

In-Touch Science: Fibers & Animals



**Dan Brown, Charlotte Coffman,
and Tatiana Stanton**



A Cornell Cooperative Extension Publication

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The project team included Sofia Betancourt, Dan Brown, Charlotte Coffman, Marcia Eames-Sheavly, Doreen Greenstein, Ann Lemley, Raylene Ludgate, Jane Mt. Pleasant, Tatiana Stanton, Dan Tennesen, John Terry, Nancy Trautmann, and Michael Walter.

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Illustrated by Marcia Eames-Sheavly
Designed by Sofia Betancourt
Edited by Susan E. Pohl



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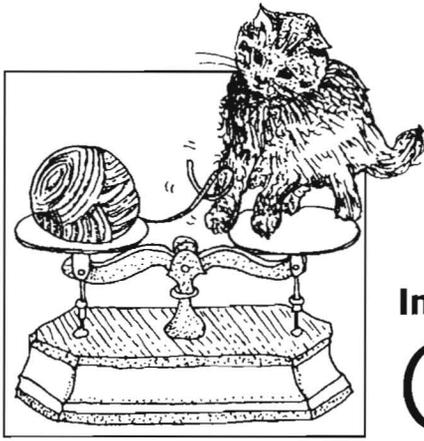
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In-Touch Science: Fibers & Animals

Contents

3 Introducing the Program

- 3 Welcoming All Children
- 4 What's in Each Session
- 7 A Way of Teaching and Learning
- 8 Encouraging Conversation
- 10 "I Wonder..." Statements
- 11 Organizing Supplies
- 13 Monitoring Success
- 14 A Preprogram Activity



15 Session 1: Microstructures:

Fuzzy Fibers • Fantastic Feathers

31 Session 2: Reflection of Light:

Light Up the Night • Night Views

47 Session 3: Heat Transfer:

Keeping Cool • Staying Warm

63 Session 4: Digestion:

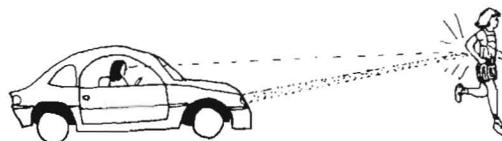
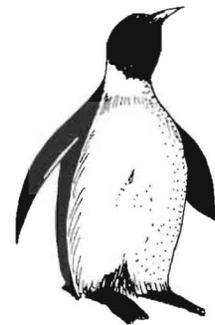
Threads of Life • Rot the String Out of It

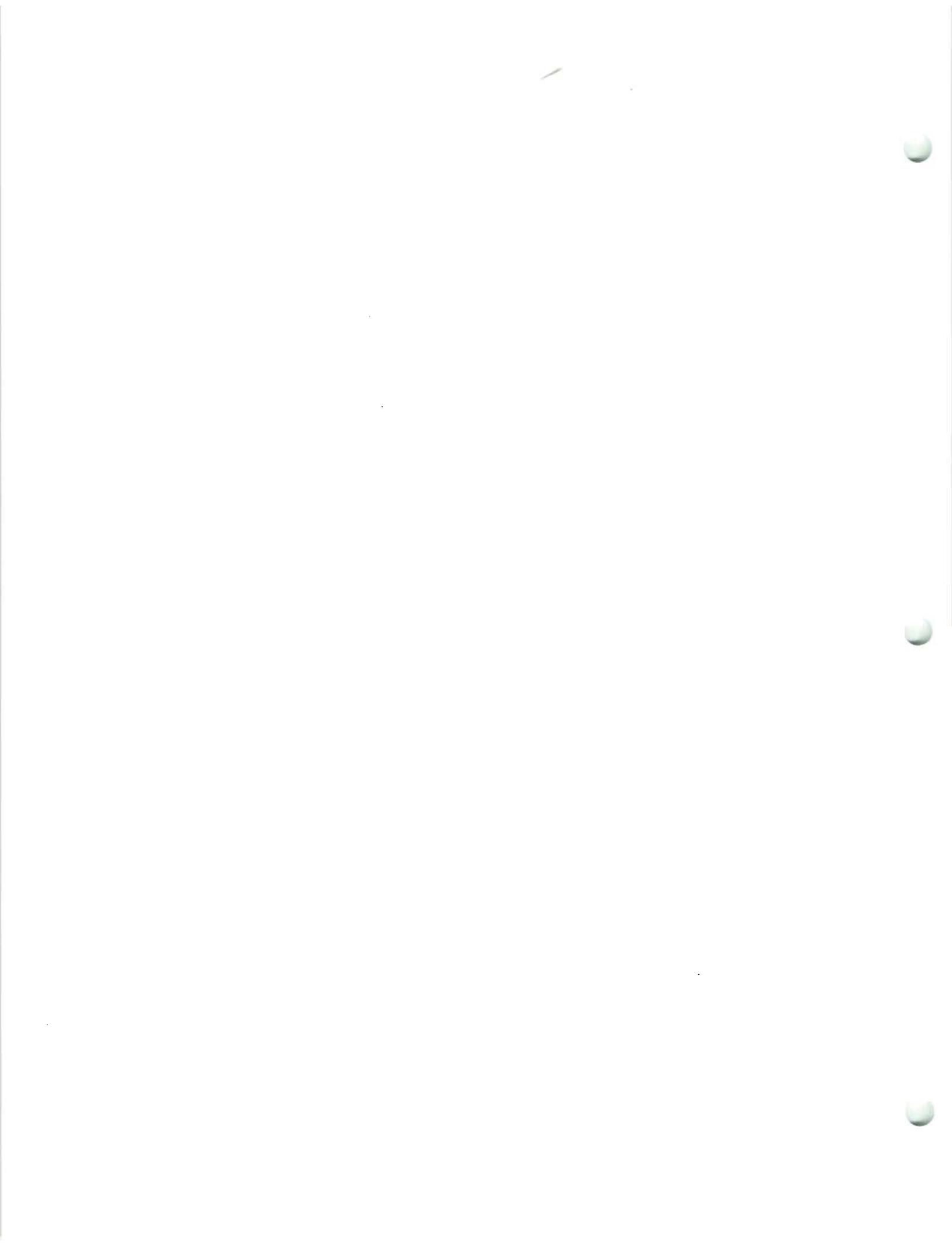
79 Session 5: Chemical Composition:

Name That Flame • Milky Ways

95 Resources and Management

- 97 Checklist for Assembling Supply Kits
- 99 Checklist for Assembling Supply Kits to Loan
- 101 Guide to Ordering Supplies
- 103 Parent Letter
- 105 Model Release
- 107 Evaluation Form
- 109 Glossary
- 111 References





Introducing the Program

In-Touch Science is a hands-on science program developed by Cornell Cooperative Extension for children in grades 3 to 5 (aged eight to eleven). The program helps children

- communicate what they are observing and learning.
- understand the science connection between two fields of study.
- recognize those science concepts in daily experiences.

In-Touch Science emphasizes giving each child an opportunity to manipulate materials and equipment, test ideas, and explore what interests them in a relaxed learning environment. This works best with groups of five to ten children. A ratio of one adult to six children is ideal.

The ten activities in *In-Touch Science: Fibers and Animals* let children observe how one science concept relates to both textile science and animal science. This unit encourages youngsters to be more curious about their everyday encounters with fiber products and animals.

The teaching style emphasizes interaction and communication among the children and between the children and the adult leader. Both adults and children are active participants. Together they experience the fun of discovery and share “I wonder...” statements that could lead to further science exploration.

In-Touch Science: Fibers and Animals was field-tested with more than 200 children from diverse socioeconomic backgrounds in 4-H clubs, school-age child care programs, scout groups, school fairs, and science clubs. It is also appropriate for use in summer camps, the Expanded Food and Nutrition Education Program (EFNEP), science and nature centers, and other community programs serving children and families. Although this program is intended to promote greater opportunities for children in nonclassroom settings, it has also been used successfully in school science classes.

Welcoming All Children

In-Touch Science welcomes all children. To that end, adult facilitators are encouraged to adapt materials and settings whenever those changes make sense for their audience. For example, if eyedroppers are too expensive you may want to teach the children to drop water by using their forefinger over the end of a plastic straw. Substitute supplies according to regional availability and ethnic preferences. Some suggestions are included in the Supplies and Preparation section, but you will doubtlessly think of others.

Remember to try the activity with your “new” supplies, noting any changes in procedures and adapting the conversation questions accordingly.

You may have little choice of location. If possible, however, choose a setting that is comfortable for the children and is conducive to conversation. Do not allow the need for a water source or table space to dictate the site. Sometimes you can move everything outdoors and simply bring along a thermos of water and a plastic bag to cover your “table” on the ground. The goal is to provide a relaxed atmosphere that promotes exploration and interaction. You and the children in your group are the best judges of whether the *In-Touch Science* laboratory should be a cozy kitchen, your backyard, the local park, or the school gymnasium.

These activities are also designed to be within the capability of children who have special needs. Sometimes the term “special needs” is equated with wheelchair accessibility, but in doing science activities such everyday things as allergies must also be considered. Specific information and handy hints are included with each activity to alert you to some of the special needs that you may encounter. Please remember, however, that a comprehensive how-to list to address all situations is not possible. Your common sense and your experience with children will often be the best guide. Many times you can ask the individual child what would be helpful, or ask the child’s parent or teacher. Many of the hints will be applicable for several activities, so browsing through the manual may provide the answer you need.

What’s in Each Session

The ten activities in *In-Touch Science: Fibers and Animals* are organized into five sessions of one to two hours each.

Each session includes the same segments and flow of delivery:

Segment:	Focus (Fibers)	Activity A	Transition	Focus (Animals)	Activity B	Closure
Time (min.)	5	20–40	5–15	5	20–40	5–10

We recommend that you start with Activity 1A and follow the sequence through Activity 5B. This sequence allows children to move from easy to difficult activities and provides consistent practice in applying one science concept to two different disciplines. Alternatively, sessions can be done in a different order or broken into two sessions. In

the latter case, remember to review at the second meeting what was done during the first so that the connecting science theme is still clear.

The first six activities require about twenty minutes but could take more or less time depending on the children's skills, interest, and efficiency in organizing and cleaning up work areas. The activities in Sessions 4 and 5 are more complicated so extra time is recommended. To ensure a fun, relaxed experience you may want to allow additional time for all activities, especially the first time you use the program.

As you read through each session, you will encounter these sections:

Mini-Poster. A one-page poster on colored card stock names the two activities and states the connecting science theme. Leaders should refer to this as needed to help the children understand how the two activities are linked.

Introduction. This page describes the fiber and animal activities and explains the common science concept.

Leader's Guide.

