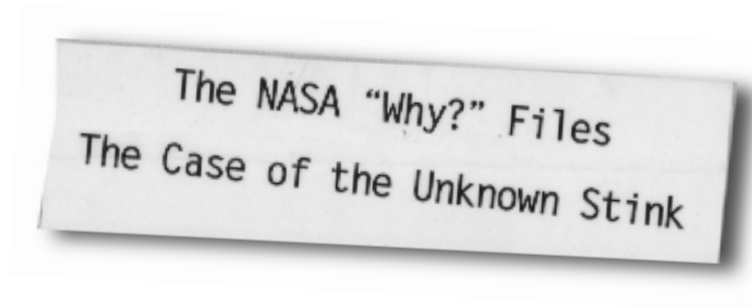
Write your guess for each canister in the appropriate blank.

Canister A	Canister B	Canister C	Canister D	Canister E

Conclusion

1. Which smell was the easiest to match?
2. Which smell was the most difficult to match?
3. Why do you think some smells were easy and some were more difficult?
4. How was your sense of smell affected while blindfolded?

Part 2



Part 2 | Search for the Stink

Age Range

Ages 8-10

Duration

15 Minutes

Science Concepts

Science as Inquiry
Science and Technology
Science in Personal and Social Perspectives
History and Nature of Science

Mathematics Concepts

Geometry and Spatial Sense
Measurement
Connections
Representation

Key Science Vocabulary

Ammonia
Hydrogen sulfide
Bacteria
Organic materials
Pollutants
Sanitation plant
Sewage
Aeration basin
Meter
Odorous substances

Program Overview Part 2 : Search for the Stink



The three tree house detectives continue their search for the solution to the cause of the curious unknown odor affecting a nearby town and threatening other towns. The children review the methods for studying science and what they have discovered thus far to help them solve the problem. They make some additions to their informational chart. The three visit a local sanitation department as a possible source of the odor. A scientist there escorts them through the waste water treatment plant, explains the steps in processing sewage and waste water, and shows how the plant uses the scientific method. After the visit, the children decide that the plant is not causing

the unpleasant odor. Meanwhile, the latest news report indicates that the odor appears to be lessening in Phewsville. However, the children know that they must continue to pursue the source of the problem in case the odor returns. Looking at a map, they find that there is a chemical plant nearby. The investigators decide to form a hypothesis based on the chemical plant as the possible cause of the bad odor. However, after their friends at school help them organize E-mail responses from the towns' residents and they analyze the data, the three detectives decide to revise their hypothesis and do some more data gathering and experimenting.

Science as Inquiry
Science and
Technology
Science in
Personal and Social
Perspectives
History and
Nature of Science

Science Concepts

Part 2 : Search for the Stink

National Science Teachers Association (NSTA) Standards

Science as Inquiry

Students develop abilities
necessary to do/to understand
scientific inquiry.

- Observe and ask questions
to identify problems.
- Plan and conduct a simple
scientific investigation.
- Compare evidence and
what is already known.

Science and Technology

Students learn how
technological systems work
to help solve problems.

- Observe technology being
used to solve problems
and perform tasks.

Science in Personal and Social Perspectives

Students understand how the
environment affects personal
health.

- Learn how science and
technology can improve
the quality of health
and sanitation.

History and Nature of Science

Students understand that
science is a human endeavor.

- Recognize that people of
all backgrounds engage
in various science career
activities.

Measurement
Data Analysis,
Statistics, and
Probability
Connections
Representation

Mathematics Concepts

Part 2 : Search for the Stink

National Council of Teachers of Mathematics (NCTM) Standards

Geometry and Spatial Sense	Connections
Students identify characteristics and properties of geometric shapes. Visualize, draw, and identify geometric shapes.	Students recognize, use, and learn about mathematics in contexts outside of mathematics. Observe the mathematics and science connections in problem solving and experiments.
Measurement	Representation
Students understand attributes, units, and systems of measurement and apply a variety of techniques, tools, and formulas for determining measurement. Use appropriate tools of measurement to collect data.	Students create and use representations to organize, record, interpret, and communicate mathematical ideas. Use graphs to mathematically represent a written image/ response to a question or problem.

Key Science Vocabulary

Part 2 : Search for the Stink

ammonia	a colorless, pungent or bitterly sharp-tasting or sharp-smelling gas used in manufacturing fertilizers and a wide variety of nitrogen-containing chemicals
hydrogen sulfide	a compound of sulfur and hydrogen, which is a colorless, odorless, and highly flammable gaseous element found in most organic compounds
bacteria	any of numerous unicellular microorganisms existing in various shapes and associated with processes such as fermentation, putrefaction, and the causation of infectious diseases in plants and animals
organic materials	substances derived from living organisms
pollutants	impurities or contaminants
sanitation plant	a building and equipment that handle the disposal of sewage and garbage for public health purposes
sewage	liquid and solid waste carried off in sewers and drains
aeration basin	an artificially enclosed area of water that charges substances with a gas and/or exposes them to fresh air for purification
meter	a device used to measure, indicate, record, or regulate
odorous substances	materials that can be perceived by a sense of smell

Before Viewing
(Questions 1-4)

After Viewing
(Questions 5-10)

Program Discussion

Part 2 : Search for the Stink

Before Viewing

1) Help the students summarize briefly what took place in the first program (*What's the Stink?*).

Three friends meet after school to watch the TV program, NASA's Kids Science News Network (KSNN). They learn that a town is being bothered by an unpleasant odor, and viewers are invited to help locate the odor's unknown source. The three friends decide to try to solve the problem. To begin their investigation, the children prepare an informational chart to determine what they know, what they need to know, and where to go for help. A neighbor, a retired science professor, gives them suggestions for informational resources and introduces them to the methods for studying science. They search for information about smells by using a computer, the internet, and a web-browser; then, they visit a NASA Langley electronics engineer to learn about conducting experiments and the role of variables.

2) Review with the students the informational chart prepared as an extension after viewing the first program (*What's the Stink?*).

Need to Know Board

What we know	What we need to know	Where to go for help
Health Department has given a warning	What's in a smell	Dr. D (science expert)
People in Phewsville smelled something bad	How a smell moves	Computer/Internet
No one knows where the smell is coming	How to experiment	NASA electronics engineer

3) If available, use the chart (page 21) prepared after viewing the first program to review the processes of the scientific method. (Remember to adapt the steps, if necessary, for third graders.)

The chart will include identifying the problem or question to be answered, asking questions about the problem, observing

and gathering data or helpful information, forming a hypothesis, testing the hypothesis, trying again if the data do not support the hypothesis, reaching a reasonable conclusion or explanation, and communicating the results to others.

4) Ask the students to predict what they think the children in the video will do next.

Accept all responses, as long as the students can support their predictions with logical reasons.

