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ABSTRACT

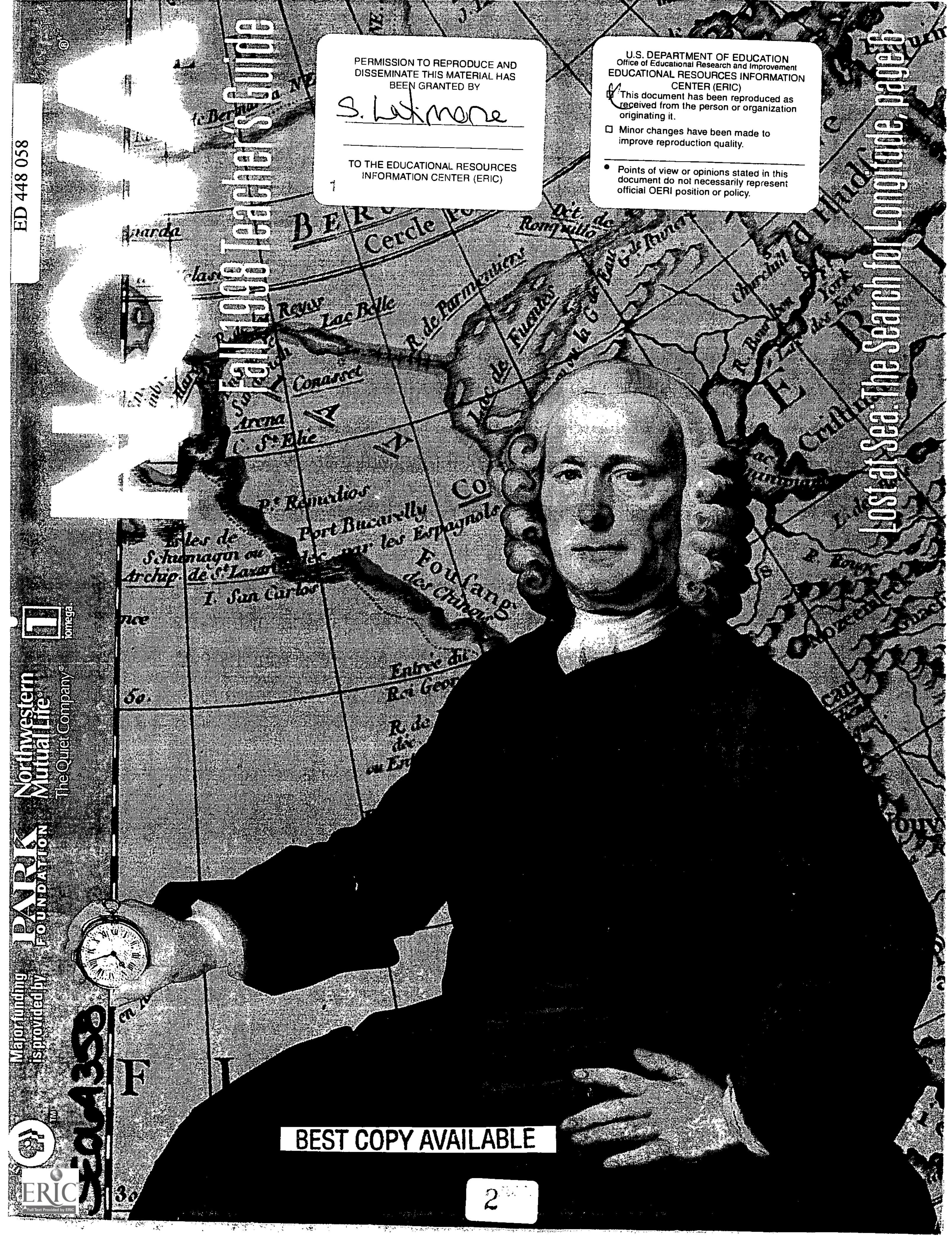
This teacher's guide is designed to accompany the PBS television program "NOVA." Six science activities correspond to: (1) "Lost at Sea: The Search for Longitude,, which researches and charts the shortest course to circumnavigate the globe; (2) "Chasing El Nino," which formulates a question and designs an experiment to evaluate the accuracy of weather folklore; (3) "Terror in Space," which explores the concept of center of mass and experiments with how altering the location of an object's center of mass can affect its motion; (4) "Special Effects: Titanic and Beyond," which investigates how geometry plays a role in perspective; (5) "Deadly Shadow of Vesuvius," which collects data and create maps to observe the relationship between volcanoes, earthquakes, and lithospheric plates; and (6) "Ice Mummies," which investigates the rate of microbial growth at different temperatures, and analyzes and interprets information in order to locate an archaeological site. All activities include a list of the National Science Education Standards addressed. (YDS)

ED 448 058

NOVA®

Fall 1998 Teacher's Guide

Lost at Sea: The Search for Longitude, page 6



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As an educator, you deal with the future on a daily basis. More than that – you deal with it on a first-name basis. Every Lisa and Michael and Maria and Tyrone is a representative of future generations to be touched and inspired by your gift for teaching.

I understand how important you are to the future. Because at Northwestern Mutual Life, the future is our business, too: every day, we're helping people make personal and financial plans that will serve them well throughout their lives.

From one future-watcher to another, it is a pleasure to present you with the fall issue of the NOVA Teacher's Guide. I think you'll find this season's offerings to be rich with stimulating material for your classroom. And as proud sponsors of this award-winning educational television series, everyone here at Northwestern Mutual Life thanks you for your dedication to shaping the future.

James D. Ericson

James D. Ericson
President and Chief Executive Officer

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Because of schedule changes and space constraints, some NOVA programs do not have lessons.

* one-year off-air taping rights
** seven-day off-air taping rights

(R) indicates a repeat program from a previous NOVA season.

📕 Lesson within this guide.

💻 Lesson online at: **http://www.pbs.org/nova/teachers/teachersguide.html**

25 Years and Still Going

Dear Educators,

This season marks NOVA's 25th anniversary in science programming and education. As the highest-rated year-round series on the PBS prime-time lineup, NOVA has defined science television for the United States and the world. Each program is watched by an average of 30 million people a month. NOVA's films are seen by viewers in more than 50 countries, from Australia to Zimbabwe. This guide is sent to more than 80,000 teachers. We are grateful for everything you do to help students discover the rewards of science.

Since our birth 25 years ago, NOVA has evolved to meet the ever-changing, rapidly-expanding needs of our viewers. Never before have our lives been so intimately linked with science and technology nor has knowledge held so much power. Our goal is to bolster and promote science literacy in the best way we know how through a variety of mediums: television, NOVA Online, and print, most notably the *Teacher's Guide.*

We have taken the opportunity of this anniversary season to revise the *NOVA Teacher's Guide* to help bring you and your students into next century's world of science education. For each program, you'll find an expanded lesson that now includes:

- a video overview that more closely defines program content;
- alignment to the National Science Education Standards;
- ideas for before and after watching to help you understand prior student knowledge, reacquaint you with the program's geographical locations, and prepare students for the program's content;
- activity setup instructions for you, including a materials list and extension ideas;
- reproducible student activity pages to guide students through each activity;
- explanations of each activity's outcome, with information to help you answer student questions; and
- annotated resources, including books, articles and Web sites.

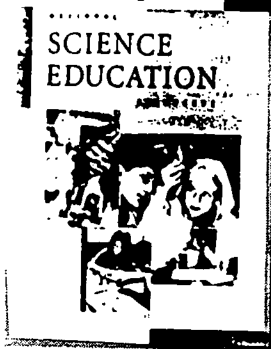
To accommodate the added material, we have more than doubled the space for our lesson plans. We hope that you like the changes we've made. We look forward to bringing you NOVA for the next 25 years and beyond.

Paula S. Apsell

Paula S. Apsell
NOVA Executive Producer

A Word About the Standards

Increasingly, schools are moving toward teaching with standards-based curricula. NOVA exemplifies the philosophy of such teaching by illustrating the realities of science and science process through topical issues. To help you identify where NOVA and its *Teacher's Guide* activities fit into such a curriculum, we have added a section to each lesson detailing how its activity aligns with the National Research Council's *National Science Education Standards* (our lessons also align with many of Project 2061's *Benchmarks for Science Literacy).* Additionally, where appropriate, we have provided connections to the *Curriculum and Evaluation Standards for School Mathematics* (published by the National Council of Teachers of Mathematics).



Because this guide is designed to help facilitate use of NOVA programs in the classroom and is not meant to be an entire curriculum, we provide lessons that allow you entry points into addressing fundamental understandings from the standards and the flexibility to customize each lesson to best meet the needs of your students.

Teaching Tips

When using these lessons, keep in mind the following:

- Explain activity concept within your larger unit.
- Consider students' prior knowledge and possible misconceptions about the science concept you're teaching.
- Provide students with several first-hand experiences of the science concept before introducing terminology.
- Work with students to develop a rubric within which their work will be measured.

Check Out Our Teachers Site

http://www.pbs.org/nova/teachers

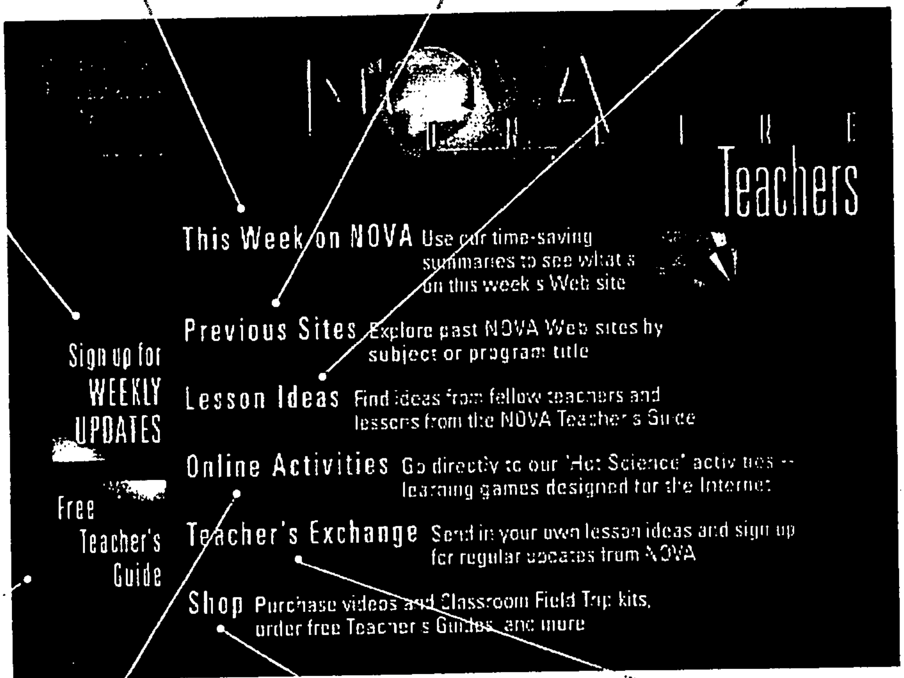
This Week on NOVA
This section features a listing of the science articles, features and activities on the Web site that accompany the most recent NOVA program. Brief descriptions and grade-level designations are provided for everything on the site.

Previous Sites
This section provides access by program title or subject area to Web content for previous NOVA programs.

Lesson Ideas
In this section, you'll find ideas from your colleagues and lesson plans from this teacher's guide to help you integrate current and past NOVA programs and NOVA Online Web sites into your curriculum.

Sign Up for Weekly Updates

Would you like to know what's coming up on NOVA each week, both on television and the Web site? Join our mailing list and find out. Each week we'll send you a reminder of the date and title of the following week's broadcast, and what you'll find online to help you integrate the Web into your curriculum. And we'll keep you abreast of any special programs or online adventures we're planning. Sign up at the Web site above.



Teacher's Guide
Sign up to receive your free teacher's guide by mail.

Online Activities
Click here to go to our activities designed especially for the Internet.

Shop
The shop gives you access to NOVA programs available for purchase and lists other educational products we offer.

Teacher's Exchange
Here you can swap ideas with other teachers about how you use NOVA, or sign up to receive updates on upcoming NOVA programs.

Visit Us at NOVA Online!

Find Web Sites for Each New Program

NOVA Online brings you new content each week throughout the Fall season. See each lesson in this guide for details or visit our Web site at:
http://www.pbs.org/nova

Participate in the Fall NOVA/PBS Online Adventure

Island of the Sharks
http://www.pbs.org/nova/cocos
Join noted underwater filmmakers as they dive into the waters of the Pacific Ocean's Cocos Island to shoot an IMAX/OMNIMAX® film on the biodiversity, ecosystem and conservation aspects of the island. For one month, NOVA will update the Web site with digital dispatches and images. **Launch date: September 23, 1998**

NOVA in the Classroom

NOVA's 25 Classrooms

As NOVA celebrates its 25th anniversary and looks ahead to the next 25 years, the NOVA education team is kicking off an initiative to make its classroom materials more effective. We've called on 25 middle and high school teachers to help us reach this goal.

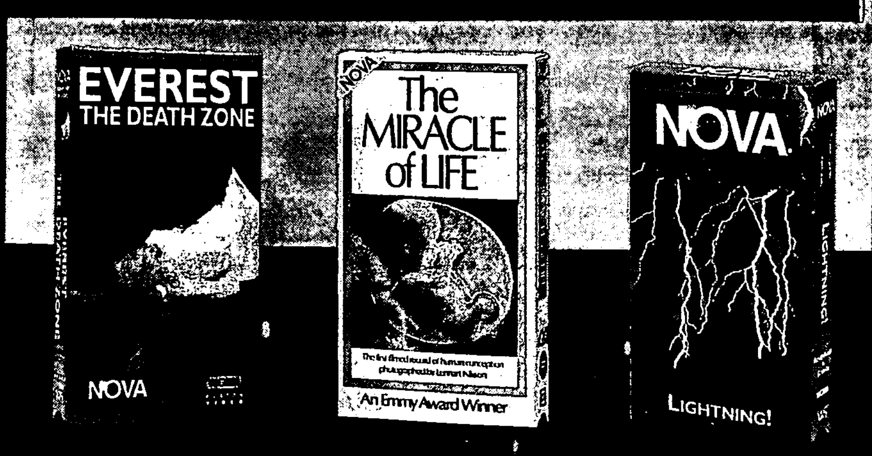
This means you will:

- **receive materials evaluated by teachers like yourself.** Our nationwide group of NOVA teachers will provide in-depth feedback on our programs, teacher's guide lessons, and Web sites. Their ideas—as well as those from our long-standing local teacher advisory board—will help us revise current materials and shape new ones.
- **have additional NOVA ideas and projects from which to choose.** Each NOVA teacher will develop a special project using NOVA resources—including in-service workshops, articles about NOVA, or multimedia lesson plans.
- **learn how you can be involved in the NOVA Challenge.** This Web event—designed especially for your students—will be held during National Science and Technology Week in April 1999. Questions for the challenge will be based on content from the 1998–99 season of NOVA programs and NOVA Online sites, and will promote active viewing and learning of science concepts. Look for hints and questions on NOVA Online throughout the year to help prepare your students. Winners will be chosen in a random drawing. Prizes will be awarded.

Look for updates about these projects and more in upcoming *NOVA Teachers' Guides* and on NOVA Online: http://www.pbs.org/nova

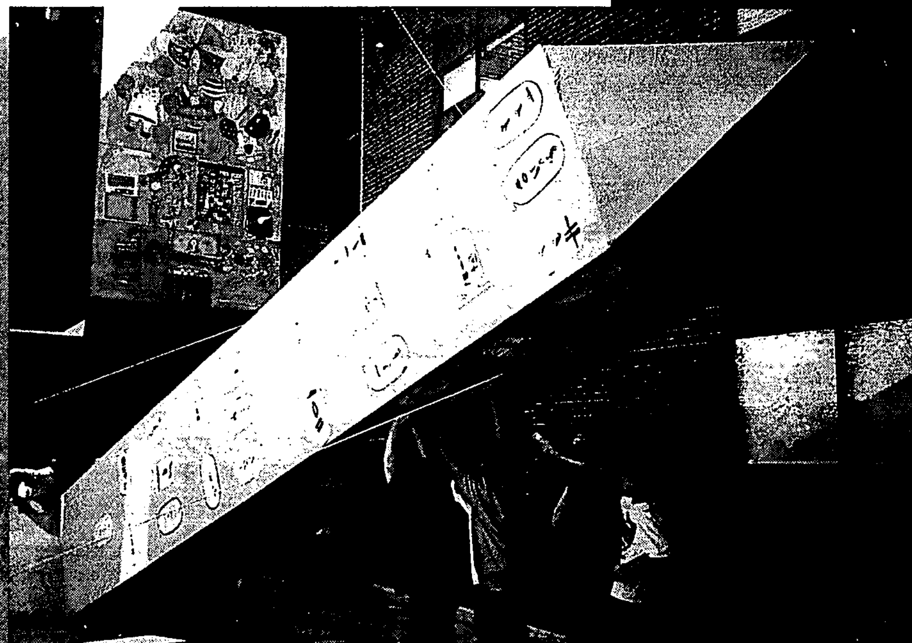
NOVA Videos 50% Off

In celebration of NOVA's 25th season, we're offering educators a special on all of our NOVA videos: 50 percent off on orders received by June 30, 1999. In addition, teachers who fill out and send back the business reply card in this guide will be entered into a drawing to win a free one-hour NOVA video of their choice. See page 40 for details.



Operation Obelisk

Students worked together to build and raise their 27-foot-tall Egyptian obelisk.



When sixth-grade social studies teacher Tim Matthews decided he wanted to teach an interdisciplinary unit on ancient civilizations, he used the Spring 1997 *NOVA Teacher's Guide* to jump-start his thinking. The guide featured lessons to accompany the four-part series "Secrets of Lost Empires," and focused on the social studies aspects of ancient civilizations and the use of simple machines to raise massive objects such as Stonehenge's trilithons or the Egyptian obelisks.

Matthews worked with fellow science, mathematics and English teachers at Day Middle School in Newton, Massachusetts, to devise a plan: The teachers would introduce their 90 students to simple machines, scale and measurement, Egyptian history, and hieroglyphics during their 45-minute team period, scheduled four days a week.

In "Operation Obelisk: How Will We Raise the Obelisk?" students were asked to use any of six simple machines they learned about to develop a plan for raising a wood-frame 27-foot obelisk in the school courtyard. Students were to include an accurate drawing of how their simple machine would work, a description of how the obelisk would be raised, and a list of the materials needed.

As with any new unit, some goals were met more successfully than others. Matthews, who hopes to do the unit again, said next time he would simplify the number of concepts being taught. As assessment tools, Matthews created a process rubric to evaluate understanding of math terminology, building terms and abilities with manipulatives; and a product rubric for students to chart their own learning.

Matthews found out about the *NOVA Teacher's Guide* through copies passed down by a former teacher, and has now signed up for his own free subscription. "The benefit of the guide for me," he said, "is that it makes connections that I might not necessarily have made."

