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Curriculum Connections

Scientific Connections and Applications
Understand and describe specific examples (historical and contemporary, reflecting diversity) of the importance of scientists, science, and technology in their lives, such as how computer scientists design smaller and more powerful tools.

Scientific Communication
Acquire information from observation, experimentation, print, and non-print sources.

** Based on the New York State Elementary Science Core Curriculum and the New York City New Standards™*

National Standards

Content Standard E: Science and Technology
- Abilities of technological design
- Understanding about science and technology
- Abilities to distinguish between natural objects and objects made by humans

Content Standard G: History of Nature and Science
- Science as a human endeavor

3-5 Exhibits List

The Mission to Land a Man on the Moon: Timeline 1960–1972
The Rocket Display at the 1964 World's Fair
Mercury-Atlas D Rocket Climb-In Capsule
Saturn 5 Engine

Guide Theme

The theme of these guides are based on popular crime and detective show investigations on TV; a mystery unfolds, questions are asked, evidence is gathered, conclusions are drawn. This process is similar to what scientists go through with the inquiry method. For more details see About the Guides.

Begin the Investigation At School

A mystery unfolds, questions are asked...
There are several ways you can introduce the topic and start the investigation. Here are some ideas that will help students start thinking about the topic and generate questions:
- How did scientists and engineers launch a 3,000 pound capsule with a man inside into space?
- What did the discovery of gun power in China have to do with launching a man into space?
- Why was the most powerful rocket engine ever built only needed for the first two and half minutes of a launch?
- Demonstrate one of the Laboratory Activities with no explanation-let the questions begin
- Do one of the Laboratory Activities and facilitate a probing discussion

Prepare for Investigation at the New York Hall of Science
Once students have generated questions around the topic tell them they are going to continue the investigation at the New York Hall of Science.

At this point you may want to begin one of the Continuum Activities. These activities have the following features:
- Vary in length and depth
- Provide continuity and purpose for the visit

• Provide a way of assessing student understanding

Orientation and Planning: If you do nothing else, do this!
Here are five reasons to conduct student orientation and planning before going on a field trip:

1. Students focus on exploring and investigation versus the novelty of the location
2. Students don't have to worry about logistics like restrooms, schedule, eating etc.
3. Students who understand the plan and purpose of the visit are more likely to stay focused
4. Students who have clear goals for their visit are less likely to race from one exhibit to another with little understanding
5. Students who get involved in the planning of the visit, take ownership and are less likely to misbehave

Read more about the Orientation and Planning Process

Investigation at the New York Hall of Science

Evidence is gathered...
Okay. The class has arrived at the next phase of the investigation. The students have questions and seek answers. Everyone knows what exhibits they should visit and why. Everyone knows the schedule for the day. Students have materials to record findings or work on a Continuum Activity if required.

If all of the above is true, congratulations on a successful Orientation and Planning.

If you are curious about what teachers can do on site, we've put together a little piece called Teacher Role.

Finish the Investigation Back at School

Conclusions are drawn...
There are several ways you can complete the investigation. Some require less time than others. Here are some ideas:

• Student or group oral or written reports on investigation questions and answers
• Student or group illustrations of visit with answers to questions or mystery
• Do one of the Laboratory Activities
• Complete the Continuum Activity

Continuum Activities

Continuum Activities are designed to carry through the entire investigation. Some activities require less time than others.

Investigation Map

Description: Detectives will often map out related events, evidence and suspects during an investigation. This helps them get an overall picture. Students can map out their investigations with a concept map. The concept map will help you assess what students learn.

Time: (3)15-30 min. Sessions

Materials Needed:

• Blank paper
• Pencils, colored markers

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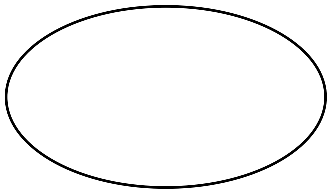
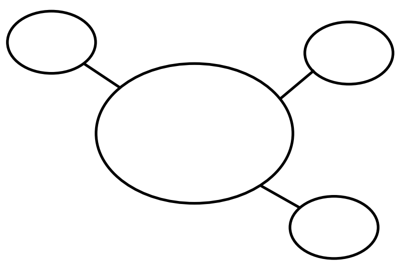
Procedure:

1. Begin with a center circle and write in the name of the main topic. (Students who do not write can have an adult assist or draw a representation of the main topic)



2. As students generate questions about the topic, they can add offshoot circles. They can also add circles for facts they know about prior to the visit to the New York Hall of Science.