After Viewing

5) Ask the students why the children in the video used a map in their investigation.

The children located Phewsville and the adjoining towns on the map. They were especially interested in how close their town was to Phewsville. They didn't know where the odor was coming from or when the bad smell might return and spread to their town and the surrounding towns. Examining things shown on the map might give them a clue.

6) Have the students explain why the children in the video went to the waste water treatment plant at the sanitation department.

Because the sanitation department and the waste water treatment plant handled sewage and garbage, the children thought they might be the source of the unpleasant odor.

7) Ask the students if the sanitation department and the waste water treatment plant proved to be the source of the bad odor. Ask them to explain their response.

The department and plant were not the source of the bad odor because after the process was completed, the remaining water was clean and had no unpleasant odor. If an odor had remained, the process and the steps of the scientific method would have been repeated until the problem was resolved (*See "Purifying Water" page 37 and "Phew Wee" pages 39-40.*)

8) Have the students relate the latest news about the mystery odor as reported by KSNN.

KSNN reported that the stink in Phewsville appeared to be gone and that no one had reported getting sick from it.

9) Have the students explain why the children in the video are not giving up on trying to solve the problem, although the stink is no longer apparent in Phewsville.

The problem of what the stink was and what caused it has not been solved. Therefore, the bad smell might return to Phewsville or to other nearby towns unless the cause of the odor is found and a recurrence can be prevented.

10) Have the students explain the process the children in the video and their school friends used to organize the E-mail responses they had received from the residents of the nearby towns with information about the unpleasant odor.

The children in the video and their friends separated the responses by towns and then by days. This separation told them who smelled the odor and when. They next used colored pins on the map to show the data visually (*See "Our School Stinks" page 41.*)

NOTE:
The extensions can be class or individual enrichment activities and should be selected and/or adapted according to student developmental levels.

Program Extensions

Part 2 : Search for the Stink

1. Mathematics and Geography

Use a state map so the students can locate their town or city and then find/name the nearest towns or cities. Have them use the map legend to estimate the distance from their town to some of the other locations. Use a local map so the students can locate their school and the next nearest school, fire department, post office, mall, or other locations of interest.

2. Mathematics and Geography

Tell the students to imagine and then draw their own maps showing the location of Phewsville, Exville, Mid City, and Big City. (The children in the tape live in Big City.) Remind the students to devise a simple scale to indicate the distance between the towns (See "Map Quest" page 42.)

3. Mathematics and Language Arts

Ask the students to use their maps to draw a straight line connecting the towns and creating a geometric shape. Ask them to write a sentence or short paragraph naming the geometric shape most nearly like the one they made. Direct them to write why they selected the particular geometric figure.

4. Science, Mathematics, and Language Arts

Ask the students to think of the different kinds of meters that might be used in the school or around their homes. Have them make a chart with three columns showing (1) the name of the meter; (2) what the meter measures or records; and (3) the unit of measure the meter uses.

Name of meter	What it measures or records	Unit of measure
Electric meter	Electricity	Kilowatts
Thermometer	Temperature	Degrees
Speedometer	Speed	Miles per hour

5. Science and Language Arts

Ask the students to draw and label a diagram (similar to a flowchart) or to write a description of the process used by the waste water treatment plant from the time waste comes into the plant to the conclusion of the process.

6. Science and Language Arts

Have the students write a paper explaining why the work of the sanitation department and the waste water treatment plant are so essential to public health and the quality of life.

7. Science, Technology, and Language Arts

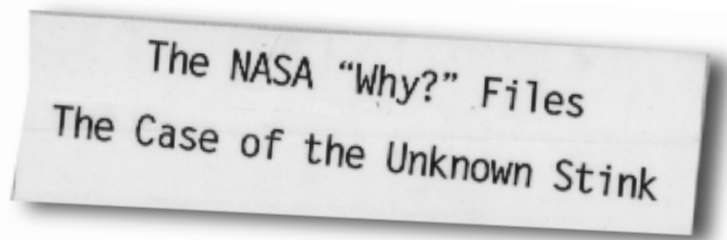
Let the students use the Internet or available print materials to learn more about ammonia and hydrogen sulfide and some of the products that contain these gaseous elements. Have the students share their findings orally or in writing.

Give the students options for further research topics: water pollution, the necessity of water for good health, the usefulness of “good” bacteria, and a particular kind of meter.

8. Science and Technology

Encourage the use of the NASA “Why?” Files web site.
<http://whyfiles.larc.nasa.gov>

Exercises



Part 2 : Search for the Stink

Problem	How is water purified?
Materials	1. gallon of water from a lake, pond, bay, or ocean 2. purification tablets (from local sporting goods store) 3. microscope 4. slides and slide covers 5. eye dropper 6. 2 beakers or 2 small containers
Procedure	1. Gather a gallon of water from a lake, pond, bay, or ocean. 2. Pour a small amount of the water in one beaker for each group. 3. Have students observe the water and write their observations on the Water Identification Chart (page 38). 4. Have students use the eye dropper to place 2-3 drops of water on a slide and cover with cover slip. Teacher Note: These items can be prepared for younger children. 5. Students will place the slide on the microscope and observe. Record observations. 6. Discuss what could possibly be in the water. Inform students that not all water is pure and often when you travel, you get sick from drinking the water. 7. Drop purification tablets into the gallon of water as per directions on label of tablets. 8. Pour a small amount of purified water into the second or empty beaker of each group. 9. Have students observe and record observations. 10. Have students make another slide for the purified water and observe under the microscope. 11. Record observations. 12. Discuss with the students why it is important to drink water only from sources that have been purified, such as a water treatment system.

Water Identification Chart

Dirty Water	Purified Water
Draw what you observe	Draw what you observe
Write a description	Write a description

Conclusion	1. What do you think is in the pond water? 2. What happened to the water once the tablets were added? 3. Why do you think it is unsafe to play in water that is found in ditches? 4. How does “dirty” water make you sick?
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Problem	What makes a landfill smell bad?
Materials	1. a large cardboard box 2. one garbage can plastic liner (trash bag) 3. masking or duct tape 4. a bag of potting soil (enough to cover the bottom of the box to a 1-2 inch depth) 5. watering can 6. water 7. students' lunch trash
Procedure	1. Cut the flaps off one end of the cardboard box. 2. Reinforce the bottom of the box with duct tape or masking tape. 3. Prepare the landfill by lining the box with the plastic liner. The liner should extend beyond the top edges of the box so that it is folded over. 4. Tape the folded edges to the outside of the box. 5. Pour potting soil in the box and distribute evenly. 6. Have students place one item left over from their lunch in the box. Make sure there is a variety of trash, including food, plastics, and paper. 7. Be sure that these items are buried and covered with dirt. 8. Water the landfill with enough water to make a mud mixture. 9. Place the landfill in an out of the way area for about a week. 10. Make sure that the landfill stays wet; water when necessary. 11. After about a week, uncover the items that were placed in the landfill. 12. Observe items and smell. 13. Discuss with students why some of the items appear to look different and some do not (the biodegrading process.) Also, discuss why there is a strong offensive smell.