For your **free subscription** to this semiannual guide, please send us a note with your name, address, and the grades and subjects you teach to:

NOVA Teacher's Guide
WGBH, 125 Western Avenue
Boston, MA 02134
E-mail:
WGBH_Materials_Request@wgbh.org

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Become a NOVA Featured Teacher

We'd like to hear from YOU! Tell us how you're using a NOVA program or NOVA Online in your classroom. Write up your ideas at:
http://www.pbs.org/nova/teachers/teacherex.html
and we'll post them in our Lesson Ideas section. Or send your ideas to:

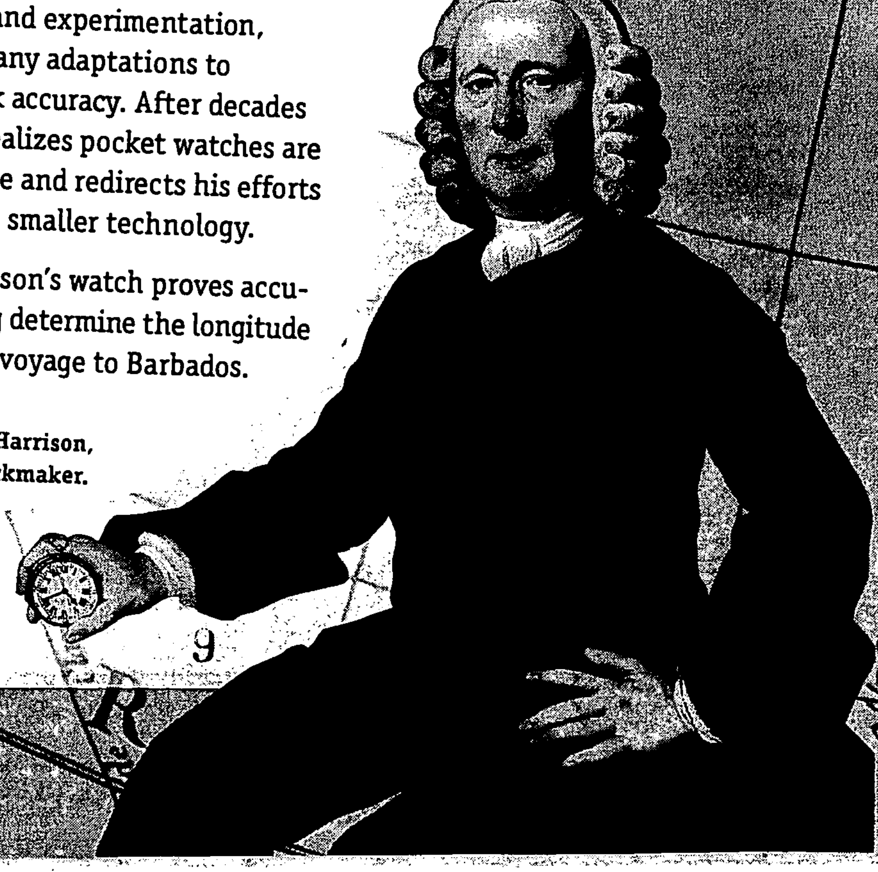
Jenny Lisle
WGBH, 125 Western Avenue
Boston, MA 02134

If we choose to feature your classroom in the *NOVA Teacher's Guide*, we'll send you and your students six free NOVA videos or two Classroom Field Trip kits of your choice.

Program Contents

NOVA chronicles the seventeenth-century journey to determine longitude.

- In 1714, following a maritime disaster, British Parliament offers £20,000 for the first reliable method of determining longitude on a ship at sea.
- It is known that longitude can be found by comparing a ship's local time to the time at the port of origin. The challenge is finding a clock—a chronometer—that can keep time at sea, where temperature changes, humidity, gravity and a ship's movement affect accuracy.
- Early attempts are based on the assumption that astronomy can solve the problem.
- Self-taught clockmaker John Harrison believes the answer lies in large mechanical clocks. Through careful observation and experimentation, he invents many adaptations to improve clock accuracy. After decades of work, he realizes pocket watches are a better choice and redirects his efforts to pursue this smaller technology.
- In 1764, Harrison's watch proves accurate in helping determine the longitude on a six-week voyage to Barbados.



Portrait of John Harrison, a self-taught clockmaker.

Before Watching

1 Review latitude and longitude with students. Have students select a few locations on a map or globe and identify them by latitude and longitude. Give groups of students a marker and an orange or grapefruit, representing the Earth. Ask them to draw and label lines of latitude and longitude on the fruit and locate where East meets West *(at 180° longitude—site*

After Watching

1 It was commonly believed in the 1700s that the secret to finding your longitude at sea was knowing the time in two places: your ship's port of origin and its current location. Ask students to explain how knowing the time in two places can help determine longitude.

of the international date line). Have students find a way to make the lines equiangular *(for example, they might cut the orange in half and use a protractor to mark equiangular segments)*. Have students approximate where their city is on the fruit model of the Earth and then confirm latitude and longitude using a map.

Activity Setup

Objective

To research and chart the shortest course to circumnavigate the globe.

Materials for each group

- copies of the **Voyage Around the World** activity sheets on pages 8–9
- world map, globe or atlas, with a scale
- small tacks, pins or self-stick notes (for marking locations)
- a 12-inch piece of string (for measuring distances)

Procedure

1 Organize students into groups and distribute activity sheets and materials to each group. Explain that the challenge is to research and chart a course that takes them to each Checkpoint Destination on their way around the world once. Have students review the Nautical Rules and Checkpoint Destinations before beginning. (You may delete or change Checkpoint Destinations to best suit your students' abilities.)

2 Have students research locations that match the Checkpoint descriptions, plot these locations on a map, record the latitude and longitude for each, and plan their course from one location to the next. Then have them estimate the distance between locations, using the string and a map scale.

3 When teams have completed their routes, have them exchange maps and recording charts to compare Checkpoint locations and estimated distances. Then, as a class, come up with the shortest route possible.

4 As an **extension**, you can have students convert the estimated distances from statute miles to nautical miles.

Standards Connection

The activity found on pages 8–9 aligns with the following **National Science Education Standards** and **Curriculum and Evaluation Standards for School Mathematics.**

Grades 5–8

Science Standard G: History and Nature of Science

Science as a human endeavor

• Science requires different abilities, depending on such factors as the field of study and type of inquiry. Science is very much a human endeavor, and the work of science relies on basic human qualities, such as reasoning, insight, energy, skill and creativity—as well as on scientific habits of mind, such as intellectual honesty, tolerance of ambiguity, skepticism and openness to new ideas.

Mathematics Standard 7: Computation and Estimation

Mathematics Standard 13: Measurement

Grades 9–12

Science Standard G: History and Nature of Science

Science as a human endeavor

• Individuals and teams have contributed and will continue to contribute to the scientific enterprise. Doing science or engineering can be as simple as an individual conducting field studies or as complex as hundreds of people working on a major scientific question or technological problem.

Voyage Around the World

You are about to embark on a voyage around the world. Your mission is to chart a course that will take you to each Checkpoint Destination on your way around the globe once. Bon voyage!

Materials for your group

- world map, globe, or atlas, with a scale
- small tacks, pins or self-stick notes (for marking locations)
- a 12-inch piece of string (for measuring distances)

Procedure

1 Read the Nautical Rules.

2 Review the Checkpoint Destination descriptions. Research and find locations that match each Checkpoint, which you must visit in order. Your goal is to visit every Checkpoint **and** circumnavigate the globe.

3 On a world map, globe or atlas mark the locations you've chosen for each Checkpoint. Record the location and its latitude and longitude for each Checkpoint.

4 Plan a course from one Checkpoint to the next and estimate the distance between each location, using the string and map scale. Then calculate the total distance for the entire voyage.

5 Trade recording charts with another team and check that team's course and distance measurements.

6 Once you have checked another team's course, work as a class to chart the shortest course around the world.

Nautical Rules

- **Begin and end your trip in Greenwich, England.**
- **Circumnavigate the globe once.**
- **Visit every Checkpoint Destination. (Each Checkpoint must be a different location.)**
- **Visit the Checkpoints in order.**

Checkpoint Destination	Location	Latitude and Longitude	Estimated Distance from Previous Checkpoint
1 Start in Greenwich, England.	Greenwich, England	51°29′ N, 0°00′ W	0 miles
2 Dodge an iceberg.			
3 Dock next to a cruise ship.			
4 Stop at a Spanish-speaking port.			
5 Stop at an English-speaking port.			
6 View a high mountain from a port.			
7 Visit a major oil-supplying port.			
8 Photograph a kangaroo.			
9 Sight a penguin.			
10 Collect exotic spices.			
11 Have lunch in a country where rice is a dietary mainstay.			
12 Visit a country that has changed its name within the past 50 years.			
13 End in Greenwich, England.			
		Total Distance	

Activity Answer

Because the Checkpoint Destinations are open-ended, the locations and courses students choose will vary (see sample course below). When students present their locations, courses and estimated distances, they should be able to explain why each location matches the Checkpoint description, how they chose the course, and the method they used for estimating distances. Most maps students will be using show statute miles, the unit of measurement for distances on land. Distances at sea are measured in nautical miles. A nautical mile is found by dividing the Earth into 360 degrees, and then dividing each degree into 60 minutes. One nautical mile equals one minute, or 1/21,600 of the Earth's circumference. Students can convert statute miles to nautical miles by dividing the number of statute miles by 1.1508.

Sample Course

Checkpoint Destination	Location	Latitude and Longitude	Estimated Distance from Previous Checkpoint
1 Start in Greenwich, England.	Greenwich, England	51°29′ N, 0°00′ W	0 miles
2 Dodge an iceberg.	Reykjavik, Iceland	64°09′ N, 21°58′ W	1,230 miles
3 Dock next to a cruise ship.	St. Thomas, U.S. Virgin Islands	18°20′ N, 64°55′ W	4,010 miles
4 Stop at a Spanish-speaking port.	Panama Canal	9°10′ N, 79°37′ W	1,540 miles
5 Stop at an English-speaking port.	Los Angeles, California	34°00′ N, 118°15′ W	3,700 miles
6 View a high mountain from a port.	(Mt. Rainier) Seattle, Washington	47°35′ N, 122°20′ W	1,540 miles
7 Visit a major oil-supplying port.	Valdez, Alaska	61°07′ N, 146°17′ W	1,230 miles
8 Photograph a kangaroo.	Sydney, Australia	33°55′ S, 151°10′ E	9,560 miles
9 Sight a penguin.	Balleny Islands, Antarctica	66°30′ S, 163°00′ E	2,470 miles
10 Collect exotic spices.	Jakarta, Indonesia	6°09′ S, 106°49′ E	4,320 miles
11 Have lunch in a country where rice is a dietary mainstay.	Singapore	1°17′ N, 103°51′ E	620 miles
12 Visit a country that has changed its name within the past 50 years.	Sri Lanka (Ceylon)	7°30′ N, 81°50′ E	1,540 miles
13 End in Greenwich, England.	Greenwich, England	51°29′ N, 0°00′ W	8,020 miles
		Total Distance	**39,780 (statute miles)** **34,567 (nautical miles)**

Resources

Books

Hobden, Heather, and Mervyn Hobden. *John Harrison and the Problem of Longitude.* Lincoln, England: Cosmic Elk, 1989. Includes a history of John Harrison and his invention of the maritime chronometer, which solved the problem of finding longitude at sea.

Sobel, Dava. *Longitude: The True Story of a Lone Genius Who Solved the Greatest Scientific Problem of His Time.* New York: Walker, 1995. Takes the reader back to the maritime world of 1714, when finding the solution to the problem of determining longitude at sea was of the highest scientific, political and economic priority.

Web Sites

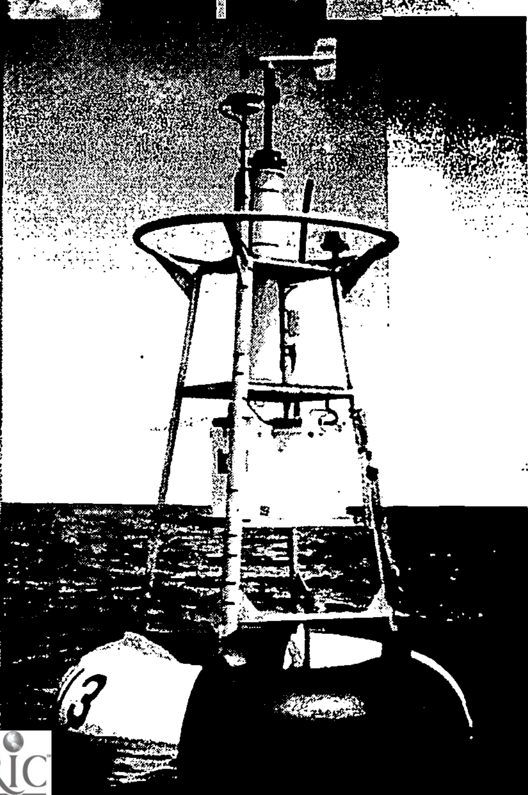
NOVA Online—Lost at Sea: The Search for Longitude
http://www.pbs.org/nova/longitude/
Will include an interactive game that provides a way to understand why knowing the time at your home port allows you to fix your longitude at sea. The site will also feature how the Global Positioning System works, a time line of ancient navigation, and contributions from leading experts on what they believe are some of the greatest scientific challenges of our day.
Launch date: October 6, 1998.

Airs the Week of October 13, 1998

Program Contents

NOVA examines the effects of past and present El Niños on global weather and follows the work of scientists who are trying to understand and predict this phenomenon.

- Scientists use computer models to describe the climate cycle that produces El Niño.
- In 1984, the National Oceanic and Atmospheric Administration (NOAA) begins building the Tropical Atmosphere Ocean (TAO) array, a network of buoys that measure surface winds, surface temperature, upper ocean temperature and ocean currents. By 1994, the first El Niño early warning system is in place.
- Scientists are unable to predict the '82–'83 El Niño due to a volcanic eruption that obscures the vision of satellites, falsely lowering the readings of sea surface temperatures by a few degrees.
- With the help of data collected by the TAO array, scientists forecast the oncoming of the '97–'98 El Niño. Even so, predictions do not accurately project the magnitude and rapid development of this El Niño.
- By flying a plane into a storm, meteorologists collect data on wind speed, temperature, rainfall and atmospheric pressure. They use this information to forecast where the storm's precipitation will fall.



Drifter buoys are part of the TAO array, which measures variables such as atmospheric pressure, air and sea temperature, wind speed and wind direction.

Before Watching

1 El Niño is a term originally used to describe the warm surface current that usually appears every three to seven years in the Pacific Ocean along the coasts of Peru and Ecuador. On a world map, have students locate the Pacific Ocean, Peru and Ecuador.

2 A change in ocean temperatures and atmospheric conditions produces El Niño, which affects weather worldwide. Discuss with students the relationship between weather *(atmospheric conditions at a given time and place)* and climate *(average weather conditions for an area over an extended period of time)*. Have students explain what they think is meant by the adage, "Climate is what you expect. Weather is what you get."

3 As they watch, have students record various ways weather is affected during El Niño years and how these changes in weather impact specific regions.

After Watching

1 Have students review their notes and discuss some of the positive and negative effects of El Niño on world weather. In response to the '82–'83 El Niño, scientists have been collecting data, comparing this data to world weather events, and building computer models to help predict future El Niños. Discuss how people might use this information.

Activity Setup

Objective

To formulate a question and design an experiment to evaluate the accuracy of weather folklore.

Materials for each group

- copies of the **Forecasting Folklore** student activity sheets on pages 13–14

Procedure

1 Ask students what they know about weather folklore and if they've ever heard any folklore that predicts weather. Generate a list of folklore sayings from those that students already know and from those that students collect by surveying their family and friends (a starter list can be found on page 14). Encourage students to survey people from older generations.

2 Organize students into pairs or small groups and distribute the activity sheets. Review sayings that students have generated as a class and discuss which of those might be proved or disproved by a controlled experiment or by observation and comparison. Have students select a saying that they think is possible to investigate. Students will use the guiding questions on the activity sheets to help them formulate a question and design an experiment to evaluate the accuracy of that saying.

3 To help students consider what makes an investigable question you may want them to consider why the following questions do or do not work:

- Do crickets chirp faster when it is warmer and slower when it is cooler? *(difficult to investigate because experimenter doesn't know what's warm or cold to a cricket)*
- Do crickets in the schoolyard chirp faster when the temperature is higher or lower? *(investigable question)*
- Why do crickets chirp at different speeds? *(most "why" questions are difficult to investigate)*

4 Once students have completed their experiments, have them present their experimental design to the class and have class members predict what they think was found. Then have the presenting team share its data and have class members interpret it. Finally, have team members share their results to the class, explain how they arrived at their conclusions, and discuss any differing opinions.

5 As an **extension**, students can research additional data that supports or contradicts their experimental findings and research why certain folklore sayings are more accurate than others.

Standards Connection

The activity found on pages 13–14 aligns with the following **National Science Education Standards.**

Grades 5–8

Science Standard A: Science as Inquiry

Abilities necessary to do scientific inquiry

- Identify questions that can be answered through scientific investigations.
- Design and conduct a scientific investigation.
- Use appropriate tools and techniques to gather, analyze and interpret data.
- Develop descriptions, explanations, predictions and models using evidence.
- Think critically and logically to make the relationships between evidence and explanations.
- Recognize and analyze alternative explanations and predictions.
- Communicate scientific procedures and explanations.

Grades 9–12

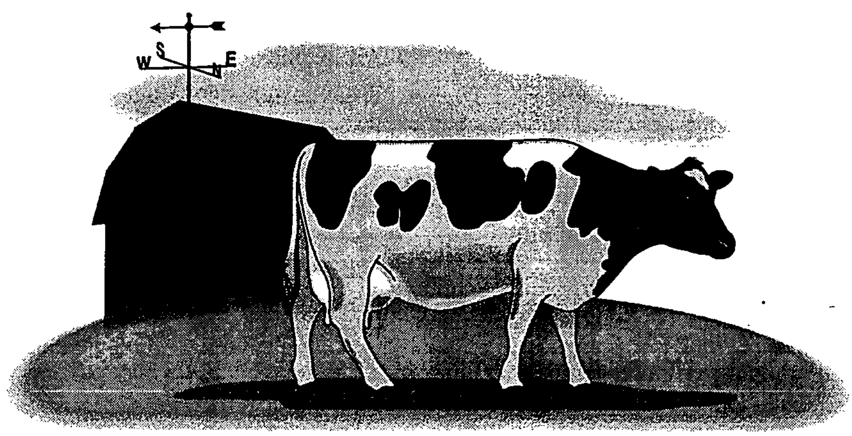
Science Standard A: Science as Inquiry

Abilities necessary to do scientific inquiry

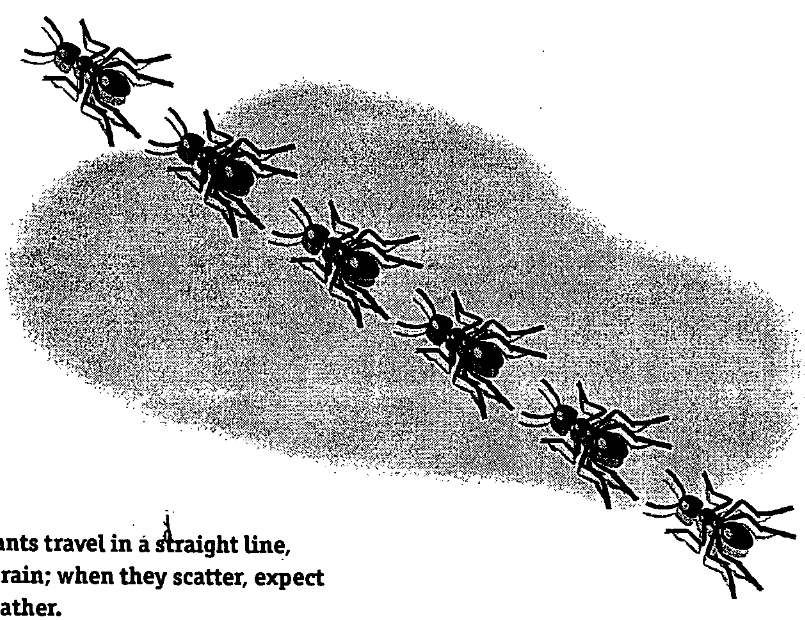
- Identify questions and concepts that guide scientific investigations.
- Design and conduct scientific investigations.
- Formulate and revise scientific explanations and models using logic and evidence.
- Recognize and analyze alternative explanations and models.
- Communicate and defend a scientific argument.