What's the point? explains what is expected of the participants, restates the main idea, and defines terms.

What's the plan? reminds you to become familiar with the activity and materials.

What's my role? emphasizes that you are a facilitator, a partner, a helper but *not* a lecturer. You set the tone and direction, then allow the children to wonder and try things at their own pace.

Plan Ahead. This section alerts you to advance preparation needs.

Special Hints. This box suggests adaptations that make the program more inclusive.

Science: Behind the Scenes. This section provides more detail about the underlying science concept. This extra dose of information may help you relax and enjoy the science experience. Please do not use this material as a lecture and avoid trying to convey everything you know to the children. Your genuine curiosity and a willingness to explore will inspire them far more than an armload of facts. If you want more background, browse your public or elementary school library or refer to the references (page 111).

Supplies and Preparation. Materials and equipment are listed along with suggestions for alternate supplies. Information is included about collecting supplies, preparing materials, and organizing workstations.

Focus. The Focus directs the group's attention to the general theme of the activity. This helps children relate what they know to what they will observe. Substitute other props or questions if you wish, but avoid revealing the outcome of the main activity.

Activities. Each session has two activities: Activity A about fibers and Activity B about animals. The activity pages include step-by-step directions, sample questions to help stimulate conversation, safety precautions (in ***bold italics***), and a reminder to listen for "I wonder..." statements (page 10).

Each child and adult should have his or her own workstation with enough materials and space to work comfortably. Some materials and equipment will be shared and helping companions is encouraged, but each person should also be able to chase an idea or ponder an interesting thought. That may mean a step back, a fast move forward, or a long detour from what the group is doing.

Transition. Review aloud the "I wonder..." statements. This not only helps the children remember and share some of the great ideas that were expressed during the activity, but it also stimulates new ideas and projects. Ideally, the children will design a follow-up activity to answer an unresolved question.

If you are doing only one activity in a session, ask the children to clean up their workstations. If you are doing both activities, clean up from the first and create workstations for the second.

Closure. This is the time to think about how the two activities are linked. Compare the "I wonder..." statements from the two activities, looking for common elements. Refer to the poster to make certain the children understand how the two activities are related.

A Step Beyond. Questions that children expressed when these activities were tested have been developed into additional activities that expand or extend the experience. This activity-question-activity-question cycle demonstrates how the Learning Cycle (page 7) works and fosters an open-minded approach to learning and teaching. Ideas for

more science activities and children's books related to this topic are included as references (page 111).

A Way of Teaching and Learning

In-Touch Science uses the Learning Cycle, a teaching method that engages children in active investigative science. The Learning Cycle follows a sequence of exploration, concept introduction, and concept application as outlined in the box below. During concept application, new questions arise and the cycle starts again. Children are asked to look for many possible answers, not just one "correct" answer. An example of how it applies to *In-Touch Science: Fibers and Animals*, Activity 1A, "Fuzzy Fibers," is given in the box on the next page.

Learning Cycle Checklist

Exploration Phase

- Exploration is engaging.
- Ample time is provided for exploration.
- Exploration provides child-child and child-adult interaction.

Concept Introduction Phase

- The concept(s) introduced are an outgrowth of observation in the exploration phase.
- The concept(s) are named, and appropriate vocabulary is developed.

Concept Application Phase

- Children are given time to repeat observations with new materials.
- Children extend concept(s) to a new situation.
- Children are encouraged to wonder more about the experience, generating ideas for continued exploration and repetition of the cycle.

Adapted from Barman, C. R., and M. Kotar. "The Learning Cycle." *Science and Children* 27(7): 30–32. 1989.

Learning Cycle in “Fuzzy Fibers”

Exploration Phase

- Children examine the piece of felt, garment materials, wool fleece, and cotton. They look at them with magnifying lenses. They touch and smell them. They observe how wool and cotton react to water. They try to felt the cotton and wool.

Concept Introduction Phase

- Children talk about what is happening (“I wonder...” statements). The leader asks questions and makes observations. The process of felting is discussed, the idea of structure is introduced, the terms “wool” and “felt” are explained.

Concept Application Phase

- Children repeat parts of the activity on their own. They wonder what would happen if they change the equipment, the materials, or the process. They relate this experience to something they have done in the past or an item they have at home. They review “I wonder...” statements and suggest ideas they would like to test or they try A Step Beyond.

Encouraging Conversation

Conversation between adults and children, and among children, is important in each phase of the Learning Cycle. The adult is both a participant and facilitator throughout the cycle.

Listen to the child’s way of describing phenomena before introducing scientific language. One strategy is to focus your attention on what the children are doing. Help them communicate what they see, hear, smell, and feel. Challenge them to make relationships among observations. Stating relationships indicates real understanding—in contrast to repeating memorized facts.

Each activity contains a shaded box, “Questions You Might Ask.” The questions are intended as a guide, not a script. Take your cues from what the children say. Encourage them to talk to each other and not just to you. Avoid asking too many questions. Until they are comfortable following the procedures and manipulating supplies, some children will consider conversation a disruption rather than a natural part of the process. Respect each child’s abilities, interests, and way of learning.

The sample questions promote conversation by using phrases that focus on the child's experience. Ask what the children saw, not why something happened. Ask how their results compared with their neighbor's, not which one was correct. Ask questions that can be answered with descriptions and comparisons, not "yes" or "no."

The following chart relates the wording of questions to specific science processes. Use it as an aid in designing child-centered questions. *InTouch Science* units rely heavily on basic science processes; additional activities would lead to greater use of complex science processes.

Developing Science Process Skills by Experimenting and Talking with Children

Basic Science Processes

Experimenting and Talking

Observing

Using the senses to gather information

How would you describe...?

Tell me about...

Classifying

Ordering or grouping observations

Which feathers are biggest? fluffiest?

How are these alike? Different?

Communicating

Exchanging information

Any expression of ideas or answers to questions

Questioning

Raising uncertainty

I wonder why...?

Predicting

Stating future cause-effect relationships

What do you think will happen?

What if...?

Using Numbers

Expressing with numbers rather than words

How many grams of fiber were left?

How many layers of fabric do you have?

Measuring

Using instruments to quantify observations

How much water is in the cup?

What is the temperature?

Complex Science Processes

Experimenting and Talking

Interpreting Data

Finding patterns or meaning among sets of data

What happened before...? After?

Compare the samples.

Controlling Variables

Manipulating factors that could influence results

How big were the ice cubes?

Designing Experiments

Planning data-gathering procedures to test ideas

Try testing, "What would happen if...?"

Inferring

Proving explanations for events based on limited facts

Try explaining, "Why?" by reasoning from gathered evidence.

Try answering, "This happens because..."

Twinkle, twinkle, little star,
How **I wonder** what you are.
—*Rhymes for the Nursery*, 1806
The Star, st. 1

Child of the pure, unclouded brow
And dreaming eyes of **wonder!**
—*Through the Looking-Glass*, 1872
Introduction, st. 1

For all knowledge and **wonder**
(which is the seed of knowledge)
is an impression of pleasure in itself.
—*The Advancement of Learning*, 1605

An “I wonder...” statement may

- be a simple observation about the materials: “This wool is smelly.”
- relate the activity to the child’s prior experience: “My Grandma made felt mittens for my birthday.”
- express discovery: “I didn’t know that pieces of wool fleece would stick together to make a ball.”
- show growth: “I thought wool and cotton were about the same thing, but they look really different under the magnifying lenses and you can’t make strong felt from cotton.”
- relate the activity to another situation: “Pieces of Velcro stick together so I wonder if Velcro and wool are a little alike.”

“I Wonder...” Statements

Because questioning and curiosity are key elements of the *In-Touch Science* program, the authors have adopted the phrase “I wonder...” to describe children’s responses. These responses are used by the adult to direct, reinforce, and evaluate learning.

An “I wonder...” statement does not have to begin with the words “I wonder.” It does not even have to be a statement. “I wonder...” statements are comments, ideas, questions, descriptions, concerns, theories, doubts—any expression that demonstrates that the children are thinking about what they are doing.

Throughout the sessions, children and leaders share, discuss, and collect “I wonder...” statements. These statements are important evidence that the children understand what they are doing, that they can see the connection between activities A and B, and that they can relate the science concepts to similar situations in their daily lives.

Most children have plenty to say, but it is not easy for a busy leader to hear or remember all of their ideas. With practice, most leaders can follow the children’s conversation enough to redirect them when they stray from the topic and to help them summarize what they learned by referring to overheard “I wonder...” statements. Some leaders invite a helper to record “I wonder...” comments and read them back at the end of the activity or session. Others ask the children to write statements on cards, newsprint, or a chalkboard for review. Some groups have enjoyed tape-recording their ideas while others express in drawings what they learned or wondered about.

Organizing Supplies

The science experience will be more enjoyable if you have a plan for collecting, cleaning, storing, and restocking supplies. Each activity has a “Supplies and Preparation” page that lists the items needed, explains any preparation procedures, and suggests alternate materials. Supplies are easier to manage if they are assembled into a kit.

Supplies

The supplies recommended in this book have been used with many children and are known to work. Their selection was based on considerations of cost, availability, preparation time, ease of maintenance, and storage. Most can be purchased at local food, drug, discount, craft, and fabric stores. Often a trade-off was made. For example, reflective tape is expensive but children love that activity, so quantity suppliers are included in the “Guide to Ordering Supplies” (page 101). You are encouraged to adapt the supply lists to suit your situation.

Reusable supplies are tools that can be used several times. Examples are magnifying lenses and thermometers. Sturdy plastic spoons, knives, and cups that might be considered disposable are intended to be reused. Resealable plastic bags may be reused depending on how well they withstand handling.

Consumable supplies include perishable and nonperishable items that are used only once. Examples are foods, fabrics, and paper towels. If you have storage space, you may want to buy nonperishable products in quantity.

Supply Kits

Because the self-discovery nature of this program is most effective with small groups, instructions for assembling supply kits are based on ten participants. The “Checklist for Assembling Supply Kits” on page 97 lists all of the supplies needed for doing the ten experiments with ten participants.

The “Checklist for Assembling Supply Kits to Loan” on page 99 excludes perishable items and groups other supplies so that you can quickly assemble a “basic” kit with only tools and reusable supplies or a “made-to-order” kit that fits your specific needs.

Hints for the Successful Use and Maintenance of Supply Kits:

- Identify one key person, such as a child who offers to help, teen, parent, or other volunteer, to monitor your kits.
- Purchase in quantity.
- Label items with name and quantity.
- Keep small items together with rubber bands or in bags or small boxes.
- Allow time to wash and dry reusable tools before they are repacked in the kit. If possible, include the children in the cleanup tasks.
- Choose a durable storage container with a tight-fitting lid such as the cardboard boxes used for packing reams of office paper.
- Tape a copy of the appropriate checklist inside the lid of the kit.