1. What caused the items to smell bad?
2. How did some of the items change their appearance?
3. Why were some items affected more than others?
4. Why did we have to add water to the soil?
5. How could we reduce the odor in landfills?

Problem	Our school is having a bad smell day! Many students and teachers are complaining about a bad odor. We need to locate the source of the smell. Therefore, our 4th grade class decided to e-mail all the classes and offices to find out if everyone is smelling the offensive odor! Here are the responses we have received. Please help us organize our data by designing a chart to classify these e-mails! Let's see where the smell is coming from. We must stop the smell!	
Data	Ms. Hill-1st grade No smell in our room. Good luck! Mrs. Smith-5th grade It stinks! Mrs. Black-2nd grade No smell here. Mr. Lee-3rd grade We smell a light, faint odor that is not pleasant! Mrs. Ricks-Kindergarten Class No smell here. Mr. Williams Kindergarten Class No smell here. Mr. Hart-1st grade No smell here. Mr. Mills-Cafeteria Manager Really smelly in here. Mrs. Hope-3rd grade We smell a bad odor, but it is not very strong.	Mrs. Keeton-4th grade We are pretty smelly in here! Mrs. Everett-Janitor Lots of stinky smell in my office. Mr. Geirsch-Head Janitor Gosh it stinks in here! Ms. Chappel 4th grade We really have a stink problem! Ms. Ricles-Principal's office No smell here! Mrs. Newby-Cafeteria It stinks and it's not us! Mrs. Ellison-2nd grade No smell here! Mrs. Duell in the office. No smell in the office.
Conclusion	- Where is the smell coming from? - How do you know? - Draw a layout of the school and locate the smell.	

Map Quest

Using an atlas or map of your state, answer the following questions.

Extension

Do an internet search for maps of your local area.

1. What is the scale of your map?
2. *Measure the distance from your town to the nearest city.*
What is that distance and what is the name of the city?
3. Which direction would you have to go to get to the nearest lake?
4. *Find the Key/Legend on your map.*

What is the symbol for

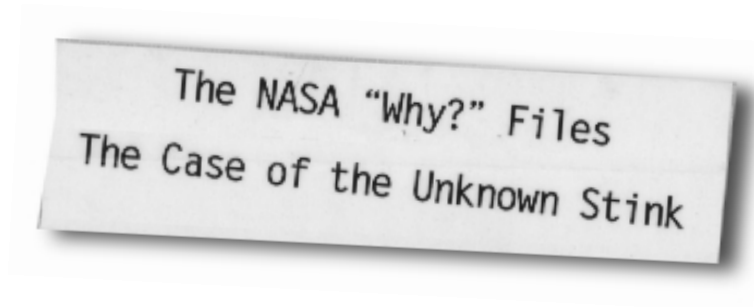
_____ Railroad track? _____ Lake?

_____ Interstate Highway? _____ River?

_____ US Highway? _____ Capital City?

5. What is the name of the city in your state with the largest population?
6. What is the capital city of your state?
7. Using the scale, determine the approximate distance across your state from east to west.
From north to south.
8. Draw a compass rose.
9. Where is your town located in your state?
Example: northwest corner.
10. Driving at 50 mph, how many hours would it take you to drive to the nearest state?

Part 3



Part 3 | We're Almost There

Age Range

Ages 8-10

Duration

15 Minutes

Science Concepts

Unifying Concepts
and Processes

Science as Inquiry

Life Science

Science and
Technology

Science in
Personal and Social
Perspectives

History and
Nature of Science

Mathematics Concepts

Patterns, Functions,
and Algebra

Measurement

Data Analysis,
Statistics, and
Probability

Connections
Representation

Key Science Vocabulary

chemical

chemical compounds

molecule

receptors

olfactory

chemoreceptors

curator

stopwatch

predictable

sampling

meter stick

Program Overview Part 3 : We're Almost There



Bianca, Jacob, and Matthew, the investigative team, continue to search for the cause of the strange, unpleasant odor that is bothering the residents of several towns. They continue to collect and analyze data, experiment, test their hypotheses, and consult with experts. They visit a doctor specializing in treating the nose (an otolaryngologist) and a museum curator who helps them learn about a shark's sense of smell. After getting advice from their neighbor, Dr. D, a retired science professor, the tree house detectives perform additional

experiments about how smells move. They elicit the help of their classmates and pay more attention to controlling the variables. Meanwhile, the latest KSNN news update reports that the stink is definitely being smelled in Big City, the children's town. The children suspect that the wind may be a variable that is playing a role in the movement of the odor, and they plan another experiment to test their idea. While they are getting closer to solving the problem, they are not there yet!

Unifying Concepts
and Processes
Science as Inquiry
Life Science
Science and
Technology
Science in
Personal and Social
Perspectives
History and
Nature of Science

Science Concepts

Part 3 : We're Almost There

National Science Teachers Association (NSTA) Standards

Unifying Concepts and Processes

Students develop an understanding that evidence consists of observations and data on which to base scientific explanations.

- Use observations, measurement tools, and experiments to gather information for basing explanations about investigations.

- Observe that organisms' patterns of behavior are related to their environment and their need for survival.

Science and Technology

Students develop abilities to understand how technological systems work to help solve problems.

- Use technological designs/tools to gather information.

Science as Inquiry

Students develop abilities necessary to do/to understand scientific inquiry.

- Observe and ask questions to identify problems.
- Plan and conduct a simple scientific investigation.
- Employ simple equipment and tools to gather data.
- Use the data to construct a reasonable explanation.

Science in Personal and Social Perspectives

Students develop an understanding of personal health.

- Learn how the nose functions in the process of smelling and how behaviors and substances, such as tobacco, can affect the sense of smell.

History and Nature of Science

Students understand that science is a human endeavor.

Life Science

Students develop an understanding of the characteristics of organisms and their environment.

- Recognize that people of all backgrounds engage in various science career activities.

Patterns, Functions,
and Algebra
Measurement
Data Analysis,
Statistics, and
Probability
Connections
Representation

Mathematics Concepts

Part 3 : We're Almost There

National Council of Teachers of Mathematics (NCTM) Standards

Patterns, Functions, and Algebra

Students understand various types of patterns and functional relationships.

- Identify and represent how a change in one variable relates to the change in a second variable.

Connections

Students recognize, use, and learn about mathematics in contexts outside of mathematics.

- Observe the mathematics and science connections in problem solving and experiments.

Measurement

Students understand attributes, units, and systems of measurement.