FORECASTING FOLKLORE

Centuries before meteorologists had advanced technology for making weather forecasts, people observed the natural world and looked for patterns to help explain and predict weather. Many of these observations were turned into sayings and passed down through generations. For example, "The louder the frog, the more the rain," or "A sunny shower won't last an hour." But how accurate is weather folklore? Find out by designing an experiment that puts it to the test.



A cow with its tail to the west makes weather best; a cow with its tail to the east makes weather the least.



When ants travel in a straight line, expect rain; when they scatter, expect fair weather.

Guiding Steps and Questions

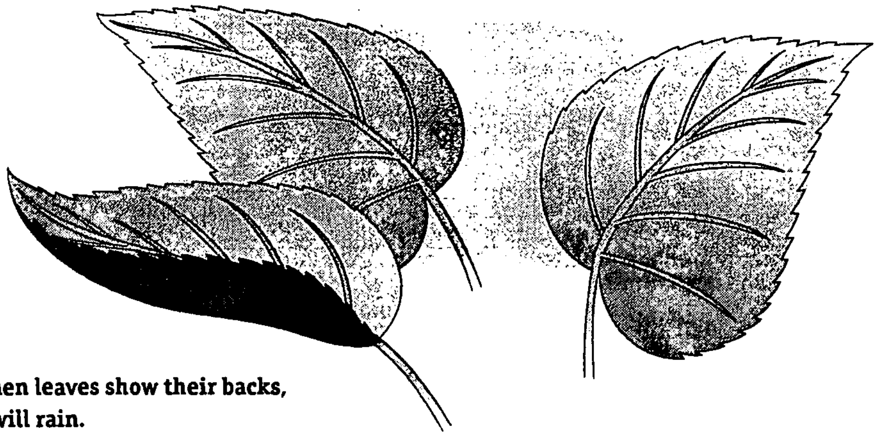
Use these steps to help you design your experiment.

1 Select a Folklore Saying

- Evaluate whether the folklore saying can be tested through scientific investigation.
- What constraints must you consider (such as availability of time and space, limitations of equipment, cost, safety issues)?

2 Create a Question

- Change the folklore saying into a question that can be answered through scientific investigation.
- What do you predict will be the answer to your question and why?



When leaves show their backs, it will rain.

3 Design the Experiment

- Identify the variables in the experiment.
- What kinds of data will help you answer your question?
- What data will you use to support your prediction?
- How will you collect, record and represent your data?
- What materials will you need?
- What steps will you take to carry out the experiment?

4 Review the Experimental Design

- Have another team review your experimental design. What questions do they raise and how might you address them? If there is any part of your experiment you are having a problem with, ask the other team for input or advice.
- Have your teacher review and approve your experiment before proceeding.

5 Do the Experiment

- Record the actual steps you take to carry out the experiment.
- Record your data.

6 Analyze the Data

- What patterns do you see in the data?
- How do you interpret the data? What evidence supports your interpretation?
- What might be inaccurate about your interpretation?
- How else can you explain the data? List two alternative explanations.
- How can you organize the data to present the strongest explanation for your conclusion?

7 Reflect on Your Experiment

- Identify some of the flaws in your experimental design. How would you change your experiment if you were to repeat it?
- What new questions do you have after doing this experiment?

8 Share Your Findings and Interpretations

- First share your experimental design and then have your fellow classmates predict what they think you found.
- Next, share your data with them and have them try and interpret what you found.
- Finally, share your own conclusions and discuss any differing views as a class.

A Sample of Weather Folklore

- Red sky at night, sailors delight. Red sky in the morning, sailors take warning.
- The louder the frog, the more the rain.
- A sunny shower won't last an hour.
- When doors and windows stick, it will probably rain.
- A wind from the south has rain in its mouth.
- Haloes around the sun or moon indicate a rain or snow real soon.
- When a cow endeavors to scratch his ear, it means a rain shower is very near. When he thumps his ribs with an angry tail, look out for thunder, lightning and hail.
- Crickets are accurate thermometers; they chirp faster when warm and slower when cold.
- High clouds indicate fine weather will prevail; lower clouds mean rain.
- When clouds look like rocks and towers, the Earth will be refreshed by showers.

Activity Answer

The main objective is for students to design a sound scientific investigation. Before students begin, you might want to review their questions and experimental designs to ensure that they can complete the experiment within classroom constraints.

Most of the sayings lend themselves to observation and comparison. Any of these sayings could be proved or disproved, depending on the factors students choose to use as measures. Different students might use different factors. For example, in the saying "High clouds indicate fine weather will prevail; lower clouds mean rain," a student who uses bright sunshine as a measure of fine weather might find the saying accurate, while a student who uses temperature over 65°F as a factor might find the saying inaccurate. Discuss with students the importance of choosing factors that are valid measures.

After students present their conclusions, discuss why some folklore sayings seem to be more accurate than others. In general, folklore that takes into account factors such as atmospheric conditions, shape and movement of clouds, and direction and force of winds can have accurate forecasting results for specific localities. In addition, sayings that are based on scientific principles are reliable. Folklore that refers to animals, birds, and insects is sometimes—but not usually—accurate. Whether a folklore saying is accurate or not has a lot to do with the locality. A folklore saying that works in one region may be entirely inaccurate in another region.

Resources

Books

Williams, Jack. *The Weather Book.* New York: Vintage Books, 1997.
Describes major weather events, has state-to-state weather comparisons, and contains profiles of the nation's top atmospheric scientists. Includes graphics and clear descriptions to explain the intricacies of how weather works.

Articles

Johnson, Kerry Anne. "El Niño and the Teacher at Sea." *Science Scope* (April 1998): 23–27.
Provides an eighth-grade teacher's account of her month-long adventure aboard one of the National Oceanic and Atmospheric Administration's (NOAA) research vessels monitoring the Tropical Atmosphere Ocean (TAO) buoys near Hawaii. Has an activity involving the Coriolis effect. Also describes the placement of the TAO buoys.

Nash, J. Madeleine. "The Fury of El Niño." *Time* (February 16, 1998): 67–73.
Gives an account of how El Niño affects weather the world over.

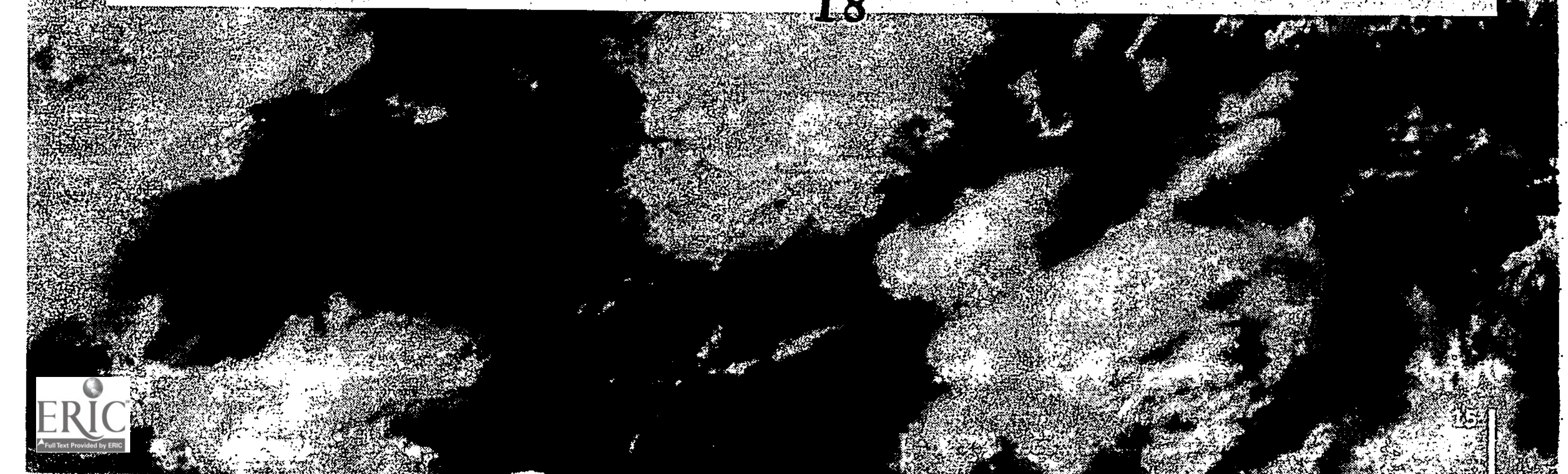
Web Sites

NOVA Online—Tracking El Niño
http://www.pbs.org/nova/elnino/
This Web site, a NOVA/PBS Online Adventure launched in Winter 1998, includes information about the anatomy and reach of El Niño. Archived dispatches of scientists' efforts to track El Niño will be updated with information on how those predictions stacked up to what actually happened with this powerful weather phenomenon.
Launch date: October 13, 1998.

NOAA El Niño Page
http://www.elnino.noaa.gov/
Provides current El Niño status reports, fact sheets, a web tour of the TAO buoy array and more.

American Weather Folklore
http://www.athena.ivv.nasa.gov/curric/weather/hsweathr/solutions.html
Reviews the validity of 14 different weather folklore sayings.

Weather-Related Sites
http://athena.wednet.edu/curric/weather/hsweathr/links.html
Contains a comprehensive chart of weather-related sites.



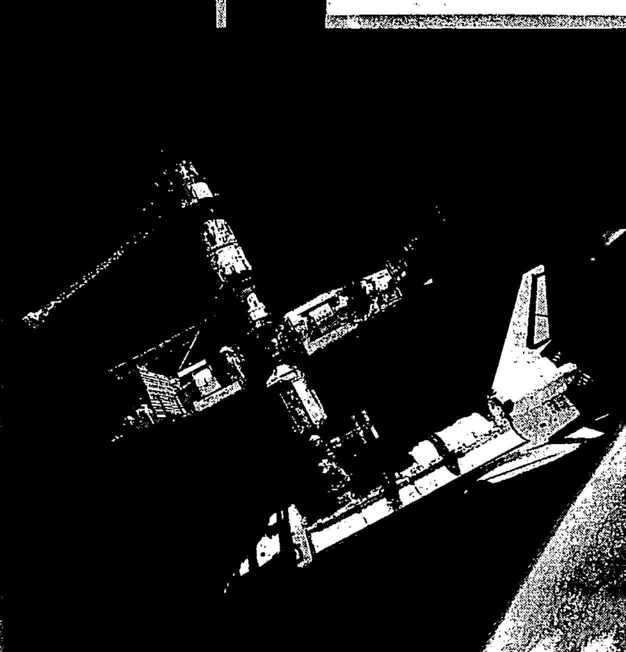
Airs the week of October 27, 1998

Terror in Space

Program Contents

NOVA looks at life on the Russian space station *Mir* and investigates the recent series of mishaps that the station has encountered.

- Launched in 1986, *Mir's* projected lifespan is five years. However, *Mir* continues to be used into the late 1990s.
- In 1995, American astronauts join Russian cosmonauts on *Mir* to study long-term endurance in space.
- During an exchange-of-astronauts celebration, a fire is discovered shooting from an oxygen canister, turning the festivities to panic. Russians and Americans disagree over the seriousness of the situation.
- Cosmonauts and astronauts struggle to repair and maintain the station's aging technology.
- While practicing a manual docking procedure, cosmonauts lose control of an unmanned supply ship, which crashes into the space station, causing the cabins to depressurize and damaging the station's solar panels.



***Mir* has hosted seven U.S. astronauts who have conducted studies in areas such as photo documentation in changes of the Earth's surface, the growth of three-dimensional cancer cells, International Space Station mitigation, and the effects of long duration space flight on the human body.**

Before Watching

1 Astronauts were sent to *Mir* to help scientists understand some of the effects of living in space for extended periods of time. Ask students what they think are some of the challenges of living in space *(such as weightlessness, close living quarters, boredom)*. As they watch, have students note the challenges faced by the *Mir* crew.

After Watching

1 Have students review their notes and discuss the challenges faced by the *Mir* crew. What incidents arose as a result of technical failures or error? What issues occurred as a result of cultural and political differences between the Russians and Americans? Discuss possible challenges and solutions that might arise in the International Space Station, which will be shared by 16 nations.

2 Have students compare *Mir* with the space station on "Deep Space Nine" or with other popular science-fiction space stations. What are the similarities and differences?

3 Ask students to support or refute the idea that from space, Earth seems like a single community.

Activity Setup

)bjective

'o explore the concept of center of mass and experiment with how altering the ocation of an object's center of mass can affect its motion.

/laterials for each group

'art I

- copies of the **Controlling the Cube** student activity sheet on page 18
- 1 Styrofoam ball
- weights: pennies, washers or marbles
- tape

'art II

- copies of the **NOVA Cube Template** on page 19, photocopied on card stock
- scissors
- tape
- self-stick notes
- 1.3-centimeter (0.5-inch) cube of modeling clay

'rocedure

1. For **Part I,** organize students into pairs and distribute the activity sheets and materials. Have students roll a Styrofoam ball across a table to a parter and observe the ball's path and motion. Encourage students to experiment ith varying the force with which they roll the ball. Then have students add a eight to alter the location of the ball's center of mass, and have them roll and bserve the ball again. Discuss how this activity relates to the behavior of the ipply ship *Progress* as it attempted to redock with *Mir.*

2. For **Part II,** distribute the NOVA Cube Template and clay. Have students cut out and assemble the cube. Students will experiment to determine the robability of a certain side of the cube landing face-up when the location of ie center of mass is in the center of the cube, and again when it is off-center.

3. For their main challenge, have students find how best to position the clay so that when they roll their cube, the NOVA logo appears face up the ost often. Have them predict before experimenting. Once students have comeleted their experiments, have them present their results to the class and xplain why they think their strategy worked.

Standards Connection

The activity found on page 18 aligns with the following **National Science Education Standards** and **Curriculum and Evaluation Standards for School Mathematics.**

Grades 5–8

Science Standard B: Physical Science

Motions and forces

- The motion of an object can be described by its position, direction of motion and speed. That motion can be measured and represented on a graph.
- An object that is not being subjected to a force will continue to move at a constant speed and in a straight line.
- If more than one force acts on an object along a straight line, then the forces will reinforce or cancel one another, depending on their direction and magnitude. Unbalanced forces will cause changes in the speed or direction of an object's motion.

Mathematics Standard 11: Probability

Grades 9–12

Science Standard B: Physical Science

Motions and forces

- Objects change their motion only when a net force is applied. Laws of motion are used to calculate precisely the effects of forces on the motion of objects. The magnitude of the change in motion can be calculated using the relationship $F = ma$, which is independent of the nature of the force. Whenever one object exerts force on another, a force equal in magnitude and opposite in direction is exerted on the first object.

Mathematics Standard 11: Probability

Controlling the CUBE

One theory about why the supply ship *Progress* crashed into *Mir* was its center of mass was not centered, making the ship move unpredictably. See what happens when you change the location of an object's center of mass. Then see if you can alter the location of an object's center of mass to make the object move the way you want.

Part I

Materials for your group

- 1 Styrofoam ball
- weights: pennies, washers or marbles
- tape

Procedure

1 Roll the Styrofoam ball across the table to your partner. Experiment with using different amounts of force. What do you observe about the ball's path and motion?

2 Insert a weight into the Styrofoam. Secure the weight with tape, if necessary.

3 Predict what will happen when you roll the ball this time.

4 Roll the ball again. Experiment with using different amounts of force. What do you observe about the ball's path and motion?

Questions

Write your answers on a separate sheet of a paper.

1 What happens to the motion of the ball, with and without the weight? Explain the similarities and differences you observed.

2 How does this activity model the behavior of the *Progress* as it attempted to redock with *Mir?*

Part II

Materials for your group

- copy of the **NOVA Cube Template**
- scissors
- tape
- self-stick notes
- 1.3-centimeter (0.5-inch) cube of modeling clay

Procedure

1 Assemble the cube, folding the edges carefully so they align as accurately as possible. Use the same size piece of tape on all sides (even the folded side). Cut out a small piece of self-stick note to hold down the lid.

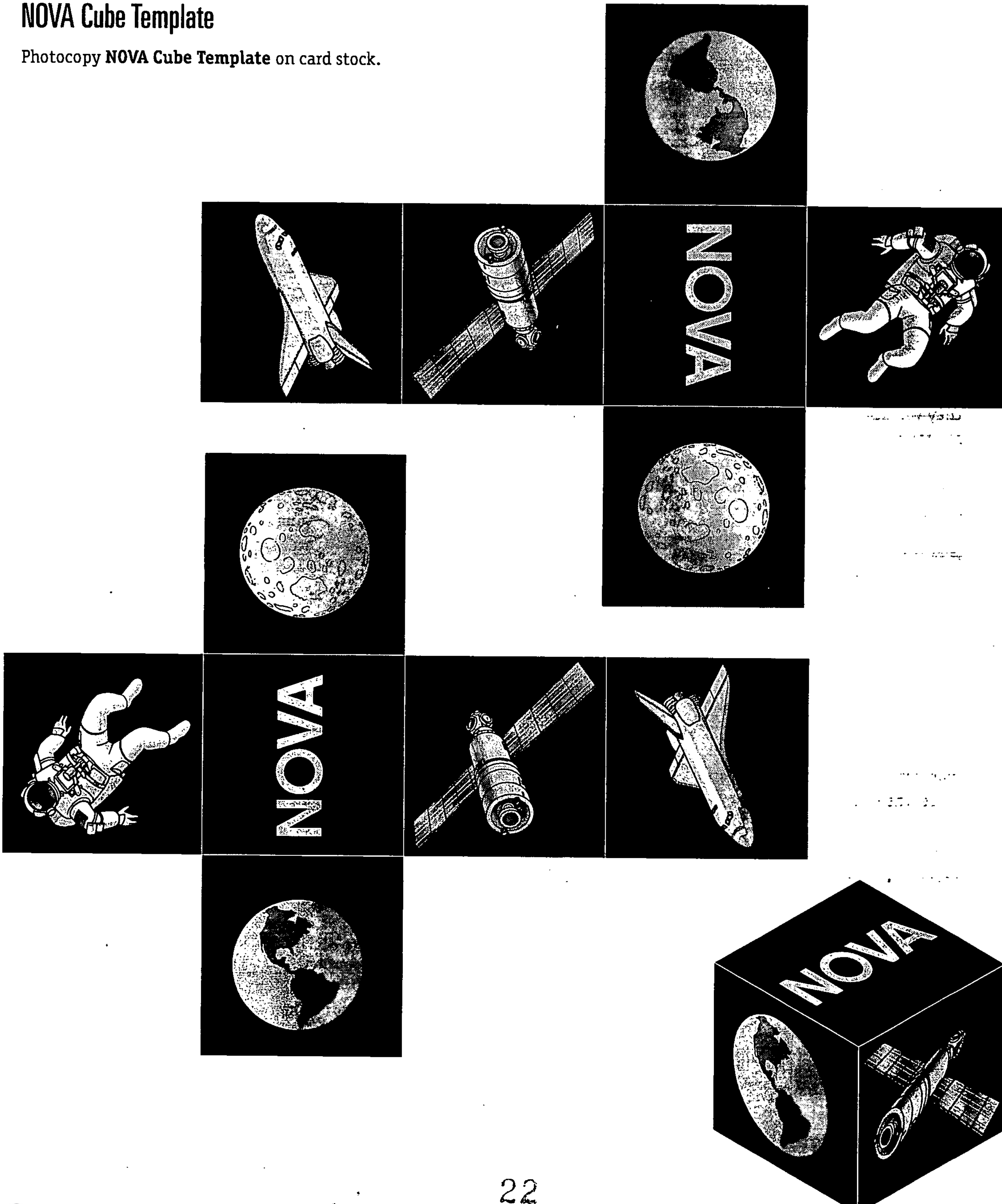
2 Roll your cube 30 times and record how often each side lands facing up.