3. When students return from their investigation at the New York Hall of Science they add additional circles of information. Their final map should reflect everything they know about the topic. Teachers can easily assess what is learned based on how the map develops.

Investigation Journals

Description: Investigation journals provide a way for students to record their questions and findings throughout the investigation.

Time: (3)15-30 min. Sessions

Materials Needed:

- Blank or lined paper
- Pencils, pens or colored markers
- On-Site Investigation Handout (print out from this web site and make copies)
- Zip-lock bags (for on-site handout only)
- Soft yarn or thick soft string (for on-site handout only)

Procedure:

1. Ask students if they have ever seen a detective take notes when trying to solve a mystery. Tell students that as "science detectives" they too will make a record of the mystery.
2. Have students begin their journal or report with questions that are generated when they Start the Investigation at School.
3. Students who do not have writing skills can make a large question mark and draw representations of their questions. If an experiment or demonstration is done, non-writing students can sketch what they observe.
4. Older students with writing skills can list their own and other students questions in their journal.
5. We strongly advise students not bring journals to the New York Hall of Science where they can get

lost. We have provided an On-Site Investigation Handout that can be copied if students want to record observations or make sketches.

6. When students return from their investigation at the New York Hall of Science have them write answers to questions or draw what they observed.

Science TV- Investigative Reporters

Description:
In this activity, students plan and produce a TV show featuring investigative reports on the topic. This is a cooperative learning activity that integrates language arts, science and technology. There is a significant amount of writing involved, however students who are not prolific writers can also contribute as camera people, script supervisors, directors and on-camera reporters. Students will video tape at school and at the New York Hall of Science so pre-planning is essential for this activity.

Time: (3) 45 minute sessions (writing)
(1) video shoot at school
(1) video shoot at the New York Hall of Science
(1) 45 minute session (writing)
(1) video shoot back at school
(1) 30 minute session for viewing final TV show

Materials Needed:
- Video camera
- (1) video tape per student group
- External wired microphone for camera (optional but suggested for good audio)
- TV
- Cables to run camera to TV for viewing
- Student internet access (optional for research)
- Lined paper and pencils
- Large plain paper and markers (cue cards)

Procedure:

First Session-Planning

1. Tell students they are going to plan and produce a TV show with investigative science news stories that are 4-5 minutes in length.
2. Divide the class into groups of four or five students.
3. Have students or the teacher chose a writer/script supervisor, camera person, director and on-camera reporter for each group.
4. Tell students about the various roles in the production team:
    - Writer-writes groups ideas for script, makes revisions
    - Cameraperson-operates camera
    - Director-supervises camera person and on-camera reporter, calls for action and cuts
    - Script Supervisor-makes cue cards for on-camera reporter, makes sure script is followed
    - On-Camera Reporter-person who reports and appears in video

5. Tell students that everyone the group will work together to create the script.

6. Remind students of the topic of study and the trip to the New York Hall of Science.

7. Instruct students to begin to create questions around the topic for the news show. They may want to create questions for interviews with New York Hall of Science “Explainers” too.

8. Tell students to watch the local news on TV so they can observe how news reporters do their job.

Second Session-Location Scout and Scriptwriting

1. Tell students they are going to do a location scout of the location they will be shooting at the New York Hall of Science. Scouting the location will help them think of more questions and give them ideas for what to shoot on location.

2. Make prints outs of the exhibits the class will visit at the New York Hall of Science OR have students access the exhibits online themselves.