- Use appropriate tools of measurement to collect data.

Representation

Students emphasize mathematical representations to foster understandings.

- Create and use representations to organize, record, and communicate mathematical ideas.

Data Analysis, Statistics, and Probability

Students pose questions and collect, organize, and interpret data to answer those questions.

- Collect data using observations, measurement, and experiments.

Key Science Vocabulary

Part 3 : We're Almost There

chemical	a substance related to or produced by chemistry (the science of the composition, structure, properties, and reactions of matter) or a chemical process
chemical compounds	substances made up of a combination of two or more chemicals
molecule	a tiny bit; the smallest particle an element or compound can be divided into without changing its chemical or physical properties
receptors	specialized cells or groups of nerve endings that are especially sensitive to an alteration of some environmental factor and that respond to sensory stimuli or actions
olfactory chemoreceptors	sense of smell organs that respond to a chemical stimulus
curator	a person in charge of a collection in a museum, art gallery, or exhibit
stopwatch	a watch that can be stopped and started instantly to measure an exact duration
predictable	likely to happen, expected, known in advance
sampling	taking a sample or a small portion, especially for examination or testing; the small portion taken
meter stick	a tool or instrument for measuring, indicating, regulating, or recording a unit of measurement

Before Viewing
(Questions 1-12)

Program Discussion

Part 3 : We're Almost There

Before Viewing

1) Review the meaning of the terms hypothesis and variable.

A *hypothesis* is an estimate or "educated guess" for solving a problem based on facts, observations, and available data.

A *variable* is a change which can be controlled by the experimenter when doing an experiment or scientific investigation

2) Students summarize briefly what they remember Dr. Schechter told them about smell and how noses work.

(Answers will vary.) Smells are made up of molecules (small invisible pieces that drift in the air). The molecules enter the nose through the nostrils and reach the nose cavity where nerve endings pick up the smells. The brain identifies the smell because of its number and kind of molecules and its location in the nose cavity. It is difficult to tell whether people identify the smells exactly the same. Individuals may have other smell molecules filling their nasal cavities that may affect what and how they smell.

3) Students compare a shark's sense of smell to a human being's.

The shark has a keener sense of smell because its sense of smell is necessary for its survival as a predator. The shark's nose is specifically designed to contain more sensory cells. Its nose is larger and longer.

4) Students explain why and how the tree house detectives conducted the tree house experiment with the air spray and what conclusion they reached.

The children needed to know how smells travel. Two of them stood in a circle with eyes closed, the third sprayed some air spray, and the two experimenters used a stopwatch to measure the time it took before they smelled the sprayed odor. (Point out to the students that the children participating in the experiment kept their eyes closed, and the spray was not directed towards them.) They decided that two of them have

similar noses and that the smell traveled at the same rate of speed. However, since the E-mail data did not support these findings for the residents of the towns experiencing the mysterious odor, the children concluded that they needed to revise their hypothesis and do some more experimenting.

5) Students recall the problems Dr. D pointed out to the tree house detectives about the way the tree house smell experiment was conducted.

They were not careful with controlling the details. They did not measure to be sure that the participants were standing an equal distance apart, they did not check to see if there were any distracting smells in the tree house, and the sampling was too small.

6) Students explain why an adequate sampling is needed for all experiments.

The sampling needs to be large enough to ensure that the results are probable and that the results are not reached just by chance. If the same results are found in a large number of situations, the chances are better that the results are reliable or probable.

7) Students describe how Bianca, Matthew, and Jacob conducted the *first* smell experiment in their classroom. Structure the description by asking them to tell why the classroom students were divided into two groups and what efforts were taken to control the variables for the test conditions.

The class was divided into two groups, with each group having a specific task to help ensure that the experiment was conducted exactly the same for each participant. The two groups were “the sniffers” and “the timers and recorders.” The sniffers stood in a circle exactly two meters from the sprayer and one meter apart; they raised their hands when they smelled the spray, and

the timers/recorders used a stopwatch to note and record the times. The children shut the windows and turned off the fans and the air conditioning. They measured the distances carefully, used stopwatches for time accuracy, and controlled the air flow.

8) Students explain the results of the first experiment. Be sure to ask them why Dr. D suggested that the tree house detectives discard the numbers that deviated sharply from the others or were extremely high or low.

The numbers for the smell times were different because there were still some variations that existed (such as George’s cold). Also, some students took deep breaths, and some took little sniffs. However, except for a few extremes, the numbers were clustered or relatively close. Dr. D explained to the children that since there were only a few numbers that deviated greatly from the others, these could have been mistakes in measuring or recording. He advised them to discard these extremes because they could be misleading when the results were analyzed.

9) Students explain the latest KSNM report. Ask them what was in the report that intrigued Bianca.

The residents in Big City were now smelling something very unpleasant. The mysterious smell seemed to be moving in a different direction, and the westerly wind was not helping the situation.

10) Students explain why the tree house detectives returned to their classroom to conduct other experiments and how these experiments were different.

Since the results might have been influenced by the variations in the first experiment and to test the idea that the wind could be influencing the smell’s movement, the children decided to try another experiment. This time they used a fan

to imitate the wind. Some of the sniffers stood in front of the fan, some in back of the fan, and some to the side of the fan. The experiment was repeated several times

11) Students report the results of the experiments with the fan. Ask them what they think the implications of the results are.

It took longer for the sniffers standing in the back and to the side of the fan to smell the spray. This result occurred each time the experiment was repeated.

Accept any of the responses for which the students can give logical explanations. Try to lead the students to surmise that if the wind acts in a similar way to the fan, it may affect the direction in which the unpleasant odor travels so that residents of different towns may smell the odor at different times, depending on the direction of the wind (*See "What's Your Smell?" page 55.*)

12) Review with the students the remaining possible sources of the stink, according to the map and the known data: chemical plant, trash burning plant, paper mill, and "unknown." Have each student write a hypothesis on a post-it note. Appoint a small committee to organize the post-it responses in columns on the chalkboard or a chart. Have the committee tally and/or graph the responses for future comparison with the problem's solution (Program 4).

Keep the tally or graph so that the students can see how their responses compared with the final problem solution.

NOTE:

The extensions can be class or individual enrichment activities and should be selected and/or adapted according to student developmental levels.

Program Extensions

Part 3 : We're Almost There

1. Science, Mathematics, and Language Arts

Duplicate the smell experiment with the students. Encourage students to do as much of the planning and conducting of the experiment as appropriate. Ask them to make a drawing or diagram representing the experiment. Guide the students to make every effort to control the variables. Caution them to take safety precautions: (1) have the sniffers use goggles or blindfolds, or keep their eyes closed; and (2) direct the spray up and away from the sniffers rather than toward them. Repeat the experiment several times to make sure that the results are similar. *(NOTE: Be sure to wait a sufficient time between experiments so that the spray smell will not still be present and distort the results.)*

Students may report their findings orally and/or in writing and tell what connections they think the results may have to the cause of the mysterious odor.