3 Assuming a cube has uniform sides and its center of mass is located at the "center" of the cube, the theory of probability states that each side has a 1 in 6 chance of landing face-up. Combine your data with data from other teams, and compare the class's results with the theoretical probability.

4 Now alter the location of your cube's center of mass by placing clay on one of the interior sides of the cube. How can you position the clay so that when you roll your cube, the NOVA logo appears face up the most often? The team that rolls the most NOVA logos in 30 rolls becomes the center of mass master!

NOVA Cube Template

Photocopy **NOVA Cube Template** on card stock.



Activity Answer

This lesson focuses on objects that are caused to rotate by some outside force. All objects in free fall (such as thrown balls and space ships in orbit) tend to rotate around their center of mass. When the center of mass doesn't coincide with the "center" of the object, the object's behavior becomes erratic, or "wobbly." Students should notice in **Part I** that the path and motion of the ball with added weight is erratic.

Unbalanced forces will cause the speed and/or direction of an object's motion to change. As students increase the force with which they roll the weighted ball, they will also notice that the ball's motion becomes increasingly erratic. This is essentially due to the fact that the frequency and amplitude of the "wobble" is greater if an object is moved with more force—thus making the motion seem more erratic. This activity models the behavior of the *Progress* as the cosmonauts attempted to redock it. Since the garbage was loaded off-center, the location of the supply ship's center of mass was no longer along its center axis. As the *Progress* was accelerated through space, the unbalanced center of mass possibly made the ship's motion increasingly erratic as it approached *Mir.*

In **Part II**, the theoretical probability that any one side of a cube will land face-up is 1 in 6 (assuming a cube has uniform sides and its center of mass is located at the "center" of the cube). When students add clay to the inside of the cube, the center of mass is no longer located in the center of the object. As the cube rolls, the side with the greater mass is more likely to be at the bottom, since the object is more stable in that orientation.

Resources

Articles

Leopold, George. "Despite Its Struggles, Give *Mir* a Chance." *EETimes* (September 15, 1997): Tech Web News.
http://www.techweb.com/se/directlink.cgi?EET19970915S0054
This online article from *EETimes* (Electrical Engineering Times) gives the engineering perspective that, despite all of its difficulties, the technological wonders of *Mir* are not to be downplayed or forgotten.

Sterling, Donna R., and Rebecca J. Graham. "And *You* Were There." *Science and Children* (March 1998): 41–46.
Chronicles a sixth grade's simulated space mission. Students assumed the identity of a chosen mission's astronaut and followed the mission through to the landing and press conference. Extensive resource list.

Web Sites

NOVA Online—Terror in Space
http://www.pbs.org/nova/mir/
Delves deeper into the program's content and themes, with features such as articles, time lines, interviews, interactive activities, resource links, program transcripts, and more.
Launch date: October 27, 1998.

NASA Shuttle/Mir
http://shuttle-mir.nasa.gov/
Provides information about the astronauts on board *Mir* and events occurring between March 1995 and June 1998. Includes sighting information.

Moscow, We Have a Problem
http://www.pbs.org/newshour/bb/science/jan-june97/mir_6-25.html
Transcript of a discussion from *The NewsHour with Jim Lehrer* (June 25, 1997) examining the future of joint missions between the United States and Russia in the wake of a crash between the *Mir* space station and a resupply ship. Includes an audio version of the segment.

Visibility Predictions for the Russian Space Station Mir
http://www.skypub.com/mir/mir.shtml
Locates *Mir*'s current position above Earth and provides predictions for where and when to look for *Mir* from your area.

Special Effects: Titanic and Beyond

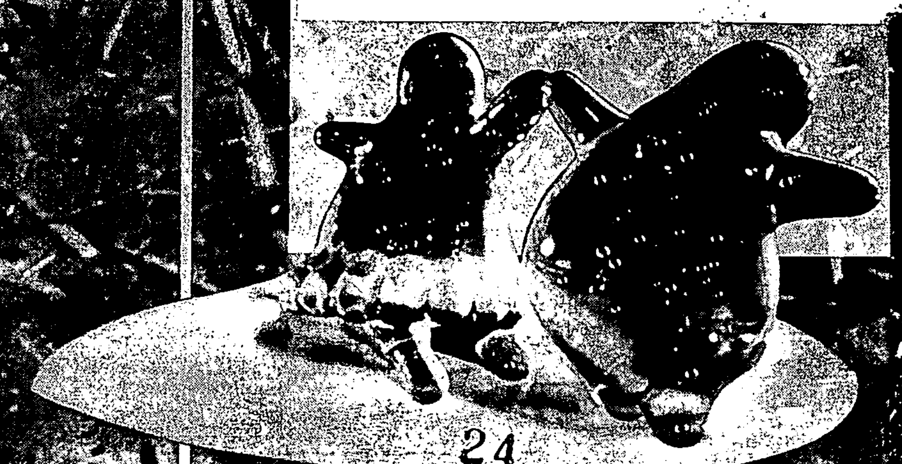
Airs the week of November 3, 1998

Program Contents

NOVA reveals the secrets behind the on-screen images that have captured moviegoers' imaginations for years.

- The art of special effects relies on understanding perception—how the eye and brain perceive the world—and using that knowledge to make something look real when it isn't.
- Special effects used in early movie making, including *King Kong, Ben Hur* and *Gone with the Wind*, are highlighted.
- The role that color, light, form, motion and depth play in perception—and how those can be manipulated to fool viewers—is explored.
- Some of the techniques used to film *Titanic*—including model making, computer animation and green screen technology—are described.
- Pyrotechnics experts—who blow up a building for *The X-Files* movie—use models, lighting and slow motion to achieve a realistic scene.
- The future challenge for computer special effects artists—how to make a computer-generated human being look completely real—is also explored.

To help them create *Flubber*, Industrial Light and Magic's animators researched real-life products of varying viscosities.



Before Watching

1 Have students think of and list the most enjoyable movies they have seen. Then have them list their favorite scenes from those movies. How do students think the scenes were made?

2 Lead a discussion about why special effects might be important in a movie *(such as, used in a scene that would otherwise be too expensive, too dangerous, or take too much time to re-create, or in a scene that couldn't be shot without special effects, or to create a place that was purely imaginary).*

3 As students watch, have them take notes about how each special effect is accomplished, paying attention to two different kinds of techniques: **mechanical** *(in which a trick is staged for the camera, like a person sitting in a car in front of a moving background image of street scenes)*, and **visual** *(in which two or more elements are photographed separately and then combined, like an explosion of a model building that is later merged with a film clip of a cityscape).*

After Watching

1 Discuss with students some of the techniques used to create special effects. What techniques, if any, surprised them and why? Have students revisit their movie list and reflect on what special effects might have been used to create their favorite scenes.

2 Work with an art teacher to introduce students to the elements of perspective drawing, such as shadow, light and vanishing point.

Activity Setup

Objective
To investigate how geometry plays a role in perspective.

Materials for each group
- copies of the **Putting It into Perspective** activity sheet on page 23
- copy of the **Distorted Room Template** on page 24, enlarged to 200 percent
- construction paper or card stock
- scissors
- glue
- two same-size models (such as plastic toy figurines or photos of people from magazines) up to 1 1/2 inches tall (the taller the better)

Procedure
1 First stage a demonstration of perspective. Have two students the same height stand side by side near the end of a hall. Have one student begin taking steps backward until students begin to notice a difference in height between the two. From where they are, have the rest of the class measure the height of each student with a ruler or their fingers and observe other surrounding clues that suggest a difference in height: How much space is between the students' heads and the ceiling? Where is each student in relation to the end of the hall? How far did the students have to back up before a difference in height was noted? Discuss perspective with students. (You might want to replay the program segment of the two ships that deals with perspective.)

2 Organize students into groups. Either make a Distorted Room for each group or have students make one from the enlarged template and materials you provide for them.

3 After they have constructed their room, have students place two same-size models inside to explore perspective, using the questions on the activity sheet to guide their inquiry.

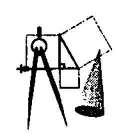
4 When students have finished, reconvene the class and discuss what they have learned, clearing up questions and inviting further investigation of perspective.

5 As an **extension**, have students build the room in different sizes and compare which size works best.

Standards Connection

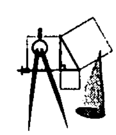
The activity found on page 23 aligns with the following **Curriculum and Evaluation Standards for School Mathematics.**

Grades 5–8



Mathematics Standard 12: Geometry

Grades 9–12



Mathematics Standards 7: Geometry from a Synthetic Perspective

Additional Activities

More special effects activities for upper-elementary and middle-school students are available on the Web at: http://www.pbs.org/nova/specialfx/fxguide/

or by writing to:
Special Effects Activity Guide
WGBH
125 Western Avenue
Boston, MA 02134

Putting It into PERSPECTIVE

American psychologist Adelbert Ames created several famous optical illusions. One was a room that wasn't exactly what it seemed to be. But what was it? Do this activity and find out!

Materials for your group

- enlarged copy of the **Distorted Room Template**
- construction paper or card stock
- scissors
- glue
- two same-size models (such as plastic toy figurines or photos of people from magazines) up to 1 1/2 inches tall (the taller the better)

Procedure

1 Assemble your Distorted Room using the template provided.

2 Look at the room through the hole cut into the side.

3 Now place the models in the corners. Move them around and observe how they look placed together and apart in different parts of the room.

Questions

1 What does the room look like through the hole?

2 What happens to your models when you put them together in each of the two far corners? What happens when you place them apart in each far corner?

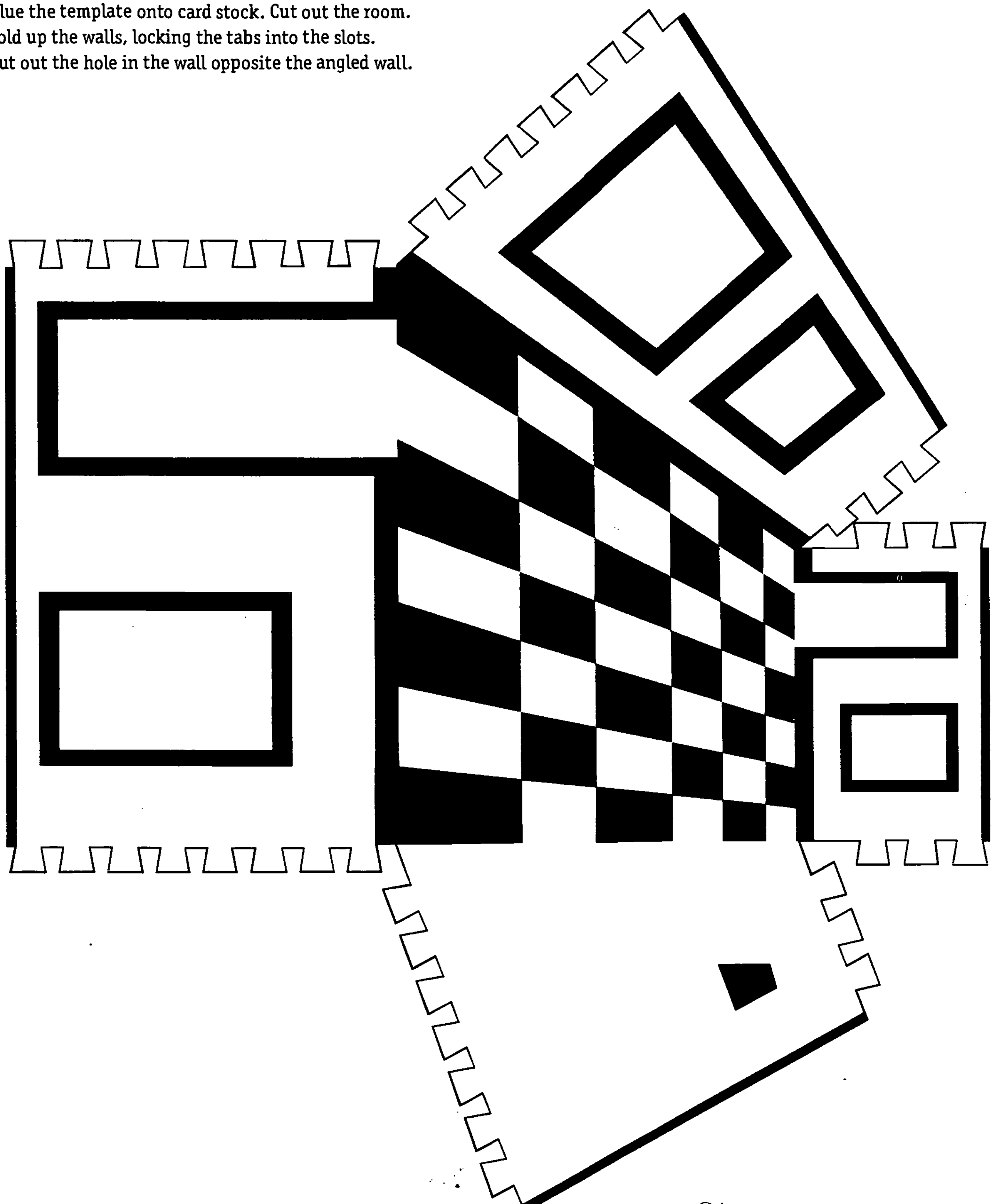
3 Why do you think the models look the way they do when placed apart in the far corners?

4 What is it about the room that makes the models look the way they do?

5 What kind of special effect might this technique be good for?

Distorted Room Template

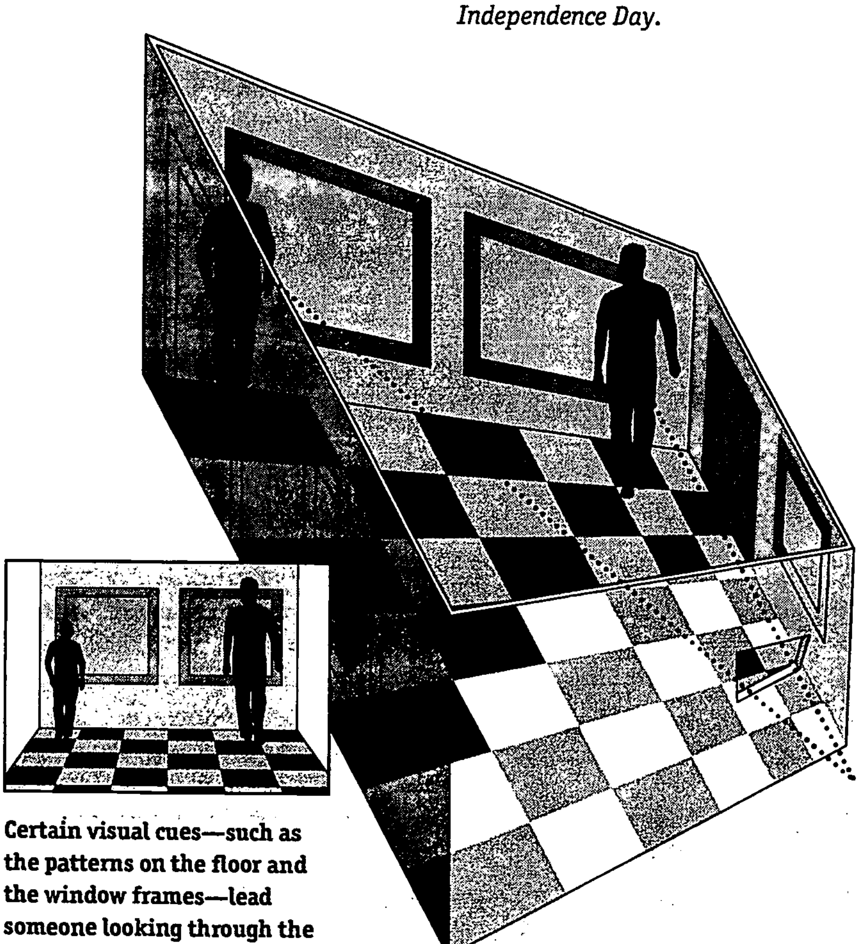
Glue the template onto card stock. Cut out the room.
Fold up the walls, locking the tabs into the slots.
Cut out the hole in the wall opposite the angled wall.



Activity Answer

Perspective is the technique or process of representing on a plane or curved surface the spatial relation of objects as they might appear to the eye. Perspective didn't appear in art until the Italian Renaissance. Leonardo da Vinci (1452–1519) was the first to describe the principles of perspective in his notebooks. He treated perspective as a branch of geometry.

Students might observe that the room appears rectangular, but it isn't; that while the walls are straight, they don't all meet at 90° angles; and that when outside the room, the two models are the same height.



Certain visual cues—such as the patterns on the floor and the window frames—lead someone looking through the viewing hole to believe the room is cubic. As a result, an object placed in the left corner *appears* to shrink when compared to an object in the right corner.

While the Distorted Room appears to be cubic, it is not—rather, the floor, some walls, and the far windows are trapezoidal.

Resources

Books

Finch, Christopher. *Special Effects: Creating Movie Magic.* New York: Abbeyville Press, 1984.
Chronicles the use of special effects from the origin of motion pictures to 1984.

Hamilton, Jake. *Special Effects in Film and Television.* New York, NY: DK Publishing, Inc., 1998.
Provides an introduction to the world of illusion. Students discover how Steven Spielberg created the dinosaurs for *Jurassic Park,* how Jim Carrey's eyes popped out in *Mask,* and how the spectacular arrival of alien spaceships was staged in *Independence Day.*

Samonek, Michael E. *The Gross-Out Get Sick & Turn Blue Cookbook, with Special Effects.* Skokie, IL: Anatomical Chart Co., 1995.
Has recipes for students to create foods that aren't what they seem.

Web Sites

NOVA Online—Special Effects: Titanic and Beyond
http://www.pbs.org/nova/specialfx2/
Will include, among other features, an interactive exploration of how moviemakers create the illusion of making a miniature set look full-size, and interviews with computer graphics experts on how they got into the world of special effects.
Launch date: November 3, 1998.

The Animation Process
http://www.pixar.com/funstuff/how-its-done.html
Pixar Animation Studios (creators of *Toy Story)* explains the process behind computer animation.

Visual Effects Reference Library
http://www.visualfx.com/library.htm
Includes references and links to visual effects magazines and online publications, and includes book references for visual effects, science fiction, cinematography/film, computer graphics, and animation.

Alt.movies.visual-effects
http://www.users.interport.net/~fletcher/fx-faq1.html
Newsgroup for discussion of movie and television effects. Current posts include technical questions about specific effects shots, industry-related news, requests for advice on how to shoot a sequence, and notices of upcoming live events, television specials and magazine articles relating to effects.