3. Once students have become familiar with the exhibits, allow time for more scriptwriting. Make sure scripts have the following components:

   - Introduction to the report (name of reporter, where they are, news headline)
   - Questions the investigative report will answer
   - Conclusion (to be done after video shoot at New York Hall of Science, comment, opinion about answers, reporter sign-off)

Third Session- Rehearsals and Final Script

1. Remind students about the various roles in the production team:

   - Writer-writes groups ideas for script, makes revisions
   - Cameraperson-operates camera, responsible for video tape
   - Director-supervises camera person and on-camera reporter, calls for action and cuts
   - Script Supervisor-makes cue cards for on-camera reporter to read, makes sure script is followed
   - On-Camera Reporter-person who reports and appears in video

2. Have groups rehearse their roles using the scripts. (Camera people can use their hands to frame shots)

3. Advise groups to make script revisions if they notice problems during rehearsal.

4. Rehearsals can be done in front of whole class or in individual groups depending on your classroom space and noise level.

5. After rehearsal have groups meet and finalize the pre-New York Hall of Science script.

Homework
Have groups give script supervisor the pre-New York Hall of Science script so they can make cue cards. (Script supervisor can ask others to help make cue cards too)

Video Shoot at School
During this session each group will shoot the introduction to their news story. Each group will have their own video tape. Make sure each group tape is labeled. If possible you may want to have groups shoot in a quiet separate location from the others or schedule group shoots during breaks

in the day. If the entire class is present during shoots, make sure the others are quiet and don't distract the shooting. After shooting make sure camera people return the group tape to the teacher for safe keeping.

Video Shoot at the New York Hall of Science

1. Make the shooting schedule for the day.
2. Allow 15-20 minutes for groups to shoot in their location.
3. Choose a central location for production groups to meet the adult who will have the video camera and group tapes.
4. Make sure production groups stay together at the New York Hall of Science and Chaperones know the schedule for the day.
5. If students plan to interview a staff "Explainer", locate the Explainer in the area before shooting and ask for their assistance and cooperation for the shoot.
6. After shooting make sure camera people return the group tape to the adult for safe keeping.

Conclusion Script Back at School

1. Production groups will need to write the conclusion to their video script after their New York Hall of Science video shoot.
2. The conclusion should include a summary or opinion of the overall story as well as the reporter sign off.
3. Allow production groups to review their video footage (if necessary) so they can form opinions or summaries.
4. Have script supervisors and others in the group make up the final cue cards and conduct short rehearsals.

Video Shoot at School
During this session each group will shoot the conclusion to their news story. If possible you may want to have groups shoot in a quiet separate location from the others or schedule group shoots during breaks in the day. If the entire class is present during shoots, make sure the others are quiet and don't distract the shooting. After shooting make sure camera people return the group tape to the teacher for safe keeping.

View the Show
Hook up the camera to the TV and run the group tapes from the beginning. Enjoy the show.

Become an Explainer

Description: Students investigate one exhibit with the goal of being able to explain it when they return to the classroom. Students can choose a variety of methods to explain and make presentations.

Time: (1) 30 min. Session
(2) 45 min. Sessions (for in-class presentations)

Materials Needed:
- Interesting objects (used for student observation)
- Print outs of On-Site Investigation Handout
(optional suggestions)
- Variety of craft materials Variety of craft materials (pipe cleaners, popsicle sticks, straws, string,

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paints)
- Variety of clean, household recyclables (meat trays, cardboard tubes, aluminum foil, plastic wrap)
- Any other odds and ends students can construct with
- Poster board or paper
- Markers, crayons, colored pencils

Procedure:

First Session

1. Tell students as they will be investigating exhibits at the New York Hall of Science and will choose one exhibit to explain to the class when they return. (students can work in groups or individually)
2. Help students prepare for careful observation of exhibits by distributing interesting objects.
3. Now ask students to verbally describe what they see. Encourage details.
4. After students have described the object in great detail, tell them they will need to use these same observation skills when they are investigating their chosen exhibit.
5. Lead a discussion on what students can do at the New York Hall of Science to help explain and record what they see. Ideas include:
    - Sketching
    - Writing
    - Using exhibit pictures on this web site
    - Photography
6. Distribute The On-Site Investigation Handout (if needed) for use at the New York Hall of Science.
7. Go to the New York Hall of Science.

Second Session

1. Upon return to class from the trip, tell students they will spend time preparing to explain one of the exhibits they saw.
2. Here are some suggestions for student presentations:
    - Verbal explanation (with or without picture)
    - Labeled diagram
    - Group or individual poster showing how an exhibit worked
    - Group or individual model using materials to represent exhibit (materials can be used to substitute and represent real materials from exhibit— ex. Clear plastic wrap simulates glass, cardboard tube becomes a rocket etc.)