2. Science and Mathematics

Students can use the numbers obtained in their class smell experiment activities to find the average time for those participants who were standing in front of the fan, those standing behind the fan, and those standing beside the fan. Have them calculate the class average.

3. Mathematics

Have the students plot the numbers of the class experiment results on a grid or bar graph for the participants in each of the three locations (refer to #2 above).

4. Science and Mathematics

Encourage the students to design a different experiment to test how smell moves. Suggest that they draw a diagram representing the directions for the experiment and write the directions. If possible, let them conduct the experiment for the class. *(NOTE: Caution the students to be aware of safety measures for their eyes and noses when using any substances as sources of the odors.) (See What's That Taste? page 56.)*

5. Science and Health

Direct the students to find the name of the medical specialty of a doctor who treats ear, nose, and throat conditions. Ask them to tell what resource they used to find the answer.

6. Science, Health, Language Arts, and Art

Have the students write a paragraph describing how smoking negatively affects the sense of smell. Suggest that they also may want to draw a poster based on their findings, encouraging people not to smoke.

7. Science and Language Arts

Ask the students to name places other than museums that might have a curator.

8. Mathematics

Students should estimate the measurements of objects within the classroom and then use appropriate measuring devices to record the actual measures in metric and U.S. Customary units. Students should compare the results of their estimate with actual measurements.

(See "Measuring Up" page 58.)

9. Science, Mathematics, Technology, and Language Arts)

Direct the students to use the Internet and/or available print materials to find and list predators other than sharks that depend on a keen sense of smell to track and trap their prey. Suggest that they prepare a chart with drawings of the predators and a scale showing the size relationship of the predators. Ask them to be prepared to share their findings with the class, including why certain predators need large or long noses.

10. Science and Language Arts

Ask the students to write a paragraph or paper telling why scientists' work is difficult and sometimes very discouraging.

11. Science, Technology, and Language Arts

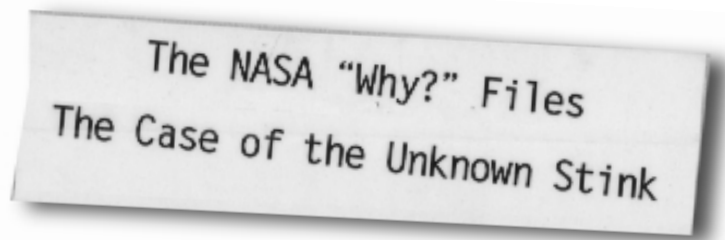
Suggest that the students use the Internet or available print materials to learn about a scientist who had to repeat his/her experiments several times and to persevere under adverse conditions before being successful. Let the students share their findings orally and/or in writing.

12. Science and Technology

Encourage the use of the NASA "Why?" Files web site.

<http://whyfiles.larc.nasa.gov>

Exercises



Part 3 : We're Almost There

What's Your Smell?

Take a survey of your class/grade/school on their favorite smell and least favorite smell. Brainstorm some ideas and decide which smells to include in your survey. After surveying the students, graph your results.

The Case of the Unknown Stink

Part 3: We're Almost There

Exercise 9

[illegible]

What's Your Smell?

Graph

The Case of the Unknown Stink

Part 3 : We're Almost There
Exercise 10

Number
of People

Smells

Materials

Apples
Oranges
Lemons
Limes
Paper plates
Knife for cutting fruit
Blindfold for each group
Napkins

Procedures

1. Group students in pairs.
2. Cut the fruit into small pieces before the activity.
3. For each group, place two pieces of each type of fruit on a paper plate.
4. Have one partner act as the tester and the other partner act as the taster.
5. The tester will blindfold the taster.
6. He/she will then ask the taster to hold his/her nose.
7. He/she will then place a piece of fruit in the taster's mouth and ask him/her to guess which fruit he/she was given.
8. The tester will record their answer on the Taste Chart on page 57.
9. Once all of the types of fruits have been tested, then the partners may change roles and repeat the experiment.
10. Compare answers.
11. Discuss why your sense of taste is not as good as it normally is when you are blindfolded and have taken away the sense of smell.

Taste Chart

The Case of the Unknown Stink

Part 3 : We're Almost There Exercise 12

Fruit	Guess
Apple	
Orange	
Lemon	
Lime	

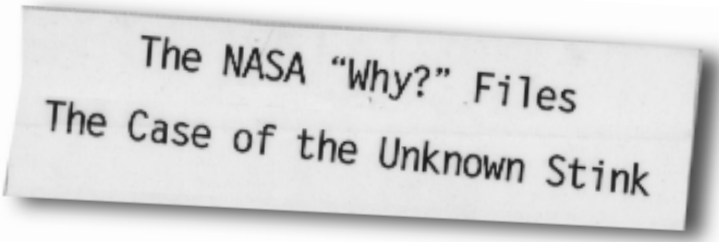
Fruit	Guess
Apple	
Orange	
Lemon	
Lime	

Measuring Up!

Use the chart below to estimate and measure objects in your classroom. Use both U.S. Customary and metric units.

Object	Estimate Customary	Actual Customary	Estimate Metric	Actual Metric

Part 4



The NASA "Why?" Files
The Case of the Unknown Stink

Part 4 | This is it!

Age Range

Ages 8-10

Duration

15 Minutes

Science Concepts

Unifying Concepts
and Processes

Science as Inquiry

Earth and
Space Science

Science and
Technology

History and
Nature of Science

Mathematics Concepts

Numbers and
Operations

Patterns, Functions,
and Algebra

Measurement

Data Analysis,
Statistics, and
Probability

Connections

Key Science Vocabulary

matrix
meteorologist
atmosphere
anemometer
clockwise
counterclockwise
satellite
kilometer
molecule
butyric acid*
ethyl alcohol*
sulfuric acid*

Program Overview

Part 4 : This is it!



The three “smell detectives” are getting very close to solving the problem of the mysterious smell. They determine that wind is definitely a factor, and they visit a weatherman (meteorologist) to find out more about the wind and the wind direction on each of the days when the towns noticed the bad odor. Dr. D suggests that they create a matrix to organize their data. The video children visit a NASA atmospheric science researcher to learn if wind can move smells long distances. The researcher describes some NASA atmospheric experiments proving that smelly gases can travel between continents and oceans. The tree house detectives, however, are still confused. The evidence points to some source near Exville, but the map does not

indicate a facility there which could be a possible cause of the bad odor. Dr. D and the children visit Exville. Much to their surprise, the stink’s source seems to be the new candy factory. After returning to his lab, Dr. D performs an experiment to demonstrate that unpleasant-smelling chemicals can produce sweet-tasting substances. The mystery is solved; the candy factory is the cause of the stink! Television station KSNM features the children telling how they used methods of science to find the solution to the problem.