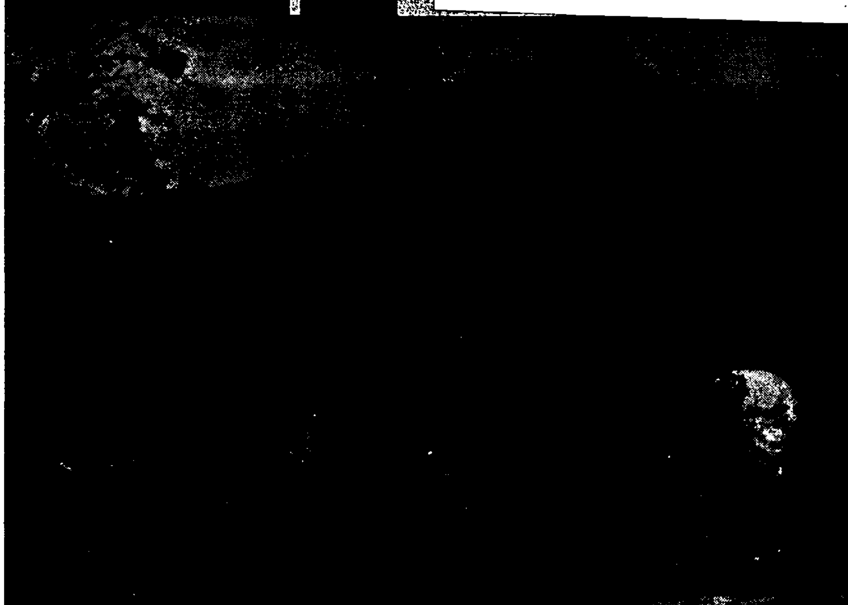
Airs the week of November 10, 1998

Deadly Shadow of Vesuvius

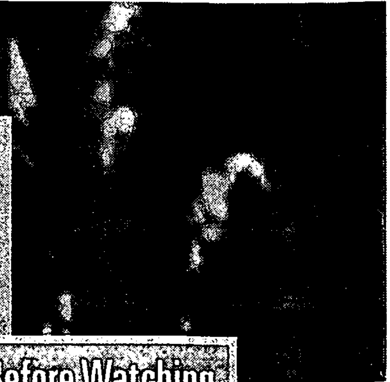
Program Contents

NOVA follows scientists' efforts to predict the future of Mt. Vesuvius by monitoring current behavior and reconstructing past eruptions.

- Scientists monitor temperature changes, volcanic gases, seismic activity, and apparent "ground uplifts" in the volcano and nearby fields to detect warning signs of a coming eruption.
- Archaeologists and geologists investigate the A.D. 79 eruption that devastated Pompeii. By comparing an eyewitness account—known as the Pliny letters—to the 1980 Mt. St. Helens eruption, examining remains of victims, and analyzing rock deposits, they conclude that the A.D. 79 eruption was most likely an explosive eruption rather than a quiet outflow.
- Scientists combine data to create a computer animation of the A.D. 79 eruption. Actual video footage captures the eruption of 1944.
- A team of geophysicists map the size, location, and condition of Mt. Vesuvius's magma chamber. The data suggests that the medium-size chamber is blocked by a plug.



Plaster casts like this one—made in cavities surrounding victim's bodies—capture details of the precise moment of death during Mt. Vesuvius's eruption in A.D. 79.



Before Watching

1 On a map of Italy, have students locate Mt. Vesuvius, Naples, and the ancient Roman cities of Pompeii and Herculaneum. Use the map's scale to determine the distance from Vesuvius to these cities. Ask students to explain why they think communities settle near active volcanoes. What are the hazards and benefits?

2 Review with students how a volcano differs from an earthquake. Have students explore the crust, mantle and core layers of the earth and what each is made of.

After Watching

1 Italy's Ministry for Civil Protection is developing a massive emergency evacuation plan for the communities surrounding Mt. Vesuvius. Ask students to think about natural hazards faced by their community. What would they do to prepare for such an emergency? Every state has an Emergency Management Agency (EMA) that assists communities in developing plans for coping with natural hazards. Class members can select a natural hazard (such as a flood or hurricane) and, as a group, write to their state's EMA to learn about local plans.

Activity Setup

Objective

To collect data and create maps to observe the relationship among volcanoes, earthquakes and lithospheric plates.

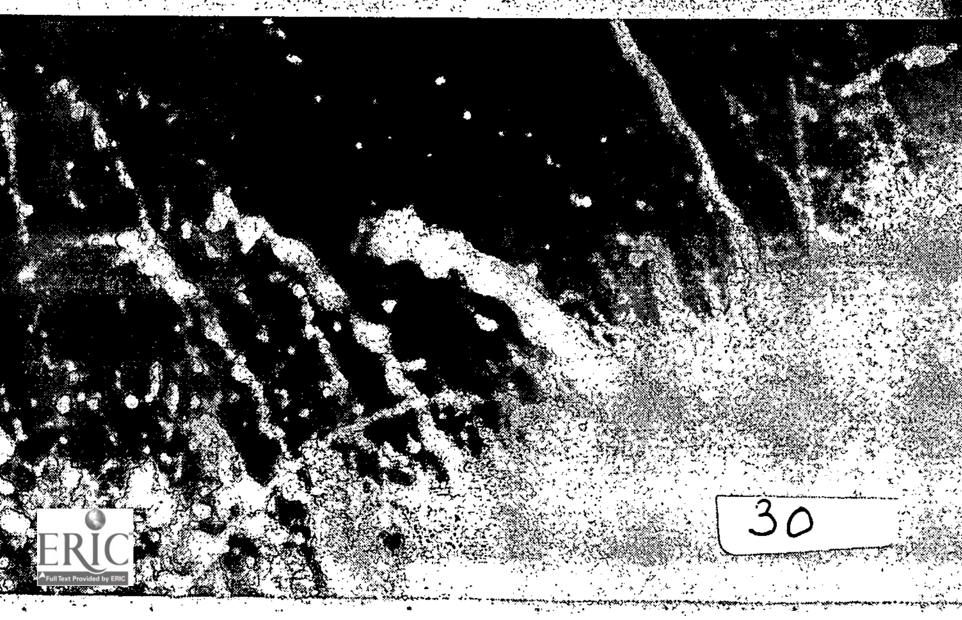
Materials

- copies of map from the **Where on Earth?** activity sheet on page 28
- access to resources from the Internet or school library
- 3 overhead transparencies
- overhead projector

Procedure

1 Organize students into three groups and distribute a map to each group. Assign each team to research and plot one of the following: 20 recent volcanoes, 20 recent earthquakes or the boundaries of Earth's major lithospheric plates. If students are having trouble finding information, direct them to the Web sites listed in **Resources** on page 29. If students are using books for their research, they can plot major or famous volcanoes and earthquakes instead of recent ones. Make sure groups use different symbols for volcanoes and earthquakes so that they can be distinguished on the overhead projection.

2 After the groups plot their data, photocopy each of the three maps onto an overhead transparency. First project the volcano and earthquake maps one on top of the other. Ask students to describe any patterns they observe. Then lay the plate boundaries map on top of the other two maps. Ask students to compare the locations of volcanoes and earthquakes with the locations of the plate boundaries and describe any patterns they observe. Finally ask students to explain the apparent relationship between the location of the plates and the occurrence of volcanoes and earthquakes in those regions.



Standards Connection

The activity found on page 28 aligns with the following **National Science Education Standards.**

Grades 5–8

Science Standard D: Earth and Space Science

Structure of the earth system

- The solid earth is layered with a lithosphere; hot, convecting mantle; and dense, metallic core.
- Lithospheric plates on the scales of continents and oceans constantly move at rates of centimeters per year in response to movements in the mantle. Major geological events, such as earthquakes, volcanic eruptions and mountain building, result from these plate motions.
- Land forms are the result of a combination of constructive and destructive forces. Constructive forces include crustal deformation, volcanic eruption and deposition of sediment, while destructive forces include weathering and erosion.

Earth's history

- The earth processes we see today, including erosion, movement of lithospheric plates, and changes in atmospheric composition, are similar to those that occurred in the past.

Grades 9–12

Science Standard D: Earth and Space Science

Energy in the earth system

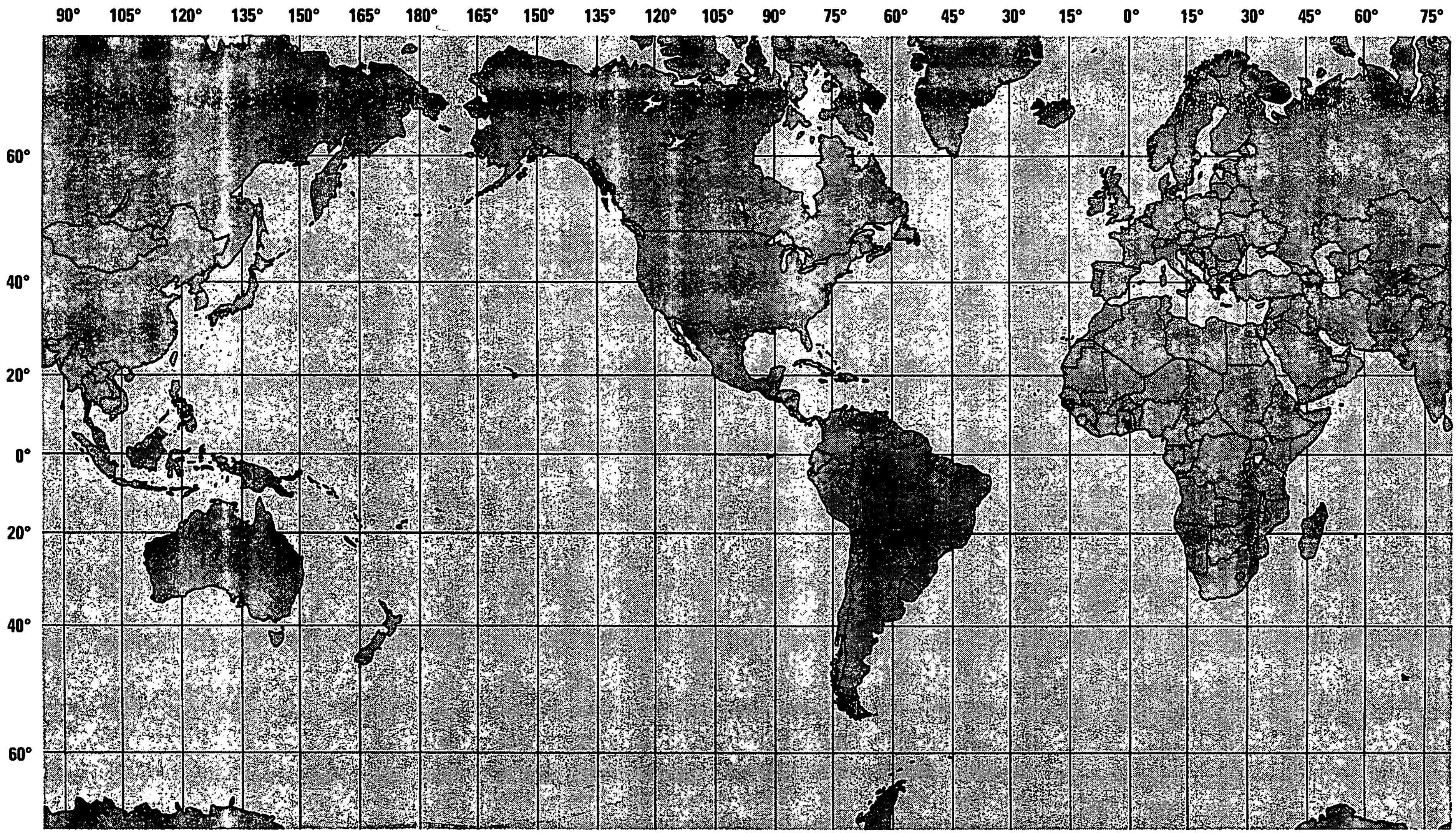
- The outward transfer of earth's internal heat drives convection circulation in the mantle that propels the plates comprising earth's surface across the face of the globe.

The origin and evolution of the earth system

- Interactions among the solid earth, the oceans, the atmosphere and organisms have resulted in the ongoing evolution of the earth system. We can observe some changes such as earthquakes and volcanic eruptions on a human time scale, but many processes such as mountain building and plate movements take place over hundreds of millions of years.

? Where on Earth ?

Mt. Vesuvius is just one of many active volcanoes in the world. Where are other active volcanoes found? And how do the locations of these volcanoes relate to the locations of earthquakes and lithospheric plate boundaries? Find out by plotting and comparing these sites for yourself.



Activity Answer

Volcanoes and earthquakes are not randomly distributed around the globe. Instead they tend to occur along limited zones or belts. With the understanding of plate tectonics, scientists recognized that these belts occur along plate boundaries. According to the theory of plate tectonics, the Earth's outer shell (lithosphere) is made up of seven large and many smaller moving plates. As the plates move, their boundaries collide, spread apart or slide past one another, resulting in geological processes such as earthquakes, volcanoes and mountain making. You might want to point out that not all volcanoes occur at plate boundaries. Some occur in the middle of plates in areas known as "hot spots." The Hawaiian Islands are an example of this type of volcano.

When comparing their maps, students will notice that volcanoes and earthquakes frequently occur at plate boundaries. Students who are familiar with the theory of plate tectonics might be able to explain the pattern or relationship they observe. Other students can conduct additional research to find information to help them explain their observations.

Resources

Articles

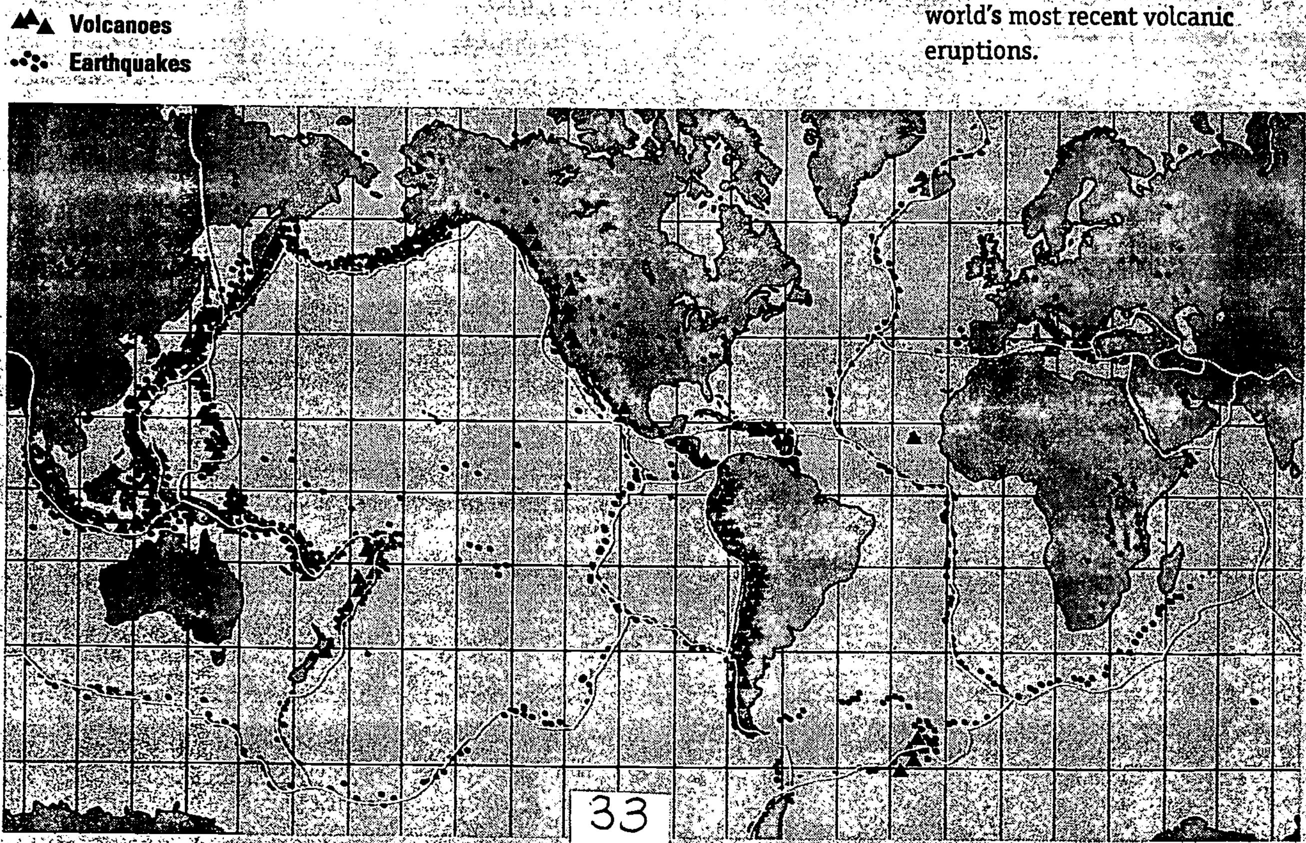
Parfit, Michael. "Living with Natural Hazards." *National Geographic* (July 1998): 2–39.
Describes volcanoes, floods, earthquakes, tornadoes, hurricanes and wildfires from the perspective of people who cope with them. Insert displays a distribution map of the natural hazards of North America.

Web Sites

NOVA Online—Deadly Shadow of Vesuvius
http://www.pbs.org/vesuvius/
Will include, among other features, an examination of the United States Geological Survey (USGS) Rapid Response Team, which waits in readiness to fly anywhere in the world at a moment's notice to monitor potentially dangerous active volcanoes. **Launch date: November 10, 1998.**

USGS Earthquake Information
http://quake.wr.usgs.gov/
Sponsored by the USGS, this site itemizes earthquake activity worldwide, including date, time, location, depth and magnitude.

Volcano World: Current Volcano Activity
http://volcano.und.nodak.edu/vwdocs/current_volcs/current.html
Includes a map and list of the world's most recent volcanic eruptions.



33

This map shows how some of the world's volcanoes and earthquakes occur along tectonic plate boundaries.

Airs the week of November 24, 1998

Ice Mummies

three one-hour programs airing consecutively on one night

Program Contents

Frozen in Heaven

Note: This program contains information about child sacrifice. You should preview the program to determine its appropriateness for your classroom.

NOVA accompanies anthropologist Johan Reinhard as he journeys to the 5,639-meter (18,500-foot) peak of Sara Sara in southern Peru in search of evidence of *capa cocha,* a ritual in which the Incas were said to sacrifice their own children to the gods.

- The program describes Spanish chronicles that detail Inca life and beliefs.
- Archaeologists ascend the mountain in search of evidence of the chronicled, but never proven, ritual. Observations of several bodies discovered earlier support the ritual's existence, including a boy found frozen in the Chilean mountains, a girl found frozen on Mt. Ampato in Peru, and a boy found on Mt. Aconcagua in Argentina.
- The program ends with the discovery of Sarita, a girl buried 500 years ago.

Researchers unearth the body of Sarita from her sacrificial burial ground on Sara Sara.

Before Watching

1 Ask students what rituals or ceremonies they or their families participate in or know about, and why these are performed. Discuss with students why ancient civilizations might have had rituals, such as providing offerings to gods. Have students record the rituals as they watch this program.

After Watching

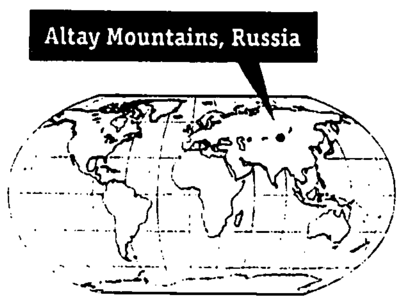
1 Have students discuss the rituals they recorded. Why might those rituals have been performed? How might they be similar to or different from rituals performed today?

Program Contents

Siberian Ice Maiden

NOVA follows archaeologist Natalya Polosmok as she journeys to the Altay Mountains in southern Siberia to search for traces of an ancient people known as the Pazyryk.

- Polosmok and her team discover and unearth a wooden tomb surrounded by the frozen remains of six horses, uncovering a 2,400-year-old woman dubbed the Siberian Ice Maiden.
- The Ice Maiden is buried alone, lying as if asleep, in a wood coffin with a headdress and a mirror. An afterlife meal, a yak horn vessel and a wooden table are also found outside the coffin. Archaeologists record the Ice Maiden's height, and discover a hole in her skull and peat packed in her body.
- They use radiocarbon dating, tree-ring chronology and biological testing to determine the age of the remains and time of death.
- The body is excavated and taken to Moscow for preservation and facial reconstruction. Another mummy, and other skeletons, are discovered elsewhere.
- The program concludes by raising the question of who has rights to the ancient graves.



Tattoos on the Ice Maiden's left shoulder show creatures in action poses.