Third Session (optional)
Use this time for students to make their class presentations if they made posters, drawings or moldels.

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Laboratory Activities

Laboratory Activities are designed for the classroom and generally require simple materials. These activities can be done before or after a visit to the New York Hall of Science. To help students use higher-level thinking and generate questions, facilitate discussion with these types of questions:

- What do you notice here?
- Tell me about this.
- What do you see?
- Why do you suppose this happens?
- What can you conclude from the evidence?

Rocket Car

Description:

Students observe Newton's third law of motion as they construct a small car that is propelled by the action/reaction force produced by a balloon.

Time:

(1) hour session

Materials Needed:

- Large clear space for cars to roll (hallway, cafeteria or gym is best)

(per student group)

- (4) push pins
- (2) Styrofoam meat trays (minimum 3"x7")
- Cellophane tape
- Flexi-straw
- Scissors
- Drawing Compass
- Marker pen
- Small party balloon
- Ruler
- Emery Board

Procedure:

1. Tell students that Isaac Newton's third law of motion is "For every action there is an opposite and equal reaction."
2. Tell students they are going to construct a model that will demonstrate this law.
3. Distribute materials to student groups.
4. Instruct students to use the ruler and marker to draw a 3 by 7 inch rectangle on one of the meat trays.
5. Instruct students to use the drawing compass to draw (4) 3 inch diameter circles on the other meat tray.
6. Have students cut out the rectangle and the circles.
7. Instruct students to use the emery board to make the circles into smooth, round wheels.
8. Have students attach the wheels to the edge of the rectangle using the push pins. The pins become the axels for the wheels and should allow the wheels to rotate freely. They have now made a model car.
9. Now instruct students to prepare the balloon by inflating it a few times to stretch it out.

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10. Have students slip the end of the balloon over the straw and seal it tight with tape so that the balloon can be inflated by blowing through the straw.
11. Now instruct students to tape the straw with the balloon to the center of the car so that the straw sticks out at one end for inflating.
12. At this point you will want to go to the location where students will test their model cars.
13. Once you are at the testing location, have students inflate the balloon and pinch the end of the straw to hold in the air.
14. Have students set the car on a smooth surface and release the straw.
15. Have fun seeing how far these rocket cars go or conduct races.
16. Return to the classroom.
17. Ask students to explain how the rocket car moved forward. (responses may touch on key principles of Newton's law so become familiar with the formal explanation below)
18. Remind students of Isaac Newton's third law of motion. "For every action there is an opposite and equal reaction."
19. Explain to students that the rocket car model shows that the balloon releases the air in one direction and the balloon is propelled in the opposite direction. Since the balloon is attached to the car, the car is pulled along by the balloon.

Two Stage Balloon Rocket

Description:
What do 16th century fireworks have to do with present day rockets? Students construct a two-stage balloon rocket and learn about the origins of launching rockets into space.

Time:
(1) 45 minute session

Materials Needed:
- Nylon monofilament fishing line (any weight)
- Plastic straws (milkshake size, non-bendable)

(per student group)
- 2 long party balloons (round balloons will not work)
- Styrofoam cup
- Masking tape
- Scissors
- Pump for balloons
- A clothespin with a spring

Preparation:
Thread 2 straws through 15-20 ft. of nylon fishing line and secure both ends so the line is taut. Make sure the line is positioned so students will not run into it by accident.

Procedure:

1. To create some intrigue, pose this question to students:

What does 16th-century fireworks maker Johann Schmidlap, have to do with how we launch rockets today?