To close the program series, Dr. D makes some summary comments about procedures for studying science and safety measures when doing experiments.

** Wait until after the students have viewed Program 4 to discuss the remaining key science vocabulary because the words and their meanings will “give away” the solution to the problem of the unpleasant odor source.*

Unifying Concepts
and Processes

Science as Inquiry

Earth and
Space Science

Science and
Technology

History and
Nature of Science

Science Concepts

Part 4 : This is it!

National Science Teachers Association (NSTA) Standards

Unifying Concepts and Processes

Students develop an understanding that evidence consists of observations and data on which to base scientific explanations.

- Use observations, measurement tools, and experiments to gather information for basing explanations about investigations.

Science as Inquiry

Students develop abilities necessary to do/to understand scientific inquiry.

- Observe and ask questions to identify problems.
- Employ simple equipment and tools to gather data.
- Use the data to construct a reasonable explanation.

Earth and Space Science

Students understand certain concepts about weather and how weather can be described by measurable quantities.

- Observe changes and patterns in wind direction.
- Learn about instruments used in gathering weather data.

Science and Technology

Students develop abilities to understand how technological systems work to help solve problems.

- Use technological designs/tools to gather information.

History and Nature of Science

Students understand that science is a human endeavor.

- Recognize that people of all backgrounds engage in various science career activities.

Numbers and
Operations
Patterns, Functions,
and Algebra
Measurement
Data Analysis,
Statistics, and
Probability
Connections

Mathematics Concepts

Part 4 : This is it!

National Council of Teachers of Mathematics (NCTM) Standards

Numbers and Operations

Students understand numbers and operations.

- Use computational tools and strategies fluently and estimate appropriately.

Patterns, Functions, and Algebra

Students understand and use various types of patterns, functions, symbols, and models.

- Represent and record patterns using tools such as tables and graphs.
- Understand the concept of variables and use variables to solve problems.

Measurement

Students understand attributes, units, and systems of measurement.

- Use appropriate techniques and tools for determining measurement.

Data Analysis, Statistics, and Probability

Students pose questions and collect, organize, and interpret data to answer those questions.

- Organize data by using tables and graphs.
- Use graphs and tables to analyze data and present information to an audience.

Connections

Students recognize, use, and learn about mathematics in contexts outside of mathematics.

- Observe the mathematics and science connections in problem solving and experiments.

Key Science Vocabulary

Part 4 : This is it!

matrix	a rectangular arrangement of elements in rows and columns
meteorologist	a scientist that deals with the science of the atmosphere, especially with weather and weather forecasting
atmosphere	the mass of air surrounding the Earth
anemometer	an instrument for measuring wind force and velocity (speed)
clockwise	in the same direction as the rotating hands of a clock
counterclockwise	in a direction opposite to the rotating hands of a clock
satellite	a celestial body orbiting another of larger size; a secondary planet; or a man-made object or vehicle intended to orbit the Earth, the Moon, or another celestial body and usually instrumented for the transmission of space data
kilometer	a metric unit of length (1.61 kilometers = 1 mile)
molecule	a unit of matter that is the smallest particle into which an element or compound can be divided without changing its chemical and physical properties

* **Wait until after the students have viewed Program 4** to discuss the remaining key science vocabulary, because the words and their meanings will "give away" the solution to the problem of the unpleasant odor source.

butyric acid*	an acid found especially in butter in the form of glycerides; in rancid butter, the free acid obtained as a colorless liquid of unpleasant odor; used chiefly in making esters (flavoring materials) or in cellulose for plastics
ethyl alcohol*	ordinary alcohol, often referred to as "household" or "rubbing" alcohol
sulfuric acid*	an acid produced from sulfur oxide; a highly corrosive, dense, oily liquid used to manufacture a wide variety of chemicals and materials

Before Viewing
(Questions 1-3)

After Viewing
(Questions 4-18)

Program Discussion

Part 4 : This is it!

Before Viewing

1) Have the students explain why safety measures are important in conducting all experiments. Ask the students to suggest some safety precautions for performing experiments. Have them tell how the children protected their classmates' eyes and noses during the classroom smell experiments.

The students should discuss why the safety of the experimenters must always be considered in planning and conducting experiments. Safety measures should include protecting all body parts from possible injury when using objects, tools, and substances. Encourage the students to suggest some general precautions such as wearing goggles, gloves, lab aprons, or coats; reading the labels on all substances to be used; keeping a water supply close by; and working under the supervision of an adult.

The children in the video used an "everyday" room spray that did not contain dangerous substances. The spray was never pointed directly at the participants. The sniffers kept their eyes closed, and none of the participants stood close to the sprayer. Although the action was not shown in the video, the teacher had checked to make sure that any students with allergies or respiratory problems were excluded from the experiment.

2) Ask the students to explain the pattern that the children in the video kept noticing when they analyzed the results of the classroom smell experiments. Have them tell how the pattern might be related to the reports from the towns smelling the unpleasant odor.

It always took longer for the students standing behind and beside the fan to smell the spray than for those standing in front of the fan.

If the wind was moving the bad smell, those towns directly in front of the wind's direction on a particular day would smell the odor faster and stronger than those towns located behind or beside the direction of the wind.

3) Have the students think back to Program 3 and predict what experts the children in the video will visit next.

The children in the video will visit a weatherman (meteorologist) and a NASA atmospheric science researcher.

After Viewing

4) Let the students react to the solution of the problem and the predictions they made on the post-it notes activity for Program 3.

The students will have various comments about how the candy factory was the cause of the bad odor and why they had predicted one of the other places or “unknown” as the source of the stink. They may want to share their favorite parts of the program series, their favorite characters, humorous incidents, what they learned, and so forth.

5) Ask the students to explain why/how the candy factory was the cause of the stink.

The chemicals used in making the candy had unpleasant odors until they were mixed and processed to produce the candy. The bad smells of the chemicals were escaping or being emitted into the air before they were processed. Now that they are alerted to the situation, the factory owners and managers promise to take steps to eliminate this problem (*See “Yummies for the Tummies” page 72.*)

6) Have the students explain why the children in the video had not considered the candy factory in any of their hypotheses.

The candy factory was so new that it was not on the map the children in the video were using. Also, the children might not have suspected the candy factory because they may have thought that something as pleasant-tasting as candy would not be made from something that smelled so unpleasant.

7) Ask the students how the information provided by the weatherman was useful to the three investigators in solving the stink problem.

The weatherman confirmed that the wind does affect the movement of smells. He gave the children weather maps which showed the direction of the wind on each of the days that the towns’ residents had been smelling the unpleasant odor. By using the wind direction data, the E-mail information, and the area map, the children were able to get an idea of where the stink was originating (*See “Which way does the wind blow?” page 73.*)

8) Have the students explain what a weather-person (meteorologist) does and some of the weather prediction tools that the meteorologist in the video showed the tree house detectives.