Before Watching

1 To set the stage, ask students to locate the Altay Mountains on a map and to calculate the approximate year the Ice Maiden died *(about 2,400 years ago, or around 400 B.C.)*.

2 Archaeologists can infer much about a culture and its beliefs from their findings. As students watch, have them make a chart and record archaeologists' findings, inferences, and any support that exists for each, such as ancient writings or scientific tests.

After Watching

1 Archaeologists draw conclusions from as many pieces of evidence as they can find. Discuss and compare student charts that list what archaeologists found and whether students think the inferences archaeologists made are valid and why.

2 Have students consider the benefits and costs of excavating a burial site and state whether they believe archaeologists should unearth these sites and why.

Program Contents

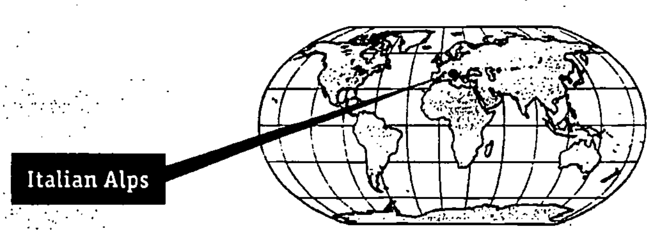
Return of the Iceman

NOVA examines how science is unlocking the secrets of the Iceman, a man discovered in 1991 frozen in the Italian Alps.

- Found with the Iceman are a copper axe, leather clothes, flint tools, shoes lined with grass, and a quiver full of arrows.
- Mapping of the site shows that the body—thought to have been discovered in Austria—was actually found 92 meters (100 yards) inside the Italian border.

Found within Italy's borders, the Iceman is carefully removed from the earth to be sent elsewhere for further study.

- A battery of tests—including carbon dating, microscopic analysis, X-rays and endoscopy—reveal that the Iceman:
  - had been frozen for about 5,300 years, making him the oldest frozen mummy ever found;
  - had heavily worn joints;
  - was about 45 years old;
  - ate a last meal of meat and rough milled wheat; and
  - had traces of copper on the surface of his hair and arsenic inside, indicating that he might have been involved in smelting.
- Reconstructive archaeology demonstrates how the Iceman might have built and used his copper axe.



Before Watching

1 This program features a number of archaeologists who study the Iceman. But what exactly do archaeologists do? How does an archaeologist differ from a paleontologist? *(Archaeologists study evidence of past human cultures, while paleontologists study life that existed in prehistoric times.)* What other scientists are involved in studying ancient civilizations, and what do they do?

2 Archaeologists inferred a lot about the Iceman's lifestyle from observations they made and tests they performed. As students watch, have them create a chart and take notes about each observation or test, what data resulted from the observations or tests, and what was inferred from the data about the Iceman.

After Watching

1 Guide a discussion about what was learned about the Iceman, listing students' notes on the board and clearing up any inconsistencies. What do students think about the conclusions that archaeologists drew? What other conclusions might have been reached?

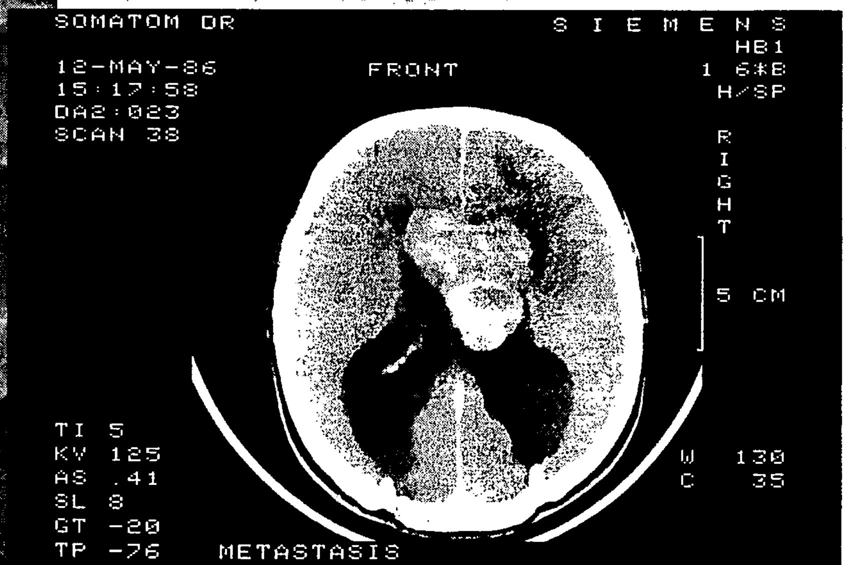
2 This program provided some evidence that the Copper Age should be redated to an earlier time in this region of Europe. Have students research the Stone Age and the Copper Age and the transition between them. What were the defining characteristics of each age? What were some characteristics shared by both ages?

36

Medical Imaging Tools

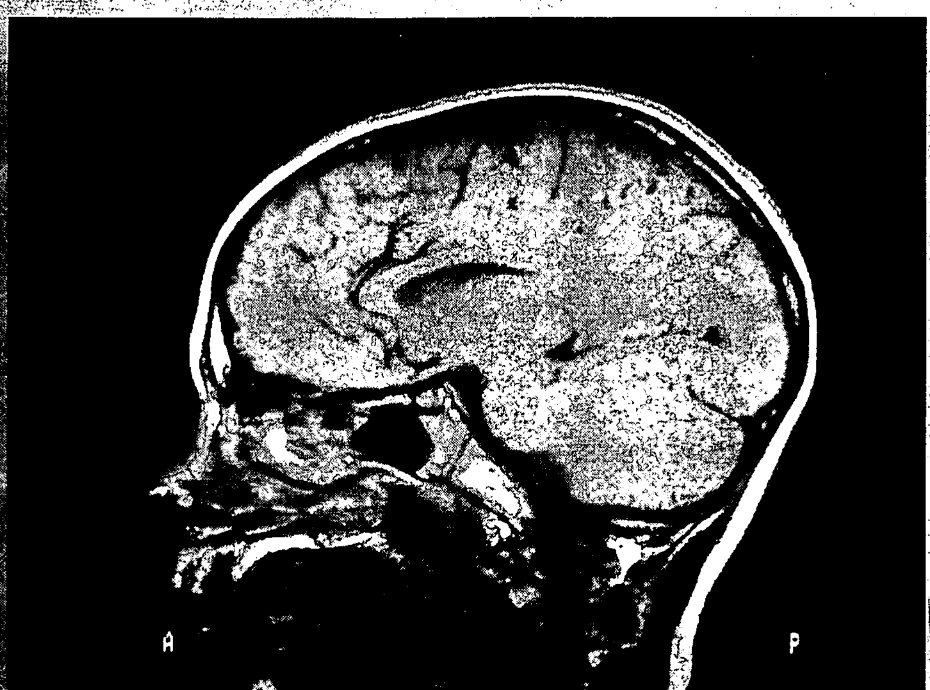
Radiography (X-rays), computerized axial tomography (CAT) and magnetic resonance imaging (MRI) allow researchers to study a body without invading or destroying it. How do each of these tools work? What were researchers able to find out with the use of each new technology?

CAT scans use X-rays to capture cross-section images of the body, which are then analyzed by computer and formed into a three-dimensional image.



X-rays are good for imaging hard, dense substances, like bone.

MRIs provide information about soft tissue that contains water.



37

Activity 1 Setup

Objective
To investigate the rate of microbial growth at different temperatures.

Materials for each group
- copies of the **This Is Rotten** activity sheet on page 35
- 3 small Petri dishes
- 1 small packet unflavored gelatin
- small saucepan
- 1/2 cup water
- 2 teaspoons sugar
- tape
- one food sample (such as tofu/bean curd, strawberries, or bread)
- knife for slicing
- refrigerator and freezer

Procedure
1 Organize students into groups and distribute materials and activity sheets. With students, determine what food they would like to use in the experiment, and assign each group one sample to study (samples might include tofu/bean curd, strawberries or bread). Also discuss how students will quantify and measure microbial growth rates.

2 Have students predict what will happen to their sample at various temperatures. Then have them prepare the medium that will contain their samples. **Important:** Discuss with students that their medium may not be completely sterile and that what grows in it might not be directly related to their samples. (As an extension, you may have students repeat the experiment using sterile techniques and compare the results with the first experiment.)

3 The containers should be left in a dark place at room temperature. Once microorganisms have begun to grow, have students record the temperature for the refrigerator, freezer, and cupboard or drawer, and then place one of their samples in each environment.

4 Have students check their samples every few days for two weeks and record their observations.

5 To conclude, ask students to describe the differences in the rate of microbial growth among the samples in the different environments, and possible reasons for those differences. Then discuss with students what might be responsible for promoting or inhibiting growth in each specimen.

6 As an **extension**, students could examine their final products unaided, with a hand-held magnifying glass, and then with a 10x (or stronger) microscope and describe what they see.

Standards Connection

The activity found on page 35 aligns with the following **National Science Education Standards.**

Grades 5–8

Science Standard C: Life Science

Populations and ecosystems

- The number of organisms an ecosystem can support depends on on the resources available and abiotic factors, such as quantity of light and water, range of temperatures and soil composition. Given adequate biotic and abiotic resources and no disease or predators, populations (including humans) increase at rapid rates. Lack of resources and other factors, such as predation and climate, limit the growth of populations in specific niches in the ecosystem.

Grades 9–12

Science Standard C: Life Science

Matter, energy and organization in living systems

- The distribution and abundance of organisms and populations in ecosystems are limited by the availability of matter and energy and the ability of the ecosystem to recycle materials.

This Is Rotten

When an organism dies, it begins to be broken down by lots of microorganisms like bacteria and mold. But what happens to the organism at different temperatures? Do this experiment with your own samples and find out!

Materials for your group

- 3 small Petri dishes
- 1 small packet unflavored gelatin
- small saucepan
- 1/2 cup water
- 2 teaspoons sugar
- tape
- your food sample
- knife for slicing
- refrigerator and freezer

Procedure

1 On a separate sheet of paper, predict what you think will happen to your food sample in each environment.

2 Boil 1/2 cup of water. Remove from heat. Add 2 teaspoons of gelatin and 2 teaspoons of sugar. Stir until dissolved. Let the solution cool for 10 minutes. Fill the bottom of each Petri dish about halfway. Put the lids on and let stand overnight. This is your medium to support microbial growth.

3 Collect your assigned food sample, slice into thirds, and place one slice in each Petri dish.

4 Tape, **but don't seal,** the Petri dishes closed (see illustration). Label each dish with the contents and date.

5 Place the dishes in a dark place, such as a cupboard or drawer.

6 Check the samples daily. Make a chart and record daily progress of the microbial growth. Describe color, size, and fuzziness, as well as anything else you see. (Make sure to not touch the samples.) You may want to draw what you see as well.

7 Once you have obtained a quantity of microorganisms growing, record the temperature of the three locations (refrigerator, freezer, and cupboard or drawer) and place one sample in each.

8 Check the samples every few days. Record your observations in your chart. Make sure you don't open your Petri dish once something has started to grow.

9 After two weeks, make your final observations and describe what you see.

Questions

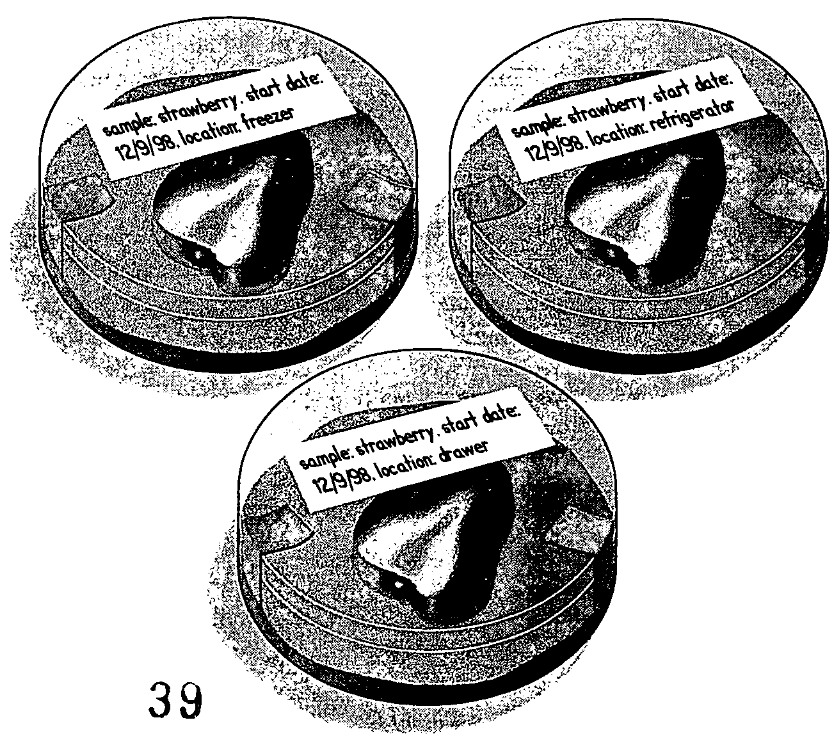
Write your answers on a separate sheet of paper.

1 Which sample showed the most microbial growth? Which showed the least? Why?

2 Did the samples in each environment grow at the same rate or at different rates? Why?

3 What else could you do with the samples to promote microbial growth? What could you do to limit growth?

4 How might an archaeological find, such as a body, be affected by the temperature of the environment in which it is found?

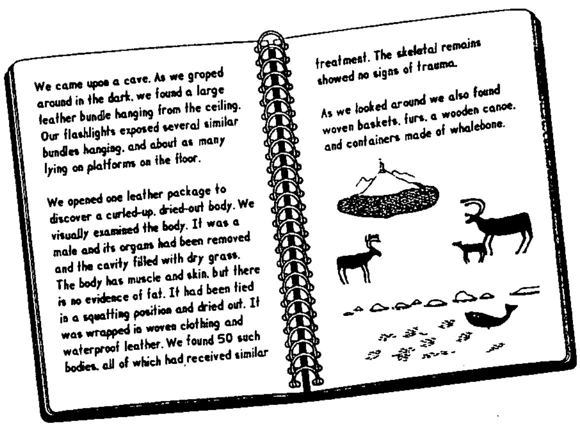


Activity 2 Setup

Objective
To analyze and interpret information in order to locate an archaeological site.

Materials for each group
- copies of the **I Can Dig It!** student activity sheet on page 37

Procedure



1 Organize students into groups and distribute the activity sheets. Have students read the scenario in the Field Journal Notes. Discuss the nature of the clues given and how students might use them in their search. (You may also want to invent your own scenario from a time period or culture you have previously studied.)

2 Have groups research the scenario. You may want to provide hints to students having difficulty solving the mystery. (For example, "You are looking for a northern culture," or "The burial site is located in a chain of volcanic islands.") Once students have completed the activity, have them present their findings to the class and explain how they arrived at their conclusions.

3 As an **extension**, consider having students create their own archaeological field journals. In groups, have students create a description of a burial or dig site, including information about items found, climatic conditions and other clues of their choice. Then have groups exchange clues and try to identify each other's culture and locale.

Standards Connection

The activity found on page 37 aligns with the following **National Science Education Standards.**

Grades 5–8

Science Standard G: History and Nature of Science

Science as a human endeavor
- Science requires different abilities, depending on such factors as the field of study and type of inquiry. Science is very much a human endeavor, and the work of science relies on basic human qualities, such as reasoning, insight, energy, skill, and creativity—as well as on scientific habits of mind, such as intellectual honesty, tolerance of ambiguity, skepticism and openness to new ideas.

Grades 9–12

Science Standard G: History and Nature of Science

Science as a human endeavor
- Individuals and teams have contributed and will continue to contribute to the scientific enterprise. Doing science or engineering can be as simple as an individual conducting field studies or as complex as hundreds of people working on a major scientific question or technological problem.

I Can DIG IT!

You have discovered a journal in your grandmother's attic. The journal is filled with field notes describing the discovery of a fascinating burial site—but the notes do not identify whose burial site it is or where it is located. Your mission is to find out. Use the clues within the notes to guide your search. Good hunting!

Procedure

1 To help you visualize the scene, you might want to make a drawing of the cave based on the description.

2 Then use reference books and any other sources you would like to solve the mystery of what culture this is and where it is located.

Questions

Write your answers on a separate sheet of paper.

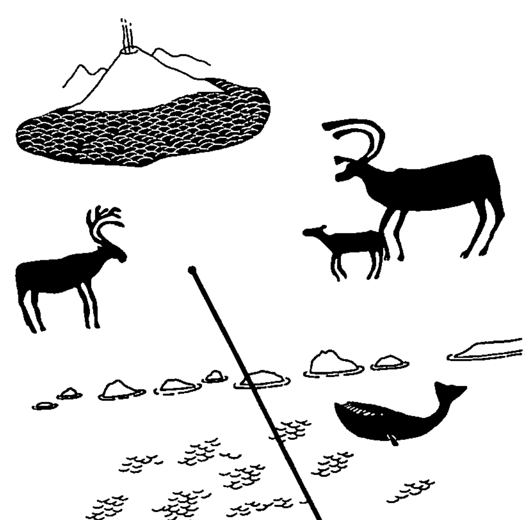
1 What culture is this?

2 Where is the burial site located?

We came upon a cave. As we groped around in the dark, we found a large leather bundle hanging from the ceiling. Our flashlights exposed several similar bundles hanging, and about as many lying on platforms on the floor.

We opened one leather package to discover a curled-up, dried-out body. We visually examined the body. It was a male and its organs had been removed and the cavity filled with dry grass. The body has muscle and skin, but there is no evidence of fat. It had been tied in a squatting position and dried out. It was wrapped in woven clothing and waterproof leather. We found 50 such bodies, all of which had received similar treatment. The skeletal remains showed no signs of trauma.

As we looked around we also found woven baskets, furs, a wooden canoe, and containers made of whalebone.



Think about the clues that might be illustrated here.

Activity 1 Answer

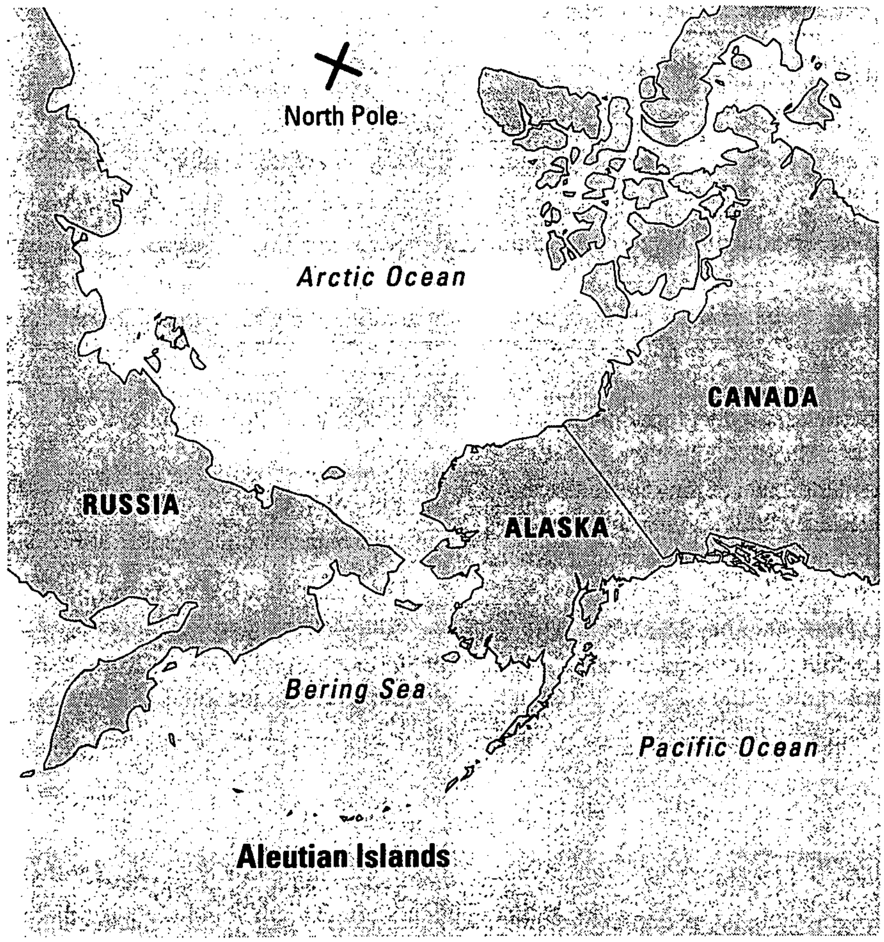
This Is Rotten

Microbial growth will continue to flourish at room temperature, will be slower in the refrigerator, and will be slowed to the extent that growth may not be visible within the given time in the freezer. The microorganisms that have grown in each sample will probably include bacteria, which are single-celled organisms that feed on waste materials and dead organisms. Mold may also be evident.