2. Tell students they will find out the answer after constructing a model rocket from two balloons.

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3. Distribute materials to student groups.
4. Instruct students to cut the styrofoam cup in half so that the top of the cup forms a continuous ring.
5. Have students loosen the balloons by inflating them a few times and stretching them out. It may be hard for the students to blow up the balloon so a pump can be used instead.
6. Select one student group to do the first rocket test.
7. Position the group near the end of the fishing line where the two straws are.
8. Instruct the student group to take the balloons to one end of the fishing line and tape each balloon to a straw then inflate one balloon about 3/4 full of air and squeeze its end tight.
9. Have one student pull the inflated balloon's nozzle through the Styrofoam cup ring and hold it shut with a spring clothespin.
10. Now have another student inflate the second balloon and make sure that the end of the second balloon extends through the ring a short distance.
11. As the second balloon inflates, it will press against the nozzle of the first balloon and take over the clips job of holding the first balloon shut.
12. Take the clothespin and shut the second balloon shut.
13. The balloons should be pointed along the length of the fishing line and the fishing line should be held taut.
14. Have students do a rocket countdown and release the second inflated balloon.

   (The escaping air will propel both balloons along the fishing line. When the first balloon released runs out of air, it will release the other balloon to continue the trip.)

15. Remove the deflated balloons from the straws.

   Repeat steps 8-15 with other student groups until each group has completed a rocket test.

16. After all groups have completed their rocket tests, remind students of the question you asked at the beginning:

   What does 16th-century fireworks maker Johann Schmidlap, have to do with how we launch rockets today?

17. Explain to students that:

   Launching rockets takes great amounts of energy. Most of that energy is needed to lift the weight of the rocket and fuel into space. Instead of making a big expensive one piece rocket, rocket engineers used a technique invented by a16th-century fireworks maker named Johann Schmidlap. Schmidlap wanted to send his fireworks higher into the sky so he attached smaller rockets to the top of the larger rockets. When the larger rockets ran out the smaller rocket kicked in and sent the firework higher. Schmidlap invented what he called the "step rocket".

   Today's rockets are launched in steps too, however they are called stages. The first stage is usually large functions for only the first two minutes of the flight. When the first stage is exhausted, it is released from the rocket and falls back to earth. With this huge weight gone, the rocket propels into space in three or four more smaller stages.

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Antacid Tablet Race

Description:

In this experiment students will observe how increasing the surface area of an antacid tablet increases the dissolve rate. Students record data and average class results. The experiment is related to how rocket propellants are manipulated to increase burn rate and thus acceleration.

Time:

(1) 45 minute session

Materials Needed:

(per student group)

- Antacid tablets (two per test)
- Two beakers (or glass or plastic jars)
- Thermometer
- Scrap paper
- Notebook for recording results
- Watch or clock with second hand
- Small block of wood or spoon for crushing one tablet

Procedure:

1. To create some intrigue, pose this question to students:

   What do dissolving antacid tablets have to do with how rocket fuel burns?

2. Tell students they are going to do an experiment to observe and record dissolve rates.
3. Distribute materials to student groups.
4. Instruct students to fill both beakers half full with water of the same temperature.
5. Have students wrap the scrap paper around one of the antacid tablets a place the wrapped tablet on a hard surface.
6. Have students to crush the tablet by pressing on it with the wood block or spoon.
7. Now instruct students to prepare to time how fast the crushed antacid powder will dissolve in water. Students should not shake or stir the solution.
8. When students are ready they can pour the crushed powder into one of the beakers and time the dissolve rate.
9. After the powder has completely dissolved, have students record the results of the time.
10. At this point you can do a short math exercise in data collection and averaging. Solicit times from all student groups and record results on the blackboard. Have students figure out the average dissolve rate from the entire class experiments or work the problem as a group.
11. Now have students prepare to time the dissolve rate of the whole antacid tablet.
12. When students are ready they can drop the tablet into one of the beakers and time the dissolve rate. Students should not shake or stir the solution.
13. After the tablet has completely dissolved, have students record the results of the time.
14. Facilitate data collection and averaging as before to arrive at the class average for the dissolve rate of the whole tablet.
15. Now compare dissolve rate averages. (the powder dissolve rate will be much shorter than the whole tablet)

16. Remind students of the question you posed at the beginning:

    What do dissolving antacid tablets have to do with how rocket fuel burns?

17. Ask students to make some educated guesses based on the antacid experiment. (students may hit on some key points so become familiar with the formal explanation below)

18. Crushing the antacid tablet into a powder increased the surface area and the rate in which it dissolved in water. Rocket engineers know that if they increase the burning surface of fuel it will come into contact with more oxygen and will burn faster. The faster burn creates more thrust or push. To create more burning surface the liquid fuel is sprayed into the combustion area of the rocket. Small fuel droplets react faster than larger droplets and increase the acceleration of the escaping gases.