Monitoring Success

Adults who use the *In-Touch Science: Fibers and Animals* program will be giving children an opportunity to explore textile science and animal science through experimentation. This may be a new experience for you, and you may never have considered teaching children about these two disciplines together.

The aim of this program is for children to gain a greater appreciation for science and its role in their everyday encounters with textile fibers and animals. The ten activities introduce several concepts, any one of which probably needs to be explored more fully for children to achieve understanding. Yet children can begin to appreciate how similar science concepts relate.

Two indicators of program success are the degree of the child's communication and the complexity of the child's "I wonder..." statements. If the children are engaged by the activities, they should express their enthusiasm by talking, drawing, pantomiming, or in some way sharing what they are doing. The children's expressions should progress from "I wonder if this yucky shortening will wash off my hands" to "I wonder if hand lotion will keep me warm (insulate) like shortening because they are both greasy." Participants may also make comments about personal experiences or future plans such as "Oh, yeah, this is like what I saw on TV" or "I'm going to show my dad what happened." The evaluation form on pages 107 and 108 is designed to collect both quantitative and qualitative data. Copy as needed, using a separate form for each session.

A Preprogram Activity

If you decide to use all the material sequentially with a group of children, you may want to introduce the program to them, especially if you haven't done many science experiences together. You might start by collecting their ideas about science and their experiences with textile fibers or fabrics and animals. You could play a word game by saying, "If I say 'science,' what do you think of? Tell me about a time that you've experienced science. What did you do? Why do you think that's science?"

Or you might have the children draw a picture or collect magazine pictures of people doing science. The pictures could include people, objects, or activities. What are the children's perceptions of science?

You could conclude an introductory activity by saying, "Science is part of almost everything we do. Every day we get dressed, we eat, we play, and we ride or walk to school. Yet we rarely think of these routine activities as involving science. We will be doing a series of ten activities to find out more about the science of fibers and animals."



Fuzzy Fibers

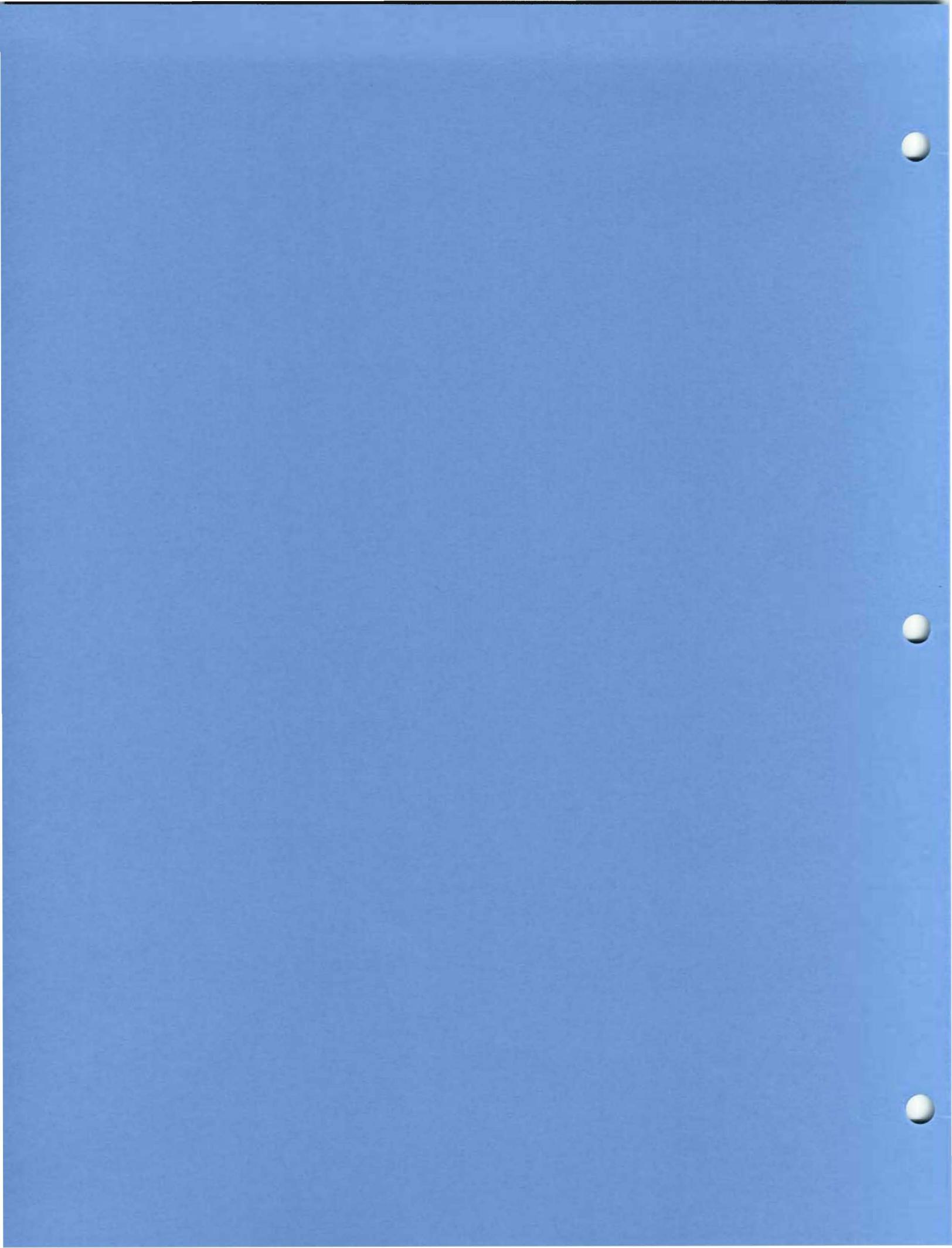


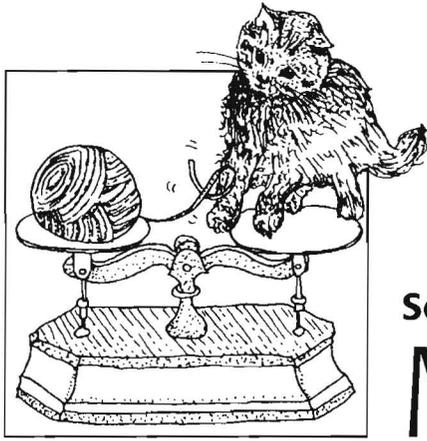
Fantastic Feathers



Microstructures







Session 1

Microstructures

Microstructures are tiny features that can be seen only with the help of a magnifier. Although small, these parts can control how an object behaves. Examples are the scales on wool fibers and the hooks on bird feathers. These two activities make children aware that actions they see may be caused by microstructures they cannot see.

In Activity 1A, *Fuzzy Fibers*, children press together layers of sheep's wool. They discover that small overlapping scales help the wool fibers stick together in the presence of heat, moisture, and pressure. The result is felt, a thick, compact fabric that will not ravel, even when cut by scissors.

In Activity 1B, *Fantastic Feathers*, children compare at least two types of bird feathers, down feathers and flight feathers. They observe how hooks on flight feathers stick together to help birds fly.

Session at a Glance

- Leader's Guide, pages 18, 24
- Plan Ahead, page 18
- Science: Behind the Scenes, pages 19, 25
- Supplies and Preparation, pages 20, 26
- Focus, pages 21, 27
- Activity, pages 21, 27
- Transition or Closure, pages 22, 28
- A Step Beyond, pages 23, 29



Fuzzy Fibers



Leader's Guide

What's the point?

Children make felt (cloth) from sheep's wool. They observe that the fuzzy wool fibers mat together better than the smooth cotton fibers. The children have fun shaping the felt into a vessel that they can decorate with feathers in Activity 1B.

This activity introduces the terms *wool*, *scales*, and *felt*. Wool is a textile fiber that comes from sheep and other animals. Wool fiber is made of protein and has overlapping scales on its surface. When these fibers get wet, the scales open, increasing the contact between fibers. If heat and pressure are applied, the fibers mat together and form felt cloth. This process is called "felting."

For additional information, read Science: Behind the Scenes (page 19).

What's the plan?

1. Read the activity (page 21).
2. Gather the supplies (page 20).
3. Do advance preparation and try the activity.
4. Note safety measures (in ***bold italics***).

What's my role?

- Guide the children through the activity by doing the procedures with them.
- Encourage conversation about what they are doing and observing. Use the conversation questions as a guide, not a script to be followed.
- Listen for and summarize "I wonder..." statements the children make during the activity. (See "I wonder..." statements, page 10, Monitoring Success, page 13, and Evaluation Form, page 107.)
- Help the children relate this activity to their daily experiences.

Plan Ahead

- If pressed for time, the leader can do the activity with cotton while the students work with wool. Or half of the group can use cotton and half can use wool.
- If children are taking felt vessels home to dry, ask parents to cut the felt.

Fuzzy Fibers

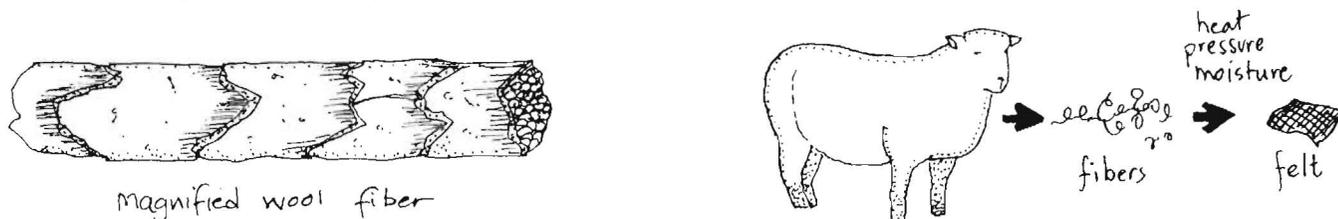


Science: Behind the Scenes

Do not use this material as a lecture. It is intended to increase your background knowledge and comfort level with the subject. Allow the children to explore.

Felt is a compact, thick fabric made of primarily wool fibers. Wool from sheep and specialty wool fibers from rabbits (angora), goats (mohair and cashmere), alpacas, camels, and other animals are the only fibers that felt naturally. Wool from different sheep breeds has different felting properties. Fine wools from Rabouillet and Merino sheep felt easily; springy wools from Suffolk and Dorset sheep require more time.

Felt is made by shrinking wool fibers together. The process of felting requires heat, moisture, and pressure. Wool fibers curl when exposed to warm, moist conditions. Overlapping scales on the fiber's surface swell and open. Applying pressure or rubbing the fibers together allows them to interlock and form a mat. Soap speeds the process by encouraging the scales to open.



magnified wool fiber

Other fibers appear to felt as they tangle together, but the resulting webs are rarely as thick and strong as wool felt. Familiar materials created by pressing fibers together are matted hair, dryer lint, and paper.