Activity 2 Answer

I Can Dig It!

The scene depicted is based on an actual Aleut burial site located on the Aleutian Islands off the coast of Alaska. The additional artifacts and cave drawings were added as clues to help students identify the site's culture and location. The Aleutian mummies were hung from the ceiling or set on platforms in this Alaskan cave nearly 260 years ago. These bodies were mummified just before 1740.



The clues can be used in a variety of ways to solve the mystery of whose burial site this is. For example, the presence of furs, whalebone and a canoe suggest that the culture is from a northern location near water, which may lead students to investigate Alaska, Russia, Greenland, Iceland and Norway. Depictions of sheep, moose and caribou on the cave walls help students pinpoint Alaska as the region in which this culture resides. Cave drawings depicting a chain of islands surrounded by water pinpoint Alaska as the land mass. If students then research where volcanoes are found in Alaska, they will discover that almost all of Alaska's active volcanoes are in the Aleutian arc. This should lead them to seek out information about the Aleuts, which will reveal that the burial site is theirs. (Students who choose to use volcanoes alone to as a method to pinpoint the location will find that a number of volcanoes exist in Alaska, Russia and Iceland.)

Resources

Books

Lauber, Patricia. *Painters of the Cave.* Washington, D.C.: National Geographic Society, 1998.
Provides an introduction to Ice Age people. Text and images depict artifacts and cave paintings left behind by ancestors of modern humans.

Moseley, Michael Edward. *The Incas and Their Ancestors: The Archaeology of Peru.* New York, NY: Thames and Hudson, 1992.
Provides the prehistory of the Andean region, including a thorough summary of Inca civilization.

Articles

Reinhard, Johan. "Research Update: New Inca Mummies." *National Geographic* (July 1998): 128–135.
Describes the December 1997 return of Reinhard and his crew of archaeologists to the summit of Pichu Pichu in the Peruvian Andes to discover more human ritual remains, gold figurines and other evidence of the Inca heritage.

Web Sites

NOVA Online—Ice Mummies
http://www.pbs.org/icemummies/
This Web site, originally a NOVA/PBS Online Adventure launched in Fall 1996, will provide updated information about the archaeological expeditions that discovered three different ice mummies.
Launch date: November 24, 1998.

Mummies 101
http://www.pbs.org/nova/chinamum/mummies101.html
Contains information about mummification, specifically the practices of the Aleut. **Note:** This site contains some graphic photos. Preview first to determine its appropriateness for your students.

Ice Treasures of the Inca
http://www.nationalgeographic.com/features/96/mummy/index.html
Contains extensive information on the Inca ice mummies.

The Incas
http://vif27.icair.iac.org.nz/People/Inca.htm
Provides information on the Inca religion, culture, agriculture and roads, as well as background on the Spanish Conquest and the Cuzco and Machu Picchu archaeological sites.

Archaeology
http://www.archaeology.org/
Archaeology is an online and print publication of the Archaeological Institute of America. The site includes articles about current archaeological topics and a news brief about the Iceman's return to Italy.

WGBH BOSTON VIDEO

The following 8 pages is a complete listing of NOVAs available on video.

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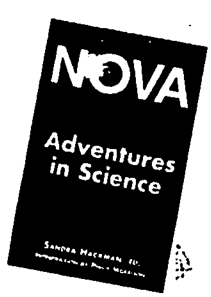


This commemorative companion book to the award-winning series celebrates 25 years of scientific discoveries in the fields of space exploration, genetics, computer science, neuroscience and the environment as documented on the hugely popular PBS series. (6" x 9", cloth cover, 256 pages, black & white photos) WG546 ~~$24.95~~ $18.50 *Available 11/98.*

CC NOVA videos are closed-captioned for the hearing impaired.

* Individual videos, not including shipping and handling; this offer good through June 30, 1999.

Forces of Nature

Adrift on the Gulf Stream

Explore the Stream's importance to ocean life, climate and human history. Writer Bill MacLeish travels its full course, sailing on top of it, under it and viewing its mighty swirl via satellites in space. *Educational Use Only.* 1 hr. **WG1606*** ~~$19.95~~ **$9.95**

Avalanche!

With no warning and in mere seconds, an avalanche wipes out everything in its path, killing hundreds of people each year. See what risks scientists are taking to protect us. 1 hr. **WG2418N** ~~$19.95~~ **$9.95**

NEW Chasing El Niño!

As scientists push to extremes to explore El Niño they are understanding for the first time the extent to which all the world's weather is connected, and just how delicate is the balance. 1 hr. **WG2512** ~~$19.95~~ **$9.95 Available 10/98.**

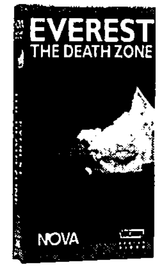
Cracking the Ice Age

Could the Himalayas be the cause of one of the planet's most dramatic climactic changes—the ice age? Take a trek to Tibet with a renegade band of researchers bent on proving this controversial concept. *Educational Use Only.* 1 hr. **WG2320*** ~~$19.95~~ **$9.95**

NEW Deadly Shadow of Vesuvius

See why new geological evidence suggests that Mount Vesuvius —infamous for the demise of ancient Pompeii—may pose a new threat to the contemporary city of Pozzouli. 1 hr. **WG2515** ~~$19.95~~ **$9.95 Available 11/98.**

NEW Everest— The Death Zone



Witness first hand why rational people can make astonishingly poor, and sometimes fatal, decisions on the world's highest peak. Narrated by Jodie Foster. 1 hr. **WG2506** ~~$19.95~~ **$9.95**

Flood!

Relive one of the greatest flood disasters—the Mississippi River in the summer of 1993—and explore the problem of taming the mightiest river. 1 hr. **WG2307** ~~$19.95~~ **$9.95**

Hawaii Born of Fire

Behold the fiery moonscapes and lush rain forests surrounding Hawaii's active volcanoes. *Educational Use Only.* 1 hr. **WGH2211** ~~$19.95~~ **$9.95**

Journey to the Sacred Sea

Travel to Lake Baikal, the world's oldest and deepest lake. Watch *NOVA* chart its dramatically changing environment over the course of four seasons. *Educational Use Only.* 1 hr. **WG2119*** ~~$19.95~~ **$9.95**

Natural Disasters Gift Set

Natural disasters strike with little or no warning—making them uniquely frightening and fascinating. Still, scientists continue to search for ways to guard us against nature's fury. 3-video set includes *The Day the Earth Shook*, *Tornado!*, and *In the Path of a Killer Volcano*. 3 hrs. **WG165** ~~$49.95~~ **$24.95**

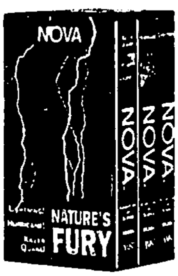
The Day the Earth Shook

Does a devastating earthquake lurk beneath Los Angeles? Have we learned any lessons from the past? Watch terrifying scenes from Kobe, Japan, and Northridge, California—and find out how new warning and rescue technology could protect us if it's put into place in time. 1 hr. **WG2302** ~~$19.95~~ **$9.95**

Tornado!
Travel with "stormchasers" as they view the awesome power of tornadoes sweeping across the land and seek to understand how they are created. 1 hr. **WG1217** ~~$19.95~~ **$9.95**

In the Path of a Killer Volcano!
The Philippines' Mount Pinatubo is about to blow big. Is there enough time to evacuate the hundreds of thousands in its raging path? Stay with the scientists who remain behind—and see some astonishing footage of the world's largest volcanic eruption in 80 years. 1 hr. **WG2005** ~~$19.95~~ **$9.95**

Nature's Fury Gift Set



Witness the awesome power of nature and then travel with the "stormchasers" into danger in an effort to better understand and predict these extraordinary cataclysms. 3-video set includes *Hurricane!*, *Lightning!* and *Killer Quake!*. 3 hrs. **WG027** ~~$49.95~~ **$24.95**

Hurricane!
Witness nature's fury as hurricanes Camille and Gilbert crash onto the Gulf coast. 1 hr. **WG1616** ~~$19.95~~ **$9.95**

Lightning!
Join an adventurous investigation into the source of lightning, nature's most dazzling and dangerous display, and take a front seat for nature's electrifying light show set to music. 1 hr. **WGA2213** ~~$19.95~~ **$9.95**

Killer Quake!
Relive the L.A. earthquake, and preview what it portends for California's future... 1 hr. **WG2116** ~~$19.95~~ **$9.95**

NEW Warnings From the Ice
Battle extreme weather conditions in Antarctica with *NOVA* scientists as they gather data that will reveal new insight into the nature of global climate change. 1 hr. **WG2508** ~~$19.95~~ **$9.95**

Culture and Exploration

NEW Ice Mummies Gift Set
Witness fascinating accounts of cutting-edge science and archaeology delving into the mysteries of frozen human remains. 3-video set includes *Frozen in Heaven*, *Siberian Ice Maiden* and *Return of the Iceman*. 3 hrs. **WG2525** ~~$49.95~~ **$24.95 Available 11/98.**

NEW Frozen in Heaven
The bizarre and fascinating story of the remains of Inca culture, frozen for posterity high in the mountains of the Andes. 1 hr. **WG2516** ~~$19.95~~ **$9.95 Available 11/98.**

NEW Siberian Ice Maiden
Mummified and then frozen by freak climactic conditions around 2400 years ago, the Siberian Ice Lady is believed to have been a shamaness of the lost Pazyryk culture. Her body has now been restored, and is providing new clues as to the role and power of women in the nomadic peoples of ancient Siberia. 1 hr. **WG2517** ~~$19.95~~ **$9.95 Available 11/98.**

NEW Return of the Iceman
Cutting-edge science and archaeology is reconstructing the life and culture of The Iceman—the five thousand year-old frozen corpse found buried in the ice of the Alps. 1 hr. **WG2518** ~~$19.95~~ **$9.95 Available 11/98.**

Iceman
NOVA covers the international efforts to unlock the secrets behind the mummified body of a man who lived over 5,000 years ago, discovered in the Alps by two German hikers. *Educational Use Only.* 1 hr. **WG1916*** ~~$19.95~~ **$9.95**

In Search of Human Origins Gift Set
The award-winning exploration of the beginnings and expansion of the human race. 3-video set includes *The Story of Lucy*, *Surviving in Africa* and *The Creative Revolution*. 3 hrs. **WGW2111** ~~$49.95~~ **$24.95**

The Story of Lucy
Discover the missing link between humans and apes. 1 hr. **WGW2106** ~~$19.95~~ **$9.95**

Surviving in Africa
Witness a living experiment to understand how early humans thrived. 1 hr. **WGW2107** ~~$19.95~~ **$9.95**

The Creative Revolution
Examine the world-wide expansion and evolution of the human race. 1 hr. **WGW2108** ~~$19.95~~ **$9.95**

In Search of the First Language
NOVA explores the common threads that link the more than 5,000 languages of Earth, including a controversial theory that claims to reconstruct words from a time when only a handful of languages were spoken, recalling the biblical story of the Tower of Babel. *Educational Use Only.* 1 hr. **WG2120*** ~~$19.95~~ **$9.95**

Lost City of Arabia
The secrets of Ubar, ancient city of mystery from the *Arabian Nights* which vanished in the shifting desert sands, are revealed as archaeology and space-age intelligence team up. *Educational Use Only.* 1 hr. **WG2312*** ~~$19.95~~ **$9.95**

NEW Mysterious Mummies of China
Perfectly preserved 3000-year-old mummies have been unearthed in a remote Chinese desert, but they have long, blonde hair and blue eyes. New evidence of the lost civilization of the Tocharians along the Silk Road offers more clues to this mystery from the past. 1 hr. **WG2502** ~~$19.95~~ **$9.95**

Nazi Designers of Death
The discovery of top-secret Nazi files reopens a painful chapter in history, revealing the careful planning behind the Nazi death camps. *Educational Use Only.* 1 hr. **WG2205*** ~~$19.95~~ **$9.95**

Nomads of the Rainforest
Visit the unique tribe of the Waironi Indians in eastern Ecuador. 1 hr. **WG1112*** ~~$19.95~~ **$9.95**

NEW The Perfect Pearl
Travel with *NOVA* to exotic locations where rare pearls are harvested by divers, and to farms where huge numbers of pearls are grown. Will the cultured pearls ruin the value of those grown in the wild? 1 hr. **WG2507N** ~~$19.95~~ **$9.95 Available 12/98.**

NEW Search for the Lost Cave People
Discover a lost civilization that inhabited caves high on the isolated cliffs of Southern Mexico nearly 1,000 years ago. The tantalizing clues, including graphic evidence of ritual child sacrifice and a sophisticated writing system, shed new light on this mysterious people, the Zoqui, who may have been precursors of the Mayans. 1 hr. **WG2507** ~~$19.95~~ **$9.95**

The Tribe That Time Forgot
NOVA travels deep into the Amazon wilderness in search of a mysterious tribe that dismembered and partially ate three prospectors in 1976. Locating the group, *NOVA* lives with them for three months, gaining insight into the customs and beliefs of a people whose lifestyle has not changed for centuries. *Educational Use Only.* 1 hr. **WG2115** ~~$19.95~~ **$9.95**

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WGBH BOSTON VIDEO

Vikings in America
Five hundred years before Columbus, the Vikings reached North America. Who were the people they met here? What happened when the two worlds collided? Archaeologists are now revealing an extraordinary story of tragedy and triumph. *Educational Use Only.* 1 hr. **WG2202*** ~~$19.95~~ **$9.95**

Warriors of the Amazon
See a rare glimpse of life today for the Yanomami, who live in a remote and inhospitable part of the Amazon rain forest. 1 hr. **WG2309** ~~$19.95~~ **$9.95**

Wonders of the World

A Man, A Plan, A Canal, Panama
Travel the Panama Canal on a luxury liner with David McCullough as he tells the human drama behind this wonder of the world. 1 hr. **WG1415*** ~~$19.95~~ **$9.95**

Secrets of Lost Empires Gift Set
Uncover the secrets of ancient civilizations as *NOVA* journeys to five archaeological sites where teams of experts use traditional techniques to test their hypotheses. 5-video set includes *Colosseum, Inca, Obelisk, Stonehenge* and *Pyramid.* 5 hrs. **WG182** ~~$69.95~~ **$34.95**

Colosseum
Try out two possible designs for the canopy that once covered the Colosseum—one of them borrowed from ancient ships. 1 hr. **WG2406** ~~$19.95~~ **$9.95**

Inca
Explore the magnificent mountainside citadels—and marvel as villagers create a 150-foot suspension bridge using nothing but grass. 1 hr. **WG2404** ~~$19.95~~ **$9.95**

Obelisk
Face the challenge of quarrying, chiseling, hauling, and mounting an obelisk—using stones, ropes, logs, and dirt. 1 hr. **WG2405** ~~$19.95~~ **$9.95**

Stonehenge
Watch a band of experts move, raise, and cap a structure like the mysterious Stonehenge—armed with Stone Age tools. 1 hr. **WG2403** ~~$19.95~~ **$9.95**

Pyramid
Join the race to erect an 18-foot stone pyramid in three weeks—while testing out some clever construction theories. 1 hr. **WG181** ~~$19.95~~ **$9.95**

Super Bridge


Take a look at "the bridge of the future" and play sidewalk supervisor on one of the world's most remarkable and risky bridge projects—the building of the elegant, cable-stayed Clark Bridge spanning the Mississippi at Alton, Illinois. 2 hrs. **WG2416** ~~$19.95~~ **$9.95**

This Old Pyramid
Join an Egyptologist as he reveals the secrets of the ancient pyramids and advises a stonemason from *This Old House* on how to build a new pyramid. 90 mins. **WGW278** ~~$19.95~~ **$9.95**

Titanic's Lost Sister


Titanic's sister ship is surrounded by mystery. Search for the wreck of the *Britannic* and explore the clues as to how it sank. Four years after the *Titanic* went down, the *Britannic* sank in just one hour, despite an overhaul to meet post-*Titanic* standards. 1 hr. **WG2402** ~~$19.95~~ **$9.95**

Treasures of the Sunken City
It's an undersea adventure in Cleopatra's erstwhile capital: Alexandria, Egypt, where marine archaeologists are frantically salvaging mysterious stone ruins from the harbor floor. 1 hr. **WG2417** ~~$19.95~~ **$9.95**

Space and Flight

Countdown to the Invisible Universe
Infrared telescopes unveil the outer regions of space. 1 hr. **WG1401** ~~$19.95~~ **$9.95**

Danger in the Jet Stream
Climb aboard and experience the exhilaration—and the terror—of trying to fly a balloon around the world. 1 hr. **WG2419*** ~~$19.95~~ **$9.95**

The Doomsday Asteroid
Join the hunt to scan the skies and earth for evidence that giant rocks from outer space have struck before and will strike again. *Educational Use Only.* 1 hr. **WGD2212*** ~~$19.95~~ **$9.95**

Faster Than Sound
The international race to build an aircraft that could crack the sound barrier was fraught with danger, ambition, and intrigue. *NOVA* tells the real story of those who risked all to make aviation history—including Chuck Yeager, who on October 14, 1947 was the first pilot to fly faster than sound. 1 hr. **WG2412** ~~$19.95~~ **$9.95**

Flying the Blimp
Revisit the giant airships that ruled the skies—before the Hindenburg disaster dashed their promise—and find out how latter-day blimp builders are resurrecting these romantic lighter-than-air machines. 1 hr. **WG1714** ~~$19.95~~ **$9.95**

Hunt for Alien Worlds
All eyes are on the heavens in the search for planets around other stars, probably the best hope for showing that we may not be alone in the universe. *NOVA* covers an effort that is turning up more and more new worlds. *Educational Use Only.* 1 hr. **WG2407*** ~~$19.95~~ **$9.95**

The Light Stuff
Reliving a Greek myth takes an effort of mythic proportions, as *NOVA* reveals in its behind-the-scenes report of the recent human-powered flight across the Aegean Sea. *Educational Use Only.* 1 hr. **WGW711*** ~~$19.95~~ **$9.95**

Mysterious Crash of Flight 201
The investigation of a mysterious jetliner crash in Panama. 1 hr. **WGW707** ~~$19.95~~ **$9.95**

The Mystery of Space Set
Travel into space to uncover the mysteries and wonders of our galaxy. 3-video set includes *Death of a Star, Eclipse of the Century* and *Rescue Mission in Space.* 3 hrs. **WG162** ~~$49.95~~ **$24.95**

Death of a Star
Witness one of the most spectacular events since creation—the supernova. 1 hr. **WG1411** ~~$19.95~~ **$9.95**

Eclipse of the Century
The race to view and study celestial splendor. 1 hr. **WG1910** ~~$19.95~~ **$9.95**