Fizz Rocket

Description:
Students construct and launch a simple rocket fueled by the chemical reaction of vinegar and baking soda or alka-seltzer tablets.

Time:
(1) 45 minute session

Materials Needed:
(per student group or individuals depending on supply)

- Styrofoam or thick paper plate
- toilet paper tube
- markers
- tape
- plastic 35mm film canister with snap on lid
- vinegar and baking soda or alka-seltzer tablets
- measuring spoons

Teacher Note:
After students have decorated their rocket launchers, this activity is best done outside as it is somewhat messy.

Procedure:

1. Tell students they are going to make a rocket and power it with a fuel they might find in their own homes.

2. Distribute materials to student groups.

3. Instruct students to create a design with markers on the toilet paper tube that will become the rocket launcher.

4. Have students tape the rocket launcher securely to the center of the plate.

5. Go outside to do the rest of the activity.

6. Instruct students to prepare the rocket and fuel. They will need to be quick with this procedure. Explain that as soon as they make the fuel they are going to have to snap the lid on the canister, drop it in the launcher and stand back. You may want to practice snapping on the lid and dropping it in the launcher with younger children.

7. Vinegar and Baking Soda Fuel

    - Put 1 tbsp of vinegar in the film canister

    - Add 1/2 tsp baking soda

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- Quickly snap the lid on and drop into the launcher lid side down
- STAND BACK
- Rocket will launch (usually 10-20 seconds)

Be sure to wait at least a minute before checking on the rocket if it doesn't launch.

Alka-seltzer Fuel

- Put 1 tbsp. water into the film canister
- Add 1/2 an alka-seltzer tablet and quickly snap on the lid
- Quickly snap the lid on and drop into the launcher lid side down
- STAND BACK
- Rocket will launch (usually 10-20 seconds)

Be sure to wait at least a minute before checking on the rocket if it doesn't launch.

Book List

Rockets
Asimov, Isaac. *Rockets, Probes and Satellites*, Dell Yearling, 1988.

Space
Apfel, Necia H. *Nebulae, Lothrop Lee and Shepard Books*, 1988.
Asimov, Isaac. *The Space Spotter's Guide*, Dell Yearling, 1989.
Asimov, Isaac. *How Did We Find Out About Outer Space?*, Avon Books, 1981.
Asimov, Isaac. *Quasars Pulsars and Black Holes*, Dell Publishing, 1988.
Berliner, Don. *Living in Space*, Lerner Publications Company, 1993.
Berliner, Don. *Our Future in Space*, Lerner Publication, 1991.
Branley, Franklyn M. *From Sputnik to Space Shuttles,* Thomas Crowell, 1986.
Grades 6-8: Branley, Franklyn M. *The Sun and the Solar System,* 21st Century Books, 1996.
Brown, Peter Lancaster. *The World of Science: Astronomy*, Facts on File Publication, 1984.
Burrows, William E. *Mission to Deep Space*, W.H. Freeman and Company, 1993.
Darling, David J. *Could You Ever? Fly to the Stars*, Dillon Press, Inc. 1990.
Darling, David J. *Where Are We Going In Space*, Dillon Press, 1984.
Fichter, George S. *The Space Shuttle*, Franklin Watts, 1990.
Fradin, Dennis B. *Moon Flights*, Children's Press, 1985.
Fradin, Dennis B. *Space Colonies*, Children's Press, 1985.
Hansen, Rosanna. *My First Book of Space*, Simon & Schuster, Inc., 1985.
Jobb, Jamie. *The Night Sky Book*, Little, Brown and Company, 1977.
Mayes, Susan. *What's Out In Space?* Edc Publishing, 1990.
Nicolson, Ian. *The Illustrated World of Space*, Simon & Schuster, 1991.
Ridpath, Ian. *The Facts on File Atlas of Stars and Planets*, Library of Congress, 1993.
Stott, Carole. *Night Sky,* Dorling Kindersley, 1993.