A meteorologist studies the atmosphere, especially weather. He/she knows how to use data such as temperature, air pressure, and wind direction to help predict weather conditions.

The meteorologist in the video showed the children an anemometer, a wind vane, weather maps, and a computer (*See “Weather Instruments” page 74.*)

9) Ask the students why it is important to know about the day’s weather and the prediction of the weather for several days.

Accept all responses for which the students can give logical explanations. They will probably suggest things such as knowing the most appropriate clothes to wear, what outdoor activities to plan, whether it would be a good

After Viewing (Continued)

time to travel, whether to leave pets outside for the day, how to prepare for any special weather conditions (e.g., ice or snow-storm, hurricane, and so forth).

10) Ask the students how they might prove that the wind changes directions.

Accept all responses for which the students can give logical explanations. They will probably suggest listening to radio or television weather reports, reading newspaper weather reports, observing wind socks on their home decks, or watching weather vanes on their roofs and then recording or charting the wind directions for several days.

11) Have the students describe and sketch on the chalkboard the matrix that Dr. D suggested the children in the video design to organize the information they had collected.

The matrix was a chart with columns in which the days of the week were written across the top and the names of the towns were listed along the left side. “X” symbols were used to designate the wind direction for each location on each day of the week.

12) Ask the students to summarize some of the information provided to the children in the video by the NASA atmospheric science researcher.

Tracking gases in the atmosphere is part of NASA’s atmospheric science research. The researchers use special equipment and instruments on planes and satellites. One experiment involved tracking smoke molecules from fires in South America and Africa for hundreds of kilometers or miles. The pollution traveled over much of the world. The pollution molecules will eventually react with other gases in the atmosphere to become other molecules that will be dissolved in rainwater and released from the atmosphere when it rains.

13) Assist the students with bringing their Need to Know Board up-to-date. Ask them what they observe about the chart now. (Only the additions are shown.)

Need to Know Board

What we know	What we need to know	Where to go for help
Wind moves smell		Weather person (Meteorologist)
Who smelled the odor on each day?		NASA atmospheric science researcher
What generates wind?		
Wind can change direction		
Wind direction for each day		

The students should observe that the “need to know” items have become “what we know” items.

14) Have the students summarize the steps of the scientific method that the tree house investigators used to discover what caused the stink.

After Viewing (Continued)

The children in the video identified the problem (What is the source or cause of the stink?) and asked questions about the problem. They determined what they already knew, what they needed to know, and where to go for additional information or help. They formed several different hypotheses; collected, organized, and analyzed their data; experimented; and changed their hypotheses when the data did not support their predictions. The children used observation, books, the Internet, E-mail, and experts to gather their information. They eventually solved the problem by analyzing all of their data and finding the hypothesis that was supported by the data (The candy factory is the source of the odor.)

15) List the responses on the chalkboard when you ask the students to name the various technology used in the program series to provide the information which helped solve the problem. (The important instructional concept is for the students to understand that the term **technology** refers to methods, materials, and tools used in the application of science. They are not expected to name all the specific technologies in the series.)

The students will probably name things such as these: computer, internet, E-mail, television, books, experts, map, telephone, waste water treatment plant equipment (meter, aeration basin, scrubber), receptor, stopwatch, fan, aquarium or shark tank, bar graph, matrix, anemometer, wind vane, weather map, satellite, airplane, and chemicals.

16) Explain to the students that the term "variable" can be used in mathematics as well as science.

Discuss how the terms are used to mean different things; for example, "variable" in science means something that can be controlled by the experimenter, while "variable" in mathematics can be a letter or symbol used to stand for an unknown number in equations.

If your mathematics curriculum includes equations with variables, teach or review a lesson on equations with variables and provide practice for the students in solving the equations.

17) Have the students identify a problem that the class can try to solve by using the scientific method. Work with them to seek the solution to the problem. Remind them that the scientific method can be used for any problem they may encounter in everyday life.

18) Consider introducing a weather unit at this time or correlating an ongoing weather unit with the video program.

NOTE:

The extensions can be class or individual enrichment activities and should be selected and/or adapted according to student developmental levels.

Program Extensions

Part 4 : This is it!

1. Science, Technology, and Mathematics

Ask the students to watch one of their local radio or television news programs or use a daily newspaper to chart the weather conditions for a week or longer. Suggest that they record the wind direction; the high and low temperatures; and whether there was sunshine, cloudiness, and/or precipitation. Some students may wish to make this a monthly project.

2. Science, Technology, and Language Arts

Have interested students use the Internet or available print materials for directions to construct a wind vane or gauge and demonstrate it to the class. Suggest that they use their vane/gauge to determine and chart the wind direction for a given period. Let them share their findings with the class orally and by displaying their vane/gauge and chart.

3. Science, Technology, and Language Arts

Ask interested students to use the Internet or available print materials to learn more about meteorology as a career. Have them write a paper telling about the job tasks, training requirements, and special skills needed to be a meteorologist. Have them include why they would or would not like to be a meteorologist.

4. Science and Language Arts

Have the students select an occupation (other than meteorologist) that they feel is dependent on the weather and write a paragraph explaining why they believe the occupation is affected by the weather. They may include an occupation such as a construction worker, bus driver, pilot, landscaper, farmer, or professional skier.

5. Science and Mathematics

Have the students suggest data that could be recorded on a matrix and have them design a matrix of their own and record data of their choice. For example, they might chart (1) their test grades for a week, (2) the height and/or weight of their friends, or (3) the number of points scored by their favorite professional basketball player in a certain number of games.

6. Science and Language Arts

Discuss with the students whether they think it is important to study and track world pollution and tell why or why not.

7. Science, Technology, Language Arts, and Art

Have the students use the Internet or other available print materials to write a paper about the particular kind of pollution that most concerns them; why they are concerned; and what, if anything, is being done to improve the pollution problem. Suggest that they draw a poster asking people to help reduce or eliminate that particular kind of pollution.

8. Mathematics and Geography

Have the students locate the continents of South America and Africa on a globe or map. Ask the students to use the map scale, if one is available, to estimate the distance from South America to their location in the United States and from Africa to their location in the United States.

Have the students convert the estimated distances from miles to kilometers (miles $\times$ 1.61). For additional practice, give the students some other distances (in statute miles) to convert to kilometers and/or from kilometers to miles (kilometers $\times$ 0.62).

9. Mathematics and Language Arts

Have small groups of students work together as researchers to conduct a survey among their friends, neighbors, or family to find the farthest distance that the people surveyed have traveled from home to another destination on a one-way trip. Direct the students to chart or graph their results and report the findings to the class orally.