Felting can be an advantage or a disadvantage. Felt fabric is warm and wind resistant but wool's tendency to felt may cause care problems. Woolen garments shrink or harden if not cleaned properly.

The word "felt" is commonly used for any thick fabric that looks like wool felt. Commercial felt may mix wool with cotton or rayon to reduce cost or with nylon for added strength. Adhesives are sometimes used to bond hard-to-felt fibers. Felt is used in coats, mittens, hats, and slippers and in rugs, filters, and insulation. It is familiar to many people as material for pennants, acoustic coverings for stereo speakers, and billiard table pads.

Activity 1A

Fuzzy Fibers



Supplies and Preparation

Focus Supplies

Focus items can be shared by the group.

- wool and cotton socks or other garments
- felt fabric or item

Activity Supplies

Activity supplies are listed for individuals unless otherwise noted; multiply as needed.

- plastic cloth, for table
- wool fleece, carded wool, or combed wool,¹ large handful
- cotton batting or rolled cotton,² large handful
- magnifying lens
- medicine dropper
- dishpan, for group
- hot water³ (as hot as is comfortable to the hand)
- bar or liquid soap, for group
- stone,⁴ 2–3 inches in circumference and approximate shape of desired felt vessel
- wool yarn, 12–18 inches in length
- washboard⁵ (minimum of 1 for 2 children)
- towels, for drying hands and felt
- single-edge razor blade or Exacto knife, for adult



¹Carded or combed wool fibers work best. Wool fleece (the coat of a sheep that has been sheared and washed but not carded or combed) is also suitable. Raw (unwashed) fleece should first be washed gently in mild detergent and hot water, rinsed thoroughly, rolled in a towel, and spread to dry. Wool may be mail-ordered (Guide to Ordering Supplies, page 101) or purchased from local spinning guilds or sheep producers. Lamb's wool, available in the foot care department of drugstores, is a good but expensive substitute. Colored wool is more fun.

²Batting is available at fabric stores and quilt shops. Polyester batting may be used instead of cotton. Rolled cotton is found in drugstores.

³Hot water may be kept in a thermos if the facility does not have a ready source.

⁴Walnuts, golf balls, or other items with a textured surface may be substituted.

⁵Any bumpy surface will speed the felting. Try textured containers used for marinating foods, ridged pans for broiling, or rough sidewalks.

Fuzzy Fibers

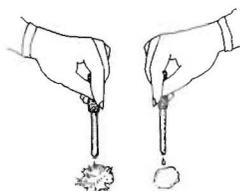


Focus

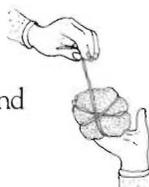
Show the children a wool garment, a cotton garment, and something made of felt. Say, "Tell me something about the fabrics in these items. What is different about them? What is the same? Have you seen items like these in your home? How are they used?"

Activity

1. Cover tables with plastic cloths.
2. Pick up a clump of wool in one hand and a clump of cotton in the other. Compare how they feel.
3. Look at the wool and cotton fibers with a magnifying lens.
4. With a medicine dropper, place two drops of water on each fiber clump and observe what happens.



5. Fill the dishpan with hot water. Lather enough soap into the water to make a sudsy bath. **Check that the water is a safe temperature.**
6. Dip the stone into the warm, sudsy water.
7. Wrap a *thin* layer of wool around the stone.
8. Wrap a second layer of wool around the stone, crosswise to the first.
9. Repeat steps 7 and 8 until the stone is evenly and completely covered.
10. Wrap a piece of yarn several times around the stone and tie the fibers in place.

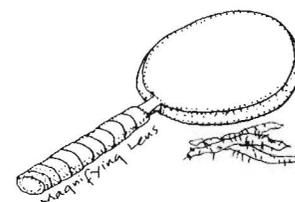


I wonder...

Keep track of "I wonder..." statements you and the children express while doing the activity. Children might wonder

how felt is made.

why felt doesn't have any holes.



Conversation

Questions You Might Ask

How do the fibers feel when dry? Are they soft, coarse, fluffy, smooth, warm, or cool?

Do the cotton and wool fibers look the same through the magnifying lens? Are they long, short, wavy, straight, or smooth?

What happened when you added two drops of water to the fibers? Did the water stay on the outside of the fiber?

What happened when you dipped the fibers in hot, soapy water, pressed them against the stone, and rubbed them on the washboard? Did the same thing happen to both the cotton and the wool fibers?

Describe the felt you made from wool.

Can you pull apart the felt?



Activity 1A

Fuzzy Fibers



11. Dip the fiber-covered stone in hot, soapy water to wet it completely.
12. Squeeze the stone for about 5 minutes or until the outside is smooth.
13. Rub and press all sides of the stone on a washboard.
14. Dip the stone occasionally in the soapy water and continue rubbing and pressing until the wool is snug around the stone.
15. Rinse out the soap.
16. Blot the felted item on a towel and let it air dry. Drying may take a day or more.
17. *An adult should cut through the felt on one side of the stone, creating an opening for the vessel.* Remove the stone.
18. Repeat steps 6–17 using cotton fibers. Compare the two vessels.



Transition or Closure

If you are doing only Activity 1A, review the “I wonder...” statements. Say, “We made wool fibers stick together to form cloth. This is possible because wool fibers have little scales that help the fibers cling together. We observed that heat, moisture, and pressure are needed for fibers to felt. What other ideas do you have about fuzzy things?” If you are doing Activities 1A and 1B together, summarize the fiber activity as you and the children clean up the work areas. Then shift their attention to the animal activity.

I wonder...

Keep listening for “I wonder...” statements after the activity. Children might wonder

if fibers from all animals will felt.

if their hair will felt.

if dryer lint is an example of felting.

what would happen to a wool sweater if it were washed in hot water.

Fuzzy Fibers



A Step Beyond

I wonder if all wool can be made into felt.

Make felt using different types and combinations of wool fibers.

- Compare carded and uncarded wool.
- Try a specialty wool.
- Try a blended yarn of wool and nylon that you have separated into fibers.
- Compare wool from two different breeds of sheep.

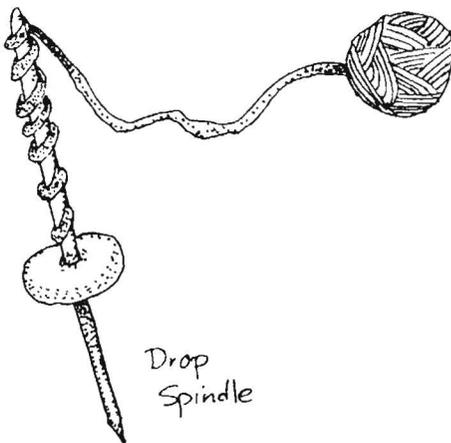
I wonder if wool will felt when I apply moisture, pressure, and heat in different ways.

Make felt using different conditions. Compare the amount of time needed in the different processes.

- Apply different pressure such as pounding fleece with a wooden spoon or stomping it with your foot.
- Wash wool balls (place inside a sock or hosiery) in a washing machine with detergent and hot water.

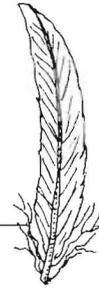
I wonder if wool fibers can stick together without heat and moisture.

- Spin wool fibers into yarn. Ask members of a local spinning guild to explain spinning with a wheel and a drop spindle or refer to one of the references in this manual. Do you think the surface scales on the wool are as important to spinning as they are to felting?



Activity 1B

Fantastic Feathers



Leader's Guide

What's the point?

Children observe how structural differences between flight and insulating feathers determine their uses. They enjoy using their feathers to decorate the felt vessel they made in Activity 1A.

New terms include *flight feathers*, *down feathers*, *shaft*, *vane*, *barb*, *barbule*, *airfoil*, and *lift*. All bird feathers have a hollow central shaft that separates their front and rear vanes. Each vane is made of thousands of slender branches or barbs. Each barb has tiny barbules on each side. Flight feathers must be strong and sleek but lightweight. Their barbules are zipped together by tiny hooks, similar to Velcro, that regulate the passage of air to help the bird fly. Down feathers are fluffy because they have no hooks on their barbules. To keep warm, birds fluff their down feathers to trap thick layers of air.

Bird wings have a special shape called an airfoil that is curved on top and flatter on the bottom. This shape forces air to travel faster over the wing than under it. The air pressure becomes lighter on top of the wing than underneath and lifts the wing up. This force is called lift.

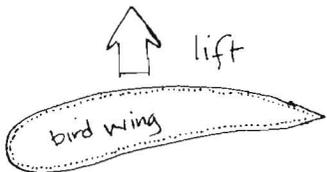
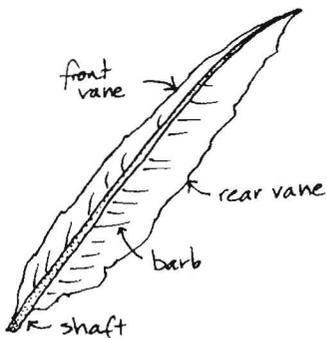
For additional information, read Science: Behind the Scenes (page 25).

What's the plan?

1. Read the activity (page 27).
2. Gather the supplies (page 26).
3. Try the activity.
4. Note safety measures (***in bold italics***).

What's my role?

- Guide the children through the activity by doing the procedures with them.
- Encourage conversation about what they are doing and observing. Use the conversation questions as a guide, not a script to be followed.
- Listen for and summarize "I wonder..." statements the children make during the activity. (See "I wonder..." statements, page 10, Monitoring Success, page 13, and Evaluation Form, page 107.)
- Help the children relate this activity to their daily experiences.



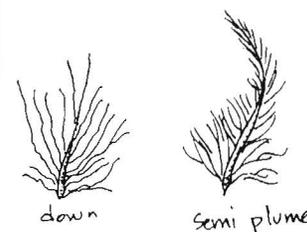
Fantastic Feathers



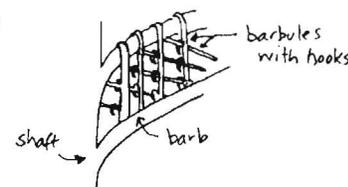
Science: Behind the Scenes

Do not use this material as a lecture. It is intended to increase your background knowledge and comfort level with the subject. Allow the children to explore.

Short, fuzzy down feathers are close to the bird's body. They trap air to insulate the bird. Many birds have a layer of semiplume feathers between their down and contour feathers for further insulation. Semiplumes look like very large down feathers.

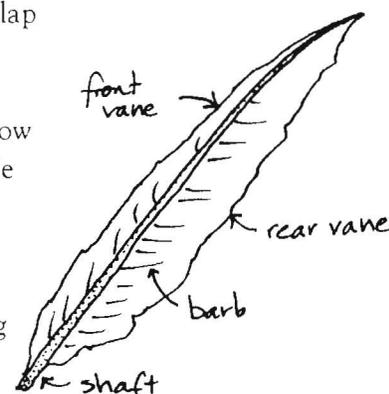


Contour feathers are the bird's outermost feathers. They include body feathers and flight feathers. Body feathers generally have hooked or interlocking barbules that create a sleek surface that resists rain and air. Birds that don't fly, such as ostriches, have modified body feathers with unhooked fuzzy barbules. Other modified body feathers include the tail of a male peacock and the crest of a cockatoo. They are more for show than for protection.



Flight feathers have strong shafts with interlocking barbules from base to tip. When the wing flaps up, the barbules unhook to let air pass freely through the wing just as when you flap your arms with your fingers spread open. When the wing starts to flap down, the barbules hook together to push air downward.

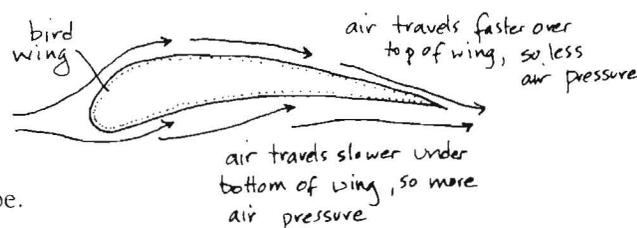
Primary flight feathers are located at the wing tip. Their front vanes are very narrow compared to their rear vanes. As the wings move downward, air pushes up the wide rear vane. The front vane twists downward just like a propeller blade, pushing air backward and thrusting the bird forward.



Birds smooth and align the barbules of their contour feathers by preening (drawing the feathers through their beak or feet). Before preening, ducks rub an oil gland at the base of their tail. This oil helps to waterproof their feathers.

Bird wings have a special teardrop shape called an airfoil. Air travels faster over the curved top (because it covers a longer distance) than it does under the flat bottom.

When air speed increases, air pressure drops. Thus the air above the wing is lighter than the air beneath the wing. This creates a force called lift that raises the bird higher into the air the faster the wing moves. That is why the curved piece of paper lifts higher the harder you blow. The wings of airplanes, bats, and most flying insects also have an airfoil shape.



Activity 1B

Fantastic Feathers



Supplies and Preparation

Focus Supplies

No supplies are needed.

Activity Supplies

Activity supplies are listed for individuals unless otherwise noted; multiply as needed.

- down feather^{1,4}
- flight feather^{2,4}
- miscellaneous feathers^{3,4} (optional)
- black construction paper
- glue stick, for group
- magnifying lens
- cups of water (1 per 2 children)
- medicine dropper
- scissors
- newspaper (1 1/2" x 6") that has been rolled around a pencil to form a curve
- newspaper (1 1/2" x 6") that has been folded in half widthwise

¹Down feathers are fluffy with short shafts.

²Flight feathers have strong, long shafts and are smooth from base to tip with hooked barbules.

³Miscellaneous feathers include all feathers that are not down or flight feathers. Examples are display feathers such as tail feathers from a male peacock, semiplume feathers (like down but longer), and body feathers (smooth and sleek on top with a tiny bit of down at the base).

⁴Feathers collected from pets, farms, zoos, pet shops, and other places can be sanitized by placing them in a 200° F oven for 15 minutes. **Remember to wash hands after handling bird feathers and to avoid handling dead birds.** Hobby stores generally sell flight and miscellaneous feathers. Some fabric stores sell down, but a more likely source is old comforters, jackets, and vests. All feathers can be mail-ordered (Guide to Ordering Supplies, page 101).

Fantastic Feathers



Focus

Stand in a circle. Ask the children to pretend they are birds and flap their arms up and down with their fingers spread. Ask, "Do you feel air passing through your fingers?" Ask them to press their fingers together and flap their arms again. Say, "Can you feel the wind passing between your fingers now? Do you think birds can open and close their feathers the way you open and close your fingers? Let's look at some feathers and think about how they are made and how they help the bird!"



I wonder...

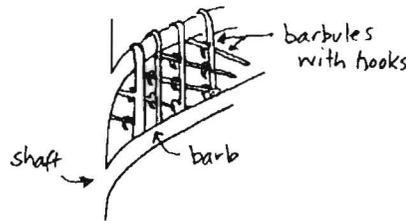
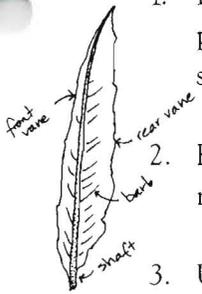
Keep track of "I wonder..." statements you and the children express while doing the activity. Children might wonder

why some feathers look different from others.

why birds fluff their feathers in the cold.

Activity

- Place one feather of each type (e.g., down, flight) on a piece of black construction paper. Use a glue stick to secure the down feather to the paper.
- Examine each feather and identify the shaft, front vane, rear vane, barbs, and barbules.
- Use a magnifying lens to look for hooks on the barbules. Pull gently on one barb and see what happens to the barbs next to it.
- Twist each feather from left to right and gently bend it.
- Hold each feather at its base while running the fingers of one hand downward from the top to bottom of the feather. Which feathers get ragged? A bird uses its beak to smooth ragged feathers. Pretend your fingers are a beak and stroke upward.
- Place two drops of water on each feather and observe what happens.



Conversation

Questions You Might Ask

Which feather is biggest? has the thickest shaft? is fluffiest?

Is the front vane narrower than the rear vane?

Do you think the feathers are strong? flexible?

Which feathers get ruffled when you stroke downward on them? Have you seen a bird ruffle or unruffle its feathers? What did it do?

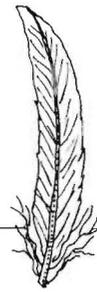
What happened when you put water on the feathers?

Describe the feather you think is used for flying. Describe the one you think is used for keeping warm. How do you think the other feathers are used?

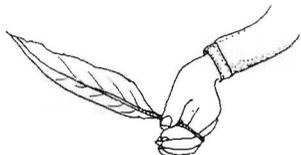
What happens when you blow hard over the rolled newspaper? over the bent newspaper? Which one do you think is a better shape for a wing?

Activity 1B

Fantastic Feathers



7. Cut the shaft at its base to see what is inside.
8. Hold a flight feather horizontally with its front (narrow) vane facing away from your face. Try to fan yourself with the feather. Observe what the front and rear vanes do.
9. Pinch the curved piece of newspaper between your thumb and index finger and let it hang over your fingers. Blow over it gently, then hard.
10. Do the same exercise with the creased newspaper, predicting what will happen and then observing.
11. The children can decorate their felt vessels from Activity 1A with their feathers.



Closure: Connecting Fibers and Animals

If you are doing only Activity 1B, review the “I wonder...” statements. Say, “We learned that different feathers do different things. Some help the bird fly; some keep the bird warm. We observed that even small features such as barbule hooks affect how the feather is used.” If you are doing Activities 1A and 1B together, review the “I wonder...” statements for both and help the children relate the two experiences to structure and function. Ask, “Do you see any similarities between feathers in this activity and the wool fibers in Activity 1A?” Compare the scales on the wool fibers to the barbule hooks on the feathers.

I wonder...

Keep listening for “I wonder...” statements after the activity. Children might wonder

if all birds can fly.

if birds can twist their wings and fly backward.

if birds keep their feathers “zipped” when not flying.

how people use feathers.

Fantastic Feathers



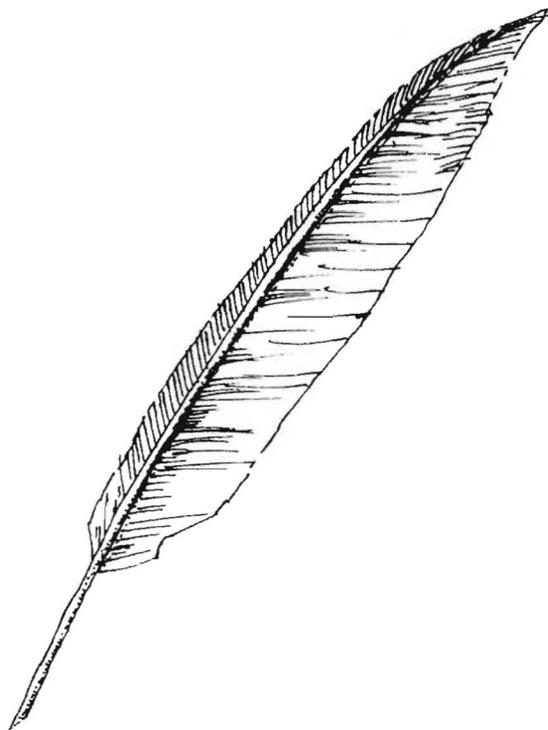
A Step Beyond

I wonder how people have used feathers in the past.

Try making a quill pen. The word for pen in Spanish and French is feather (*pluma* or *plume*). This is because people used to make their writing pens from the flight feathers of large birds. The hollow shaft works as an ink reservoir.

You can make a quill pen to write a note to a friend. Cut the tip of the shaft diagonally so that it forms a point and an oval opening. Dip it carefully into a bottle of India ink. You can also cut off the end of the shaft and replace it with a metal quill. Metal quills can be purchased at many art stores.

You can even make your own ink. Mix a little water with lamp black, berries, or soot. Add gum arabic to thicken the ink to a consistency that works well with your quill.







Light Up the Night

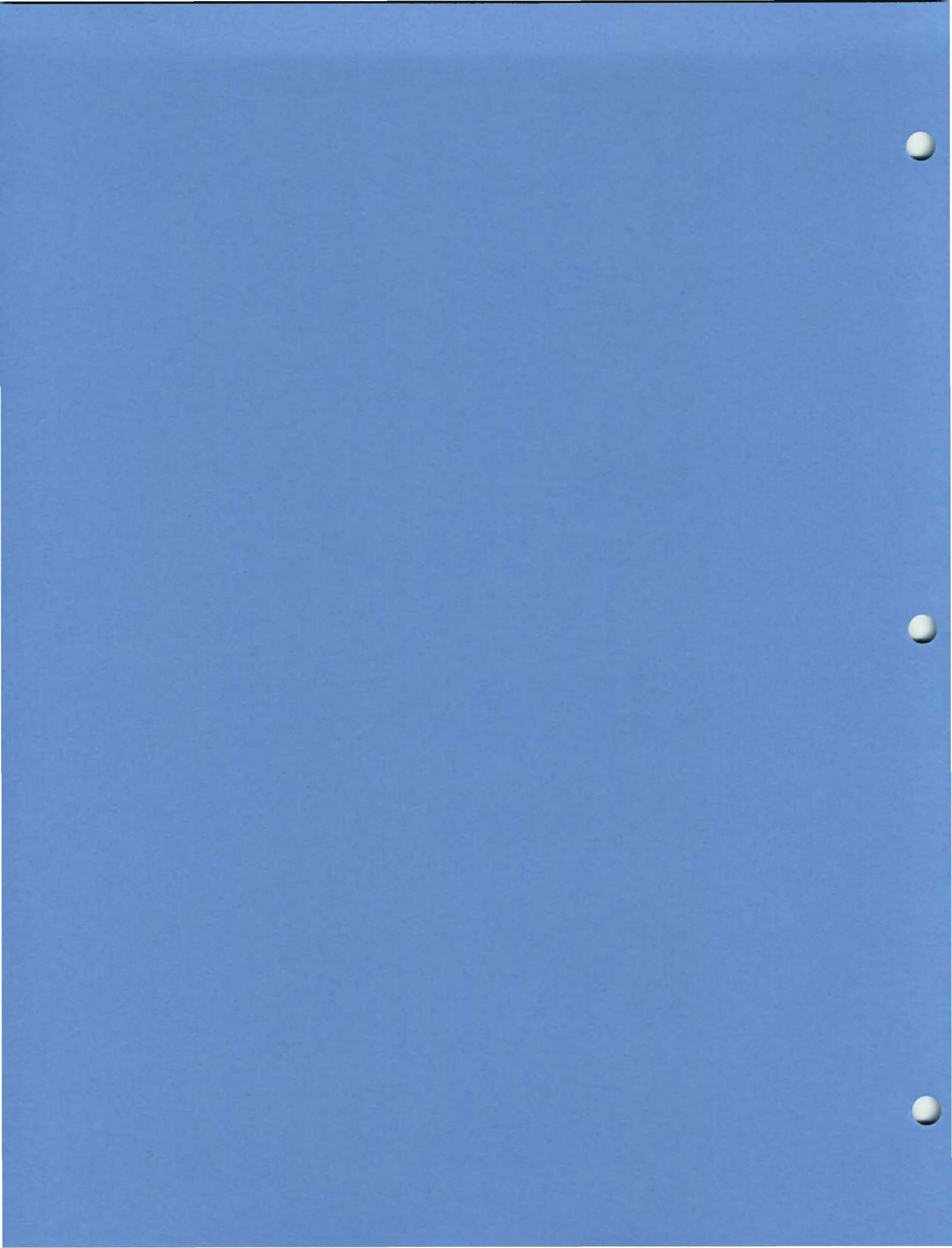


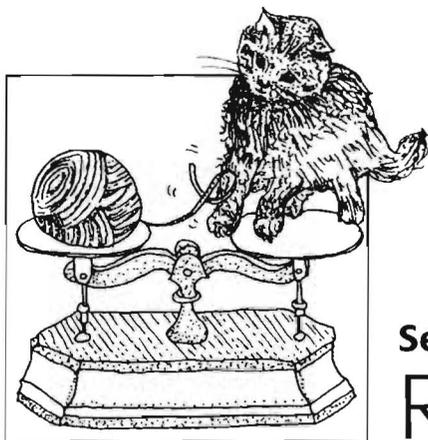
Night Views



Reflection
of Light







Session 2

Reflection of Light

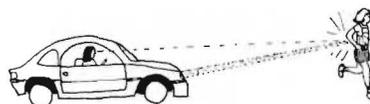
This session explores the effects of light reflection in clothing and in the animal kingdom. The two activities make children more aware of the things that produce light and the things that reflect light. Children should also become more interested in how animals see and in safety issues related to visibility.

In Activity 2A, *Light Up the Night*, children observe how light is reflected from different materials. They learn that reflective tapes and fabrics make pedestrians, cyclists, road workers, traffic officers, and firefighters more visible at night or at other times when it is hard to see.

In Activity 2B, *Night Views*, children use the shiny bottom of a coffee can to demonstrate why a cat's eyes appear to glow in the dark. They also view the world through a tiny hole that makes focusing easy just as cats do when hunting during daylight.

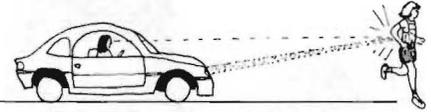
Session at a Glance

- Leader's Guide, pages 34, 40
- Special Hint, page 36
- Science: Behind the Scenes, pages 35, 41
- Supplies and Preparation, pages 36, 42
- Focus, pages 37, 43
- Activity, pages 37, 43
- Transition or Closure, pages 38, 44
- A Step Beyond, pages 39, 45



Activity 2A

Light Up the Night



Leader's Guide

What's the point?

Children observe how different materials reflect light. They use reflective and nonreflective tapes of the same color to create what at first appears to be a red and white checkerboard design. Mystery designs are revealed when the group shines a flashlight on the patterns in the dark.

The terms *light*, *reflect*, and *visibility* are introduced. Light is a form of energy. It travels in waves that move in a straight line. When it hits something, it bounces off, or is reflected. Cloth tapes reflect light in many directions. Reflective materials reflect light back toward the light source. Thus a night rider wearing a jacket with reflective tape can be seen at a greater distance when caught in the headlights of a passing car than someone wearing nonreflective materials. Increased visibility means increased safety.

For additional information, read Science: Behind the Scenes (page 35).

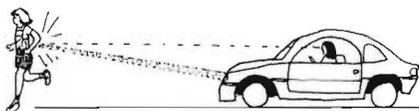
What's the plan?

1. Read the activity (page 37).
2. Gather the supplies (page 36).
3. Locate a place that can be darkened. Try the activity.
4. Note special hints (page 36).

What's my role?

- Guide the children through the activity by doing the procedures with them.
- Encourage conversation about what they are doing and observing. Use the conversation questions as a guide, not a script to be followed.
- Listen for and summarize "I wonder..." statements the children make during the activity. (See "I wonder..." statements, page 10, Monitoring Success, page 13, and Evaluation Form, page 107.)
- Help the children relate this activity to their daily experiences.

Light Up the Night



Science: Behind the Scenes

Do not use this material as a lecture. It is intended to increase your background knowledge and comfort level with the subject. Allow the children to explore.

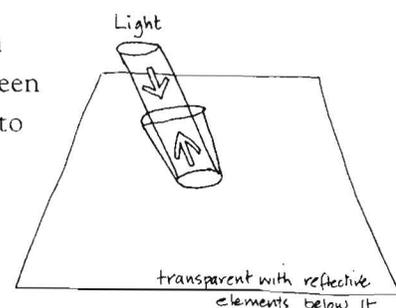
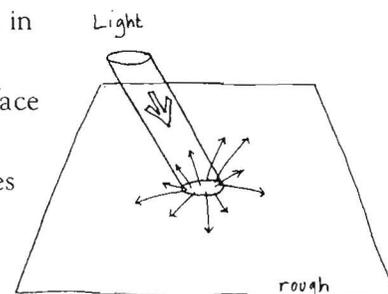
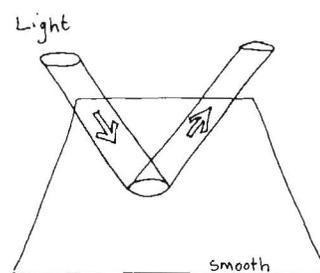
Visibility is an important safety consideration. Joggers, cyclists, road workers, traffic officers, and others are at risk in the dark or fog because they cannot be seen by drivers of moving vehicles. The rescue of injured persons may be delayed when smoke, dust, or steam obscures their location. People can improve their personal safety by wearing clothes of contrasting colors or by attaching reflective tapes.

Visibility of clothing depends on the light reflected by the clothes in relation to the light given off by the surroundings. Yellowish-green clothing surrounded by spring foliage would not be as visible as red clothing, but in most settings yellowish-green clothing would be easier to see than red. At night, white and silver offer the greatest contrast and the best visibility.

Direction of the reflected light also affects visibility of clothing. Light waves travel in a straight line. When they hit something, they bounce off (are reflected). Light is reflected in three ways: mirror, diffuse, and retro. When light strikes a smooth surface such as a mirror, the light bounces off at an equal but opposite angle. When light strikes something with an irregular surface like newsprint or cloth, the light bounces off in many directions. When light strikes a retroreflective material, the light bounces directly back toward the light source.

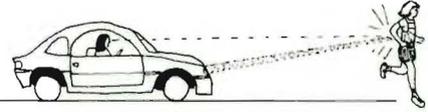
Retroreflective fabrics and tapes are made of beads or microprisms that reflect all the light back toward the light source. This makes the object easy to see even at a great distance. For example, in the beam of a car headlight, dark clothing can be seen from about 120 feet, white clothing up to 300 feet, and retroreflective fabrics up to 700 feet.

Reflective materials differ from fluorescent and phosphorescent materials. Fluorescent materials shine when exposed to sunlight. These “dayglow” colors fade quickly if the material is removed from sunlight. Phosphorescent materials shine in the dark after exposure to any form of visible light. These glow-in-the-dark items return very slowly to their original state.



Activity 2A

Light Up the Night



Supplies and Preparation

Focus Supplies

The focus item can be shared by the group.

- photo or magazine clipping of a school bus, emergency vehicle, or any other items that have highly visible colors

Activity Supplies

Activity supplies are listed for individuals unless otherwise noted; multiply as needed.

- highlighter
- square grid, page 46
- reflective tape¹ of 1-in. width, two colors (red and white are recommended), 20 in. each
- scissors
- glue stick
- cloth utility tape² (nonreflective) of 1-in. width, same two colors as the reflective tape, 20 in. each
- graph paper
- flashlights, for group

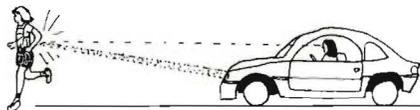
¹Reflexite by Reflexite North America, Scotchlite by 3M, and reflective tapes by Manco or United Tape Company

²Reflective and cloth tapes are available in several widths and colors. One-inch tapes are convenient because they require less measuring and cutting. The colors and textures of the two tapes must be as nearly the same as possible. Most reflective tape has a backing; most cloth tapes do not. Tapes may be purchased from sporting goods, hardware, craft, auto, and cycle stores or mail-ordered (Guide to Ordering Supplies, page 101).

Special Hints

- A child who has a visual impairment may not be able to participate fully.
- For children lacking dexterity, make tape-covered magnetic squares. Apply tapes to magnetic sheeting. Cut sheeting into 1-inch squares. Place a mark on the back to identify reflective squares. Children create designs by placing the squares on metal trays.

Light Up the Night



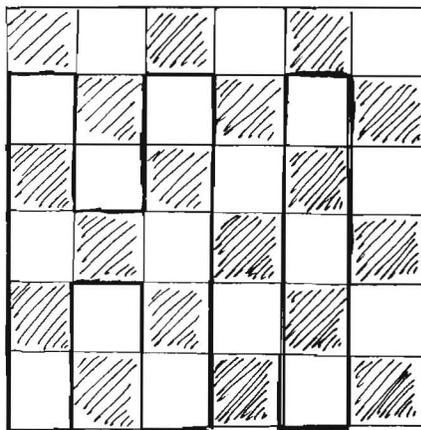
Focus

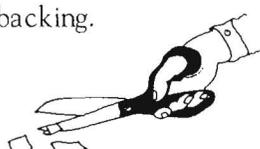
Show a picture of a school bus or emergency vehicle (usually bright yellow, yellowish green, or white). Ask, “What is this? What color is it? Why do you think it is this color? What colors always get your attention? Do some colors stand out even in the dark? Let’s think about how easy it is to see things with and without light and let’s look at what we can do so that others can see us better.”



Activity

- Use a highlighter to outline a “secret” number, letter, or design onto the grid. The easiest designs have straight lines and follow the grid. Curved or diagonal lines require shaping of the reflective and nonreflective squares.



- Cut red reflective tape and white reflective tape into 1-inch squares. Do not remove the backing.
- 
- Be careful: cover only grid squares that are part of your design and maintain the checkerboard color combination.** Glue squares of red reflective tape into the shaded boxes of the grid that are part of your design. Glue squares of white reflective tape into the white boxes of the grid that are part of your design.
 - Stick the red and white cloth (nonreflective) tapes onto a piece of graph paper. Cut into 1-inch squares.

I wonder...

Keep track of “I wonder...” statements you and the children express while doing the activity. Children might wonder

why school buses aren't red.

why crossing guards wear brightly colored vests.

Conversation

Questions You Might Ask

Describe the reflective and nonreflective tapes. Are they thick, thin, smooth, rough, shiny, or dull?

Can you see through the reflective tape? Can you see your reflection in it?

Do you have anything in your house with reflective tape?

Have you seen reflective tape on other people’s clothing? on clothing in magazines?

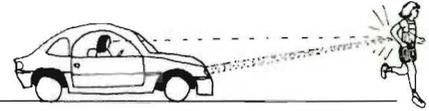
Was it easy to see what others wrote or designed with the lights on? lights off? when using a flashlight?

Have you seen cyclists or joggers on the road at night? What were they wearing? Were they easy to see?

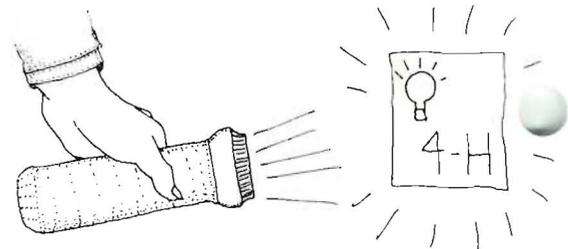
What other things shine in the dark?

Activity 2A

Light Up the Night



5. **Be careful: fill in the grid squares outside your design but maintain the checkerboard color combination.** Glue squares of red cloth tape into the remaining shaded boxes of the grid. Glue squares of white cloth tape into the remaining white boxes of the grid.
6. Place the design about 20 feet away from the group in a lighted room or outdoors in daylight. Try to read the number or letter or describe the design.
7. Place the design about 20 feet away from the group in a dark room or outdoors at night. Without any light, try to read the number or letter or describe the design.
8. Hold a flashlight close to your head at eye level and shine it directly at the design.
9. Read the number or letter or describe the design.
10. Walk past the design holding your flashlight in front of you and observe what happens.



Transition or Closure

If you are doing only Activity 2A, review the “I wonder...” statements. Say, “We know that some materials are good reflectors of light. We can put reflective tapes on our clothes so that drivers can see us better at night. What other ideas do you have about light reflection?” If you are doing Activities 2A and 2B together, summarize the fiber activity as you and the children clean up. Then shift their attention to the animal activity.

I wonder...

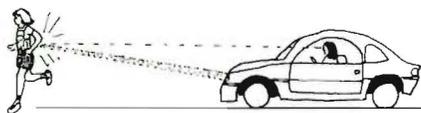
Keep listening for “I wonder...” statements after the activity. Children might wonder

if reflective tape is made from glitter.

why light has to hit the tape before it becomes visible in the dark.

if different-colored tapes reflect the light differently.

Light Up the Night



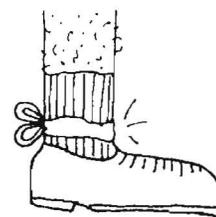
A Step Beyond

I wonder if dayglow and glow-in-the-dark stickers work like reflective tapes.

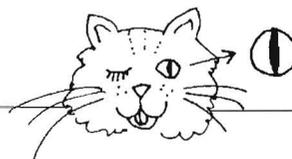
Recreate the message or design from Activity 2A using fluorescent and phosphorescent materials. Shine a flashlight on your three designs in a dark room. Carry them into the sunlight. Expose your message to the light of a lamp and then take it to a dark area. Compare your observations in these three different situations.

I wonder if different colors of reflective tape act the same way.

Make bands from different-colored reflective tapes. Attach a piece of reflective tape to a ribbon. Tie the ribbon around the ankle or wrist. Give everyone a small flashlight. Play a game of tag. Turn out the lights. Whenever a flashlight beam hits your band, you are out of the game. Can you identify a player by the color of the band he or she is wearing?



Night Views



Leader's Guide

What's the point?

Children learn the names for parts of the eye and investigate how animal eyes use reflected light. New terms include *pupil*, *lens*, *retina*, *tapetum*, and *nocturnal*. The black opening in the center of your eye is the pupil. Light is reflected from an object through your pupil onto the lens of your eye. The lens focuses the image on your retina. Nerve fibers in the retina send the picture to your brain so you can "see" it. In dim light, your pupils open very wide to get enough light to your retina to form an image.

Cats are nocturnal, hunting at night and sleeping during the day. They have a small mirrorlike structure (the tapetum) on the back wall of their eyes that helps them see at night and that makes their eyes appear to glow. In daylight, cats make their pupils into tiny slits to reduce the amount of light that enters. You, too, will see some advantages to seeing through tiny holes.

For additional information, read Science: Behind the Scenes (page 41).

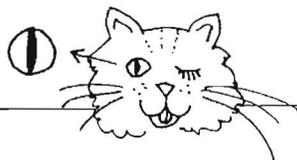
What's the plan?

1. Read the activity (page 43).
2. Gather the supplies (page 42).
3. Locate a place that can be darkened. Try the activity.

What's my role?

- Guide the children through the activity by doing the procedures with them.
- Encourage conversation about what they are doing and observing. Use the conversation questions as a guide, not a script to be followed.
- Listen for and summarize "I wonder..." statements the children make during the activity. (See "I wonder..." statements, page 10, Monitoring Success, page 13, and Evaluation Form, page 107.)
- Help the children relate this activity to their daily experiences.

Night Views



Science: Behind the Scenes

Do not use this material as a lecture. It is intended to increase your background knowledge and comfort level with the subject. Allow the children to explore.

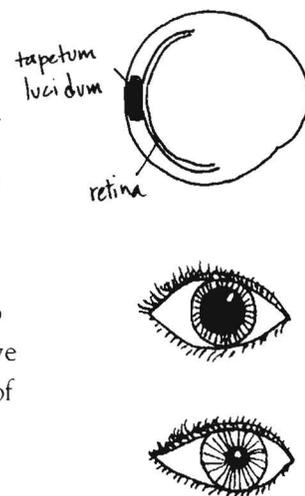
The iris gives your eye its color. It is a muscle that opens and closes the black opening in the center of your eye called the pupil. When you look at a tree, light is reflected from the tree through your pupil onto the lens of your eye. Lenses are transparent, curved structures that bend light. The lens focuses the light to form an image on vision cells much as a camera lens focuses an image on light-sensitive film. Nerve fibers in the vision cells send impulses to your brain so that you “see” the tree.

The layer of light-sensitive vision cells inside your eye is called the retina. It consists of cones and rods. Cones require lots of light but provide fine-detail information to the brain. Birds of prey have many cones so they can see small mice in the grass far below them.

Rods are effective in dim light but collect information only about the degree of darkness and the general shape of an object. The rods contain a pigment called rhodopsin. Rhodopsin breaks down into retinene and opsin when subjected to bright light. In the dark, retinene and opsin are converted back to rhodopsin. This is why it takes time for eyes to adjust to darkness.

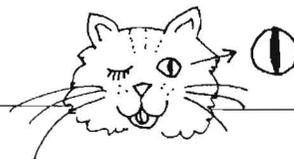
In dim light, your pupil must open wide to get enough light to your lens to form an image. Humans cannot see well at night. Nocturnal animals like cats sleep during the day and hunt at night. How do they see in the dark? Cats have a small mirrorlike structure called the tapetum on the back wall of their eye. After the light goes through the vision cells it hits the tapetum and is bounced back onto the vision cells again, giving them double the light. If you shine a light on cat eyes, the tapetum reflects the light, causing their eyes to “glow.” Lemurs, fruit bats, dolphins, whales, and many ungulates (hoofed animals) also have a tapetum. The tapetum of alligators, crocodiles, and many fish contains silvery crystals of a chemical called guanine that can reflect even minuscule amounts of light.

All this light bouncing around cats’ eyes makes it hard for them to see in the daylight. When hunting on a sunny day, cats make their pupils into tiny slits, allowing only a small amount of light to enter. When you look through a pinhole you are mimicking how a cat’s eye behaves in daylight. Images look darker but sharper when seen through a pinhole.



Activity 2B

Night Views



Supplies and Preparation

Focus Supplies

The focus space can be shared by the group.

- Brightly lit room or bright sunlight

Activity Supplies

Activity supplies are listed for individuals; multiply as needed.

- 14-oz. coffee can with a shiny inside bottom
- 1 sheet of 8½ x 11-in. black construction paper
- pencil
- ruler
- scissors
- two cardboard patterns of pupils¹, one oval (cat), one round (human), for group
- masking tape
- flashlight, 1 for 2 children
- visual aids with small print²
- 1 ½ sheets of 8½ x 11-in. black construction paper³ (to make pinhole)
- large sewing needle or paper clip

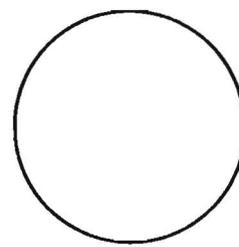
¹Make cardboard patterns from these two pupil shapes (below).

²Examples of visual aids with small print are ingredient lists on cereal, soup, or vitamin labels; map legends; measurement marks on a ruler; and magazine or newspaper text glued to an index card. If you are outdoors, ask the children to stare at specific tree branches, model names on cars, license plate numbers, and so forth.

³Cut construction paper into eighths (rectangles of about 2 ½ in. x 4 ¼ in.). Poke one very smooth hole in each with a paper clip. The hole should be near to one end of the rectangle to align with one eye.



cat eye



human eye

Night Views



Focus

Gather in a brightly lit room. Say, "The black circle in the center of your eye is your pupil. It lets light into your eye so you can see. Let's see how much the size of your pupil can change." Ask children to check the size of a partner's pupils. Half the partners close their eyes, cover them with their hands, and count to 60 twice. Say, "Look into your partner's eyes and see if his or her pupils have changed size." Then reverse roles. Talk about what they observe. Say, "In the dark your pupils get large to let in as much light as possible. Do you wonder how night-hunting animals like cats see in the dark?"



Activity

- Partners choose the cat eye or human eye. If you are making the human eye, cut a circle of black construction paper the same size as the bottom of the coffee can. Slide the cutout inside the can to fit snugly over the bottom.
- Draw a circle around a coffee can on another piece of construction paper. Draw a second circle about $\frac{1}{2}$ inch larger and cut along this line.

- Place the cardboard pattern for the human eye (round) or the cat eye (oval) in the middle of the round paper and draw around it. Cut along the line to make a pupil-shaped opening.



Black construction paper with hole in center



- Tape the round paper with the hole over the open end of your coffee can.
- Half the children stand in a row. They hold the human-eye can over one eye and the cat-eye can over the other, with "eyes" straight ahead.
- When everyone is ready, turn off the lights.

I wonder...

Keep track of "I wonder..." statements you and the children express while doing the activity. Children might wonder

why pupils change size.

why cats need to see better than humans in the dark.

Conversation

Questions You Might Ask

Describe the pattern shapes. Do you think they look like animal pupils?

Have you seen a cat's eyes glow in the dark? What color were they?

Do you think your eyes glow in the dark?

What did you see when you shined the light at the can with the round opening? the can with the oval opening?

Why do you think a cat makes its pupils into tiny slits in bright sunshine?

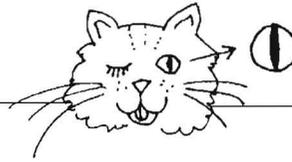
What happens to the blurred image when you look at it through a pinhole? Do you see a difference when you hold the visual aid close to or far from your eyes?

Do you think a lot of light passes through a pinhole?

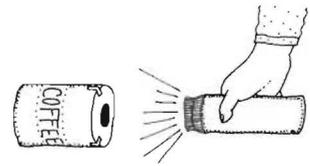
Light passes through your pupil onto the lens of your eye. What other things have lenses?

Activity 2B

Night Views



7. The remaining children shine flashlights at the coffee can eyes.



8. Children switch places and repeat Steps 5–7.

9. Turn on the lights, set aside the cans, and discuss what you observed.

10. In a brightly lit room, bring a visual aid with small print close to your eyes until the image blurs. Hold it in this position.

11. Place the pinhole paper in front of your eyes so that one eye is looking at the visual aid through the pinhole.



12. Lower the pinhole paper and move the visual aid away from you until the image blurs. Hold it in this position.

13. Lift the pinhole paper back to your eye and look again at the visual aid.

Closure: Connecting Fibers and Animals

If you are doing only Activity 2B, review the “I wonder...” statements. Say, “We discovered something about how animal and human eyes work and why cats’ eyes appear to glow in the dark. If you are doing Activities 2A and 2B together, review the “I wonder...” statements for both. Talk with the children about how these activities helped them think about light and sight. Ask, “Can you think of other things that reflect light?”

I wonder...

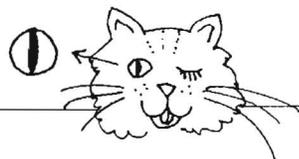
Keep listening for “I wonder...” statements after the activity. Children might wonder

why mirrors reflect light.

why I feel blinded when someone flashes a light in my eyes.

what other animal eyes are like.

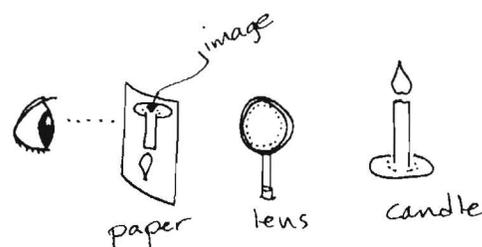
Night Views



A Step Beyond

I wonder how the lenses in our eyes work and how they are different from a camera lens.

To demonstrate how lenses focus, you need a reading lamp or candle (do not use the sun), magnifying lens, and piece of waxed paper. Turn on the lamp in a darkened room. Stand about 7 feet from the light and hold the paper about a foot in front of your eyes. Line up the magnifying lens between the candle and the waxed paper. Move the magnifying lens back and forth until the image of the candle comes into focus on the paper. The image will be upside down just as it would appear on the retina of an eye. Our brains adjust for this change so that we perceive the image right side up.

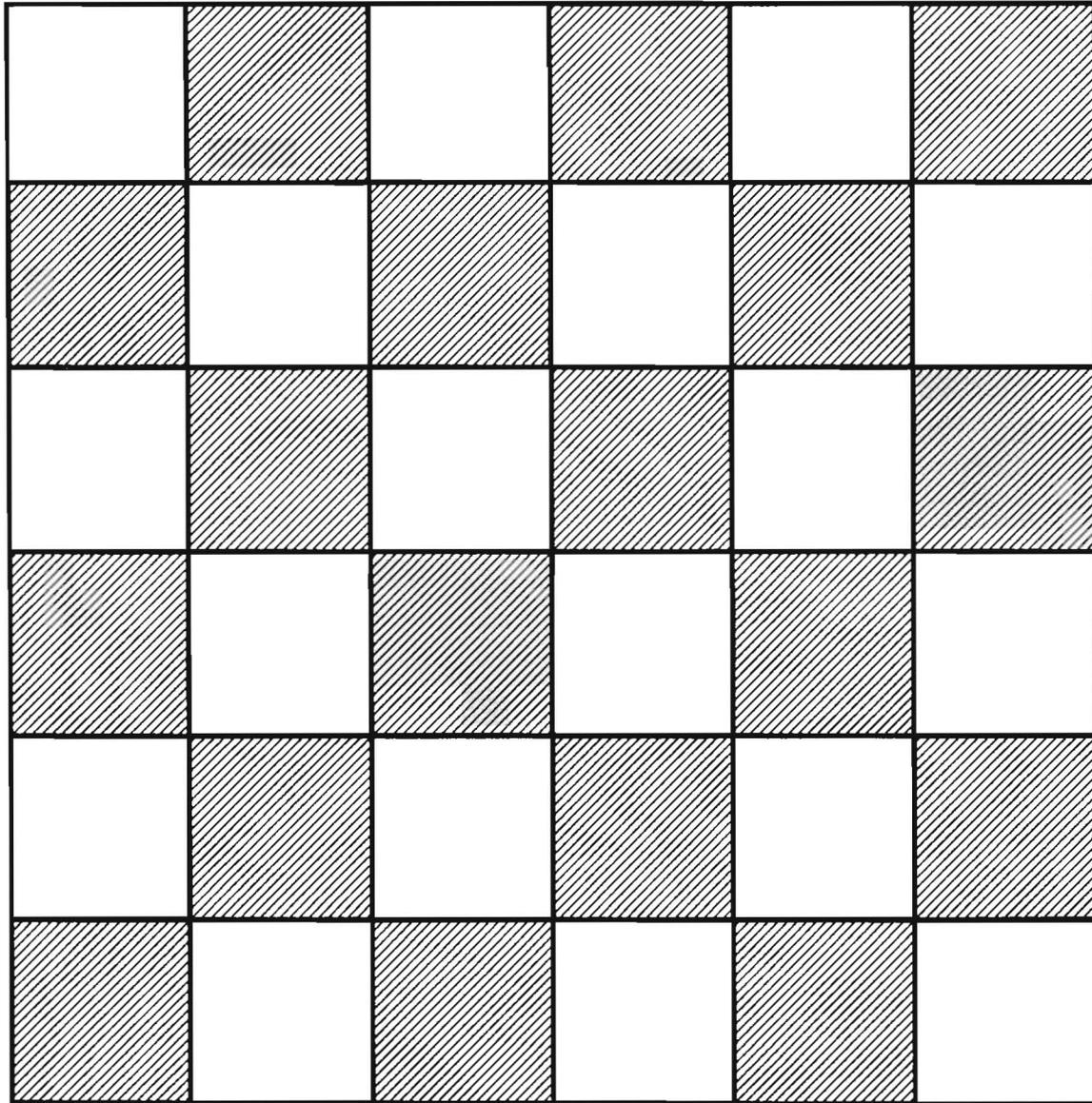


To demonstrate how a pinhole can focus images, substitute a piece of firm poster paper with a clean 1-millimeter pinhole for the magnifying lens. Standing about 7 feet from the light, hold the paper at arm's length with the pinhole lined up between one of your eyes and the light. Hold the waxed paper with your other hand between the pinhole and your eye. The image of the lamp or candle should be focused on the sheet of waxed paper even if you move the pinhole farther forward or back. This is different from a lens, which must be a specific distance from the waxed paper to focus the image. This distance is the plane of focus of the lens.

Make a pinhole camera with a sheet (not roll) of photographic film or paper, an empty rolled oats carton (preferably with a cardboard lid), electrician's tape, and a large sewing needle. Poke a clean hole in the bottom of the oats cylinder. Put a small piece of electrician's tape over the hole. If the lid is plastic, cover it with black paper to keep out the light.

In a completely darkened room, work with an adult to tape photographic film or paper inside the lid. Secure the lid over the cylinder, making certain that no light can enter and expose the film. Go outdoors and select a subject to photograph. Aim the covered hole in the cylinder at the subject. Holding the cylinder very still, pull the tape back from the hole. If using paper, count for 45 seconds in midday or very bright sunshine (120 seconds in early morning or late afternoon sun, 5 minutes if cloudy); if using film with ASA 125, count for 3 seconds, 7 seconds, and 18 seconds, respectively, and then replace the tape. Experiment using different exposure times and light intensities.

Design Grid
Activity 2A: Light Up the Night





Keeping Cool