Rescue Mission in Space
Witness the dramatic space repair of the Hubble Telescope and view the stunning images of space that it now produces. 1 hr. **WG2118** ~~$19.95~~ **$9.95**

NEW Supersonic Spies


This true tale of cold war espionage tells the shocking details of the race for supersonic passenger travel. 1 hr. **WG2503** ~~$19.95~~ **$9.95**

NEW **Terror in Space**
Witness the harrowing and life-threatening problems aboard the aging Mir space station through the eyes of the Russian and American astronauts who lived through them. *Educational Use Only.* 1 hr.* **WG2513** ~~**$19.95**~~ **$9.95 Available 10/98.**

Three Men and a Balloon
For a few diehard daredevils, it's "the last great challenge in aviation": to fly a balloon non-stop around the world—simply because it's never been done before. Follow one of the foremost teams in a hair-raising race against time, technology, and hot competition. 1 hr. **WG2313** ~~**$19.95**~~ **$9.95**

The Thrill of Flight Set
A rare opportunity to fly in some of the world's most fascinating airplanes. 3-video set includes *Aircraft Carrier!*, *Daredevils of the Sky* and *B-29 Frozen in Time.* 3 hrs. **WG163** ~~**$49.95**~~ **$24.95**

Aircraft Carrier!
The grueling, yet suddenly thrilling, life aboard the USS Independence. 1 hr. **WGW2110** ~~**$19.95**~~ **$9.95**

Daredevils of the Sky
Strap in for a ride with America's greatest stunt pilots. Stunning in-air photography puts you in the pilot's seat with the U.S. Aerobatic Team. 1 hr. **WGW2103** ~~**$19.95**~~ **$9.95**

B-29 Frozen in Time
Join a grueling expedition to recover this rare plane from the North Pole after 50 years—a trip which tests team members in ways they never imagined. 1 hr. **WG2303** ~~**$19.95**~~ **$9.95**

Top Gun Over Moscow
For half a century we feared them. Now, for the first time, meet the rugged pilots of the Russian Air Force—and take a close-up look at the heart-stopping maneuvers that still fill Western flyers with awe. 1 hr. **WG2315** ~~**$19.95**~~ **$9.95**

Venus Unveiled
Travel with the spacecraft *Magellan* as it flies by Venus to reveal the planet's true face, one of the most bizarre places in the solar system. *Educational Use Only.* 1 hr. **WGV2210*** ~~**$19.95**~~ **$9.95**

Scientific Detectives

The Best Mind Since Einstein
A profile of the late Richard Feynman—atomic bomb pioneer, Nobel prize-winning physicist, acclaimed teacher and all-around eccentric—who helped solve the mystery of the space shuttle *Challenger* explosion. *Educational Use Only.* 1 hr. **WGW708*** ~~**$19.95**~~ **$9.95**

Can Buildings Make You Sick?
Join the quest to uncover baffling cases of bad air found in offices, schools, homes and even hospitals! *Educational Use Only.* 1 hr. **WG2217*** ~~**$19.95**~~ **$9.95**

Chip vs. the Chessmaster
NOVA explores what it took to prepare *Deep Thought*, a computer chess program, to take on world champion Gary Kasparov in 1989. *Educational Use Only.* 1 hr. **WG1803*** ~~**$19.95**~~ **$9.95**

Codebreakers
NOVA delves into the history of secret communications and the people who decipher them, probing the most celebrated of all cryptographic coups: the breaking of the World War II codes used by Japan and Germany. *Educational Use Only.* 1 hr. **WGW2101*** ~~**$19.95**~~ **$9.95**

Einstein Revealed

Journey into the life and thoughts of a genius—through interviews with "Einstein" (Andrew Sachs of *Fawlty Towers*), insight from experts, and some whimsical computer animation. 2 hrs. **WG2311*** ~~**$19.95**~~ **$9.95**

NEW **The Proof**
Eureka! Follow Princeton math whiz Andrew Wiles, who spent eight secluded years perfecting the proof of Fermat's Last Theorem, a famous enigma that had stumped experts for 300 years. *Educational Use Only.* 1 hr. **WG2414*** ~~**$19.95**~~ **$9.95**

Wanted: Butch and Sundance
Forensic sleuth, Clyde Snow, and a posse of experts travel to Bolivia in search of the remains of Butch Cassidy and the Sundance Kid. They find that Hollywood and legend got a few things wrong. *Educational Use Only.* 1 hr. **WGW702*** ~~**$19.95**~~ **$9.95**

Animals and Nature

All-American Bear
Share a year in the life of the North American black bear—mating, playing, foraging for food, and hibernating. 1 hr. **WG1520*** ~~**$19.95**~~ **$9.95**

NEW **Animal Hospital**

Go behind the scenes for this off-beat, sometimes humorous, sometimes sad portrait of pets, their owners and their vets. From racehorses under the knife for cancer, to Manhattan hounds on Prozac, you'll view the mini-dramas that unfold everyday in homes, zoos and veterinary hospitals. 1 hr. **WG2504** ~~**$19.95**~~ **$9.95**

Animal Imposters
A gnarled twig. A stretch of sand. A shadow. Suddenly they twitch—or lunge—and you realize you've been taken in by a cleverly disguised animal. 1 hr. **WG909*** ~~**$19.95**~~ **$9.95**

Buried in Ash
Learn what life was like ten million years ago when an enormous volcanic eruption buried much of what is now Nebraska in up to ten feet of ash, preserving countless skeletons of prehistoric big game animals. 1 hr. **WG2117*** ~~**$19.95**~~ **$9.95**

City of Coral
Dive into the beauty and wonder of a Caribbean coral reef. 1 hr. **WG1006*** ~~**$19.95**~~ **$9.95**

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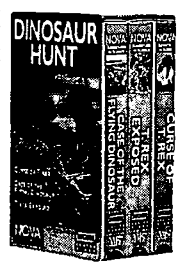
Creatures of the Sea Set
Experience the undersea beauty of the Pacific Ocean. 2-video set includes *Treasures of the Great Barrier Reef* and *Kingdom of the Seahorse.* 2 hrs. **WG738** ~~**$29.95**~~ **$14.95**

Treasures of the Great Barrier Reef
Swim through a day in the life of Australia's greatest natural wonder, and view the undersea world's brilliant colors and extraordinary inhabitants. 1 hr. **WG2215** ~~**$19.95**~~ **$9.95**

Kingdom of the Seahorse
Discover this remarkable fish whose male becomes pregnant and gives birth. Tour the magical and complex world of the seahorse—from an under-water enclave in Australia to a village in the Philippines dependent on the seahorse for survival. 1 hr. **WG2410** ~~**$19.95**~~ **$9.95**

Dinosaur Hunt Gift Set



Of all the creatures that ever walked the earth, none captures the human imagination like the dinosaur. See scientists offer important clues to the mystery of the evolution of life. 3-video set includes *Curse of T. rex*, *Case of the Flying Dinosaur* and *T. rex Exposed.* 3 hrs. **WG737** ~~**$39.95**~~ **- $19.95**

Curse of T. rex
An unusual battle is brewing: Who gets to keep "Sue," a magnificent million-dollar T. rex that turned up on a South Dakota ranch? Everyone wants a piece of her, from the tribal council to the fossil dealers to the scientists. Head out west and join the investigation in this tale of fossil crime and punishment. 1 hr. **WG2408** ~~**$19.95**~~ **$9.95**

Case of the Flying Dinosaur
Explore the link between dinosaurs and birds, and tune in to the fierce debate—about whether dinosaurs are truly extinct—that continues to captivate no matter how you choose to draw the family tree. 1 hr. **WG1805** ~~$19.95~~ **$9.95**

T. rex Exposed
Go on a suspenseful dig in Montana, where a crew is carefully uncovering one of the most complete Tyrannosaurus rex specimens ever found. 1 hr. **WG1806** ~~$19.95~~ **$9.95**

Dinosaurs of the Gobi
NOVA accompanies an American Museum of Natural History expedition to the Gobi Desert. The trip relives the exploits of the Museum's dashing explorer of the 1920s, Roy Chapman Andrews—said to be the real-life model for Indiana Jones. *Educational Use Only.* 1 hr. **WGW2102*** ~~$19.95~~ **$9.95**

The Great Wildlife Heist
NOVA goes undercover with a U.S. government sting that breaks an international parrot smuggling ring, landing some surprising suspects. *Educational Use Only.* 1 hr. **WG2111*** ~~$19.95~~ **$9.95**

Haunted Cry of a Long Gone Bird
NOVA explores the legacy of the great auk, a magnificent flightless bird that was hunted to extinction over a century ago. *Educational Use Only.* 1 hr. **WG2113*** ~~$19.95~~ **$9.95**

Journey to Kilimanjaro
Travel from an equatorial blizzard on Mount Kenya to the majestic crown of the mighty Kilimanjaro. *Educational Use Only.* 1 hr. **WGW2104*** ~~$19.95~~ **$9.95**

Little Creatures Who Run the World
Peer close-up into the worlds of the most amazing ants and understand why some believe ants are the most successful life form on earth. 1 hr. **WG2203** ~~$19.95~~ **$9.95**

Mammoths of the Ice Age
Watch scientists piece together a picture of the life our ancestors shared with the woolly mammoth. *Educational Use Only.* 1 hr. **WG2201*** ~~$19.95~~ **$9.95**

Mystery of the Animal Pathfinders
Travel to bird feeding grounds in Brazil, bat caves in Mexico and eel habitats in Maine to understand the mystery of animal migration. 1 hr. **WGW710*** ~~$19.95~~ **$9.95**

NEW Night Creatures of the Kalahari

Discover bush babies, meerkats, striped polecats, brown hyenas, flying termites, and many more rarely seen exotic creatures. 1 hr. **WG2501** ~~$19.95~~ **$9.95**

The Private Lives of Dolphins
Discover the deep-sea drama of life for the ocean's most charming and sophisticated mammals. 1 hr. **WG1917*** ~~$19.95~~ **$9.95**

Rescuing Baby Whales
Join the dramatic rescue of young, stranded pilot whales, and learn what is behind this puzzling phenomenon. 1 hr. **WG1908*** ~~$19.95~~ **$9.95**

Shadow of the Condor
NOVA soars with the condor, an extraordinary bird that lives a tenuous existence in the California mountains and the Andes of South America. *Educational Use Only.* 1 hr. **WGW705*** ~~$19.95~~ **$9.95**

The Shape of Things
Marvel at the endlessly inventive patterns of natural objects like crystals, honeycombs, seashells, eggs and seeds through photomicroscopy, computer animation and time-lapse photography. 1 hr. **WG1206*** ~~$19.95~~ **$9.95**

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Shark Attack!
Are sharks developing a taste for human flesh? A rash of shark attacks off Hawaii spurs a team of researchers to track the predators' elusive movements—and the scientists discover some surprising truths about the way sharks kill. 1 hr. **WG2316** ~~$19.95~~ **$9.95**

Physics & Chemistry

Race to Catch a Buckyball
Learn about the chance discovery of an entirely new form of carbon—soccer-ball-shaped miraculous molecules called Buckyballs. *Educational Use Only.* 1 hr. **WG2216*** ~~$19.95~~ **$9.95**

Roller Coaster!
NOVA takes viewers on the ride of their lives as it explores the science of roller coasters, where physics and psychology meet. New rides of the future may take place entirely in the mind—with virtual reality. *Educational Use Only.* 1 hr. **WGW706*** ~~$19.95~~ **$9.95**

War & Technology

Behind the Scenes with King Kong in Special Effects
Welcome to the wild world of special effects, where anything can happen! *NOVA* takes you behind the scenes as effects experts bring a legend to life in this exclusive look at how King Kong was created for the Oscar®-nominated IMAX film *Special Effects.* 1 hr. **WG093** ~~$12.95~~ **$6.50**

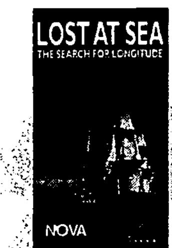
Bomb Squad
A former IRA member reveals some of the organization's most chilling tactics as *NOVA* looks at the British Army's latest technological advances—in which science and ingenuity are the key to survival. 1 hr. **WG2413** ~~$19.95~~ **$9.95**

Fast Cars
The exhilaration of speed meets the challenges of aerodynamic design as champion driver Bobby Rahal and a team of experts race to ready his custom car for the Indianapolis 500. 1 hr. **WG2208** ~~$19.95~~ **$9.95**

Kaboom!
Experience the ultimate chemical reaction—the explosion. With high speed photography and dramatic reconstructions, *NOVA* examines the history of explosives and their role in accidents, war and terrorism. 1 hr. **WG2401** ~~$19.95~~ **$9.95**

The KGB, the Computer and Me
NOVA follows computer sleuth Clifford Stoll as he tracks down a data thief through a maze of military and research computers. 1 hr. **WG1710*** ~~$19.95~~ **$9.95**

NEW Lost at Sea: The Search for Longitude



One of humankind's most epic quests—navigation beyond the sight of land—is celebrated in the story of John Harrison, an English clockmaker, and an adventurous expedition demonstrating the life and death importance of finding longitude at sea. 1 hr. **WG2511** ~~$19.95~~ **$9.95 Available 10/98.**

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The Science of Crime Gift Set

Serial criminals wield a particular brand of terror. Fortunately for us, scientific sleuths are on their trail. 3-video set includes *The Bombing of America, Mind of a Serial Killer* and *Hunt for the Serial Arsonist.* 3 hrs. **WG164** ~~$40.95~~ **$24.95**

The Bombing of America

Follow investigators using the latest forensic techniques and psychological insights to crack such notorious cases as the World Trade Center and the Unabomber—as well as many lesser-known, tragic incidents. 1 hr. **WG2310** ~~$19.95~~ **$9.95**

Mind of a Serial Killer

Follow the FBI's psychological detectives as they race against time to penetrate the mind of a serial killer—and stop him from striking again. 1 hr. **WG1912** ~~$19.95~~ **$9.95**

Hunt for the Serial Arsonist

Trail along with fire sleuths as they discover the mysterious source of a series of LA. store fires, and capture a surprising suspect filmed by *NOVA.* 1 hr. **WGA2214** ~~$19.95~~ **$9.95**

Secrets of Making Money

Learn the secrets of counterfeiting—made easier by today's technology—and find out what the Feds are doing to fight back: a new look for US currency, with layers of security features to keep counterfeiters at bay. 1 hr. **WG2314*** ~~$19.95~~ **$9.95**

Terror in the Minefields

Investigate the terror and tragedy of Cambodia's deadly legacy of minefields. 1 hr. **WG2301** ~~$19.95~~ **$9.95**

War Machines of Tomorrow

Take a look back at the war technology employed in the Gulf War, "Desert Storm," and preview the military machines of the future. 1 hr. **WG2305** ~~$19.95~~ **$9.95**

Health and Wellness

NEW The Brain Eater

Highly infectious and incurable, "mad cow disease" has claimed the lives of nearly a million cattle in Britain. Scientists race to determine whether a variant of the disease spells a deadly epidemic for humans. *Educational Use Only.* 1 hr. **WG2505*** ~~$19.95~~ **$9.95**

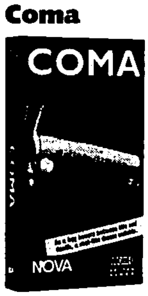
NEW Brain Transplant

NOVA follows a remarkable, little-known, medical detective story, leading from an inexplicable paralysis among drug abusers, to a bad batch of synthetic heroin, to a research breakthrough in understanding Parkinson's Disease, to the prospect of curing brain diseases with fetal implants. *Educational Use Only.* 1 hr. **WG1918*** ~~$19.95~~ **$9.95**

Can China Kick the Habit?

NOVA visits the most cigarette-addicted nation in the world—China. Western advertising and trading practices have exacerbated the fatal problem where lung cancer cases are beginning to strain the nation's health care system. *Educational Use Only.* 1 hr. **WGW2109*** ~~$19.95~~ **$9.95**

Coma



In a gripping real-life drama, NOVA follows famous neurosurgeon Jam Ghajar as he struggles to save a young boy with massive head trauma, using simple but crucial techniques that are dangerously absent from most hospitals across the country. 1 hr. **WG2411** ~~$19.95~~ **$9.95**

Cut to the Heart

Can a radical form of surgery from the jungles of Brazil save desperately ill heart-disease patients? Watch this cutting-edge procedure in action—and listen to the stories of those whose lives it has renewed. 1 hr. **WG2409** ~~$19.95~~ **$9.95**

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Witness an absorbing view of one of this century's most influential Americans and his profound impact on changing ideas about child care. *Educational Use Only.* 1 hr. **WG2308*** ~~$19.95~~ **$9.95**

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NOVA covers the tense vigil of three people with terminal lung disease as they await the most complex of all organ transplants—a new lung. Months of waiting end in a few frenzied hours of intricate surgery. *Educational Use Only.* 1 hr. **WGW704*** ~~$19.95~~ **$9.95**

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The Ebola virus and its devastating impact is profiled as *NOVA* travels behind the quarantine line to observe the scientists battling to contain this most deadly of viruses. 1 hr. **WG2304** ~~$19.95~~ **$9.95**

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Hidden from the human eye, the wonder of life unfolds in, on and around us with startling beauty and unexpected drama. 4-video set includes *The Odyssey of Life Set* (*The Ultimate Journey, The Unknown World, The Photographer's Secrets*) and *The Miracle of Life.* 4 hrs. **WG177** ~~$59.95~~ **$29.95**

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Travel with the creator of *The Miracle of Life* into the mysterious and previously invisible world inside our bodies. The 3-video set includes *The Ultimate Journey, The Unknown World* and *The Photographer's Secrets.* 3 hrs. **WGB2317** ~~$49.95~~ **$24.95**

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Stunning microphotography by Lennart Nilsson shows how the developing human embryo reveals links to other species—reflecting a shared ancestry that harks back to the dawn of creation. 1 hr. **WG2317** ~~$19.95~~ **$9.95**

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They're hiding in your closet. They're lurking in your bed. They're all over you—and now, thanks to the microphotography of Lennart Nilsson, you can catch these creepy crawlers in the act, magnified to monster size. 1 hr. **WG2318** ~~$19.95~~ **$9.95**

The Photographer's Secrets

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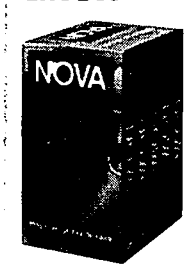

Enjoy a celebration of the senses— a vivid blend of science and imagery. 5-part series includes *Hearing, Smell, Taste, Touch* and *Vision.* 5 hrs. **WG2214**† ~~$69.95~~ **$34.95**

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NOVA profiles "Genie," a girl whose parents kept her imprisoned in near total isolation from infancy. Includes footage of Genie during her rehabilitation and probes how and when we learn the skills that make us "human." *Educational Use Only.* 1 hr. **WG2112*** ~~$19.95~~ **$9.95**

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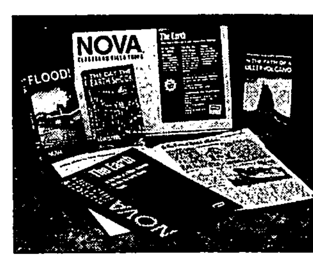

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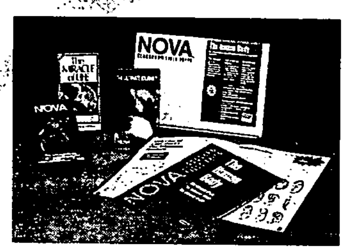

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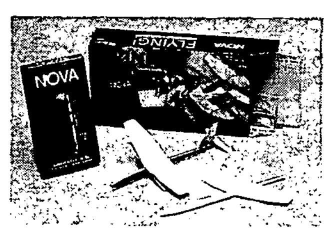

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