10. Science, Mathematics, and Language Arts

Remind the students that they “met” a number of experts in the program series (science professor, NASA electronics engineer, NASA atmospheric science researcher, otolaryngologist, meteorologist, waste water treatment plant scientist, and museum curator). Ask the students to select one of the experts and write a paper telling why that particular expert needed science and mathematics courses in school when he/she was preparing for his/her career. Include how the expert uses both science and mathematics in performing his/her job.

11. Science and Language Arts

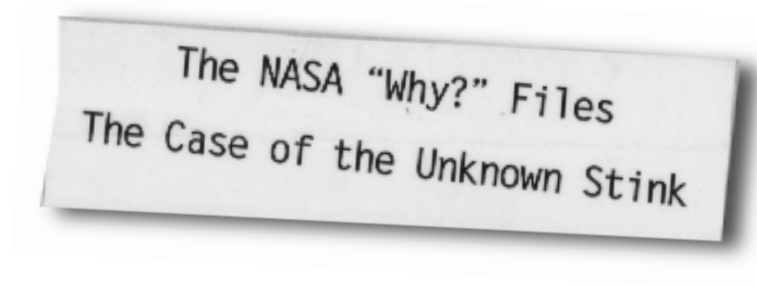
Let the students choose their favorite character in the program series and write a paragraph telling why they picked the particular character and how that character contributed to solving the stink problem.

12. Science and Technology

Encourage the use of the NASA “Why?” Files web site.

<http://whyfiles.larc.nasa.gov>

Exercises



Part 4 : This is it!

Review	In the video, the Tree House Detectives discovered it was the candy factory that was creating the stink. However, not all candy making has to smell bad. Here is a quick recipe for you to follow to make your own sweet smelling candy.
The Recipe	Peanut Butter Balls <i>For students who are allergic to peanuts, you can leave out the peanut butter and add a teaspoon of vanilla.</i>
Ingredients	• 1 box of 10x confectioner's sugar • 1 stick butter or margarine • 3/4 cup peanut butter • 10 plain chocolate bars • toothpicks • waxed paper
Steps	1) Allow butter or margarine to soften. 2) Add sugar and thoroughly combine. 3) Last, add the peanut butter (or vanilla) and knead the mixture until smooth. 4) Pinch off small amounts and roll into 1 inch balls.
Adult Must Do Steps 5 -7	5) Melt chocolate in a double boiler or in microwave. 6) Students will now insert a toothpick into their peanut butter ball and dip into the melted chocolate if desired. 7) Place on waxed paper until cooled and the chocolate has hardened.
Eat and Enjoy!	8) Be sure you smell the chocolate and peanut butter to better enjoy the taste.

Which way does the wind blow?

Using a wind vane and compass, go outside and make recordings of the direction of the wind at the same time each day for the AM and repeat for the PM. Record your observations in the chart and compare. Determine if there is a pattern in wind direction.

The Case of the Unknown Stink

Part 4: This is it!
Exercise 13

Date	Time AM	Wind Direction	Time PM	Wind Direction

Conclusion

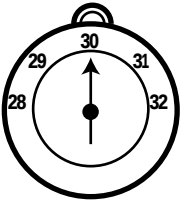
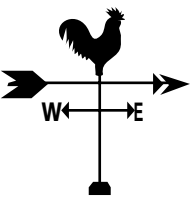
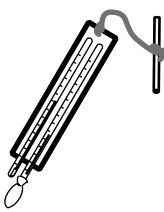
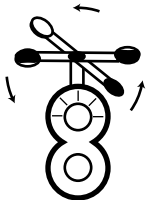
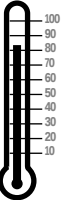
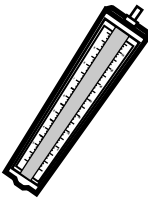
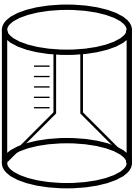
1. Did the wind blow from the same direction each day?
2. Did the wind always blow from the same directions in the AM? PM?
3. Explain your answers and why you think it is so.

Weather Instruments

The Case of the Unknown Stink

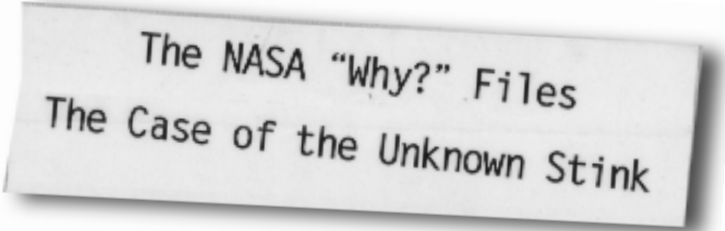
Part 4 : This is it!
Exercise 14

Match each weather instrument to its definition.

A  Barometer	B  Wind Vane	C  Psychrometer	D  Anemometer
E  Thermometer	F  Wind Meter	G  Hygrometer	H  Rain Gauge

- _____ 1. Measures wind speed.
- _____ 2. Tells from which direction the wind is blowing.
- _____ 3. Measures wind speed.
- _____ 4. Measures air pressure.
- _____ 5. Measures air temperature.
- _____ 6. Measures humidity.
- _____ 7. Measures humidity.
- _____ 8. Measures the amount of precipitation.

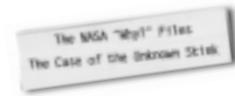
Related Literature



The NASA "Why?" Files
The Case of the Unknown Stink

The Case

Related Children's Literature



Kramer, Stephen P.:

How to Think Like a Scientist: Answering Questions by the Scientific Method.

Thomas Y. Crowell, (1997). ISBN 0690045654

Carey, Stephen S.: *A Beginner's Guide to Scientific Method.* International Thomson Publishing, (1997). ISBN 0534528430

Kneidel, Sally S.: *Creepy Crawlies and the Scientific Method: More Than 100 Hands-On Science Experiments for Children.* Fulcrum Publishing, (1993). ISBN 155511188

Sprung, Barbara and Patricia B. Campbell, and Merle Froschi: *What Will Happen If...-Young Children and the Scientific Method.* Educational Equity Concepts Incorporated, (1985). ISBN 0931629020

Parker, Steve: *Shocking, Slimy, Stinky, Shiny Science Experiments.* Sterling Publishing Company Inc., New York, (1998). ISBN 080696295X

Markle, Sandra: *Measuring Up!: Experiments, Puzzles, and Games Exploring Measurement.* Atheneum, (1995) ISBN 0689319045

Levine, Shar and Leslie Johnstone: *The Microscope Book.* Sterling Publishing Company, New York, (1996). ISBN 0806948981

Hickman, Pamela: *Animal Senses: How Animals See, Hear, Taste, Smell and Feel.* Kids Can Press, (1998). ISBN 1550744232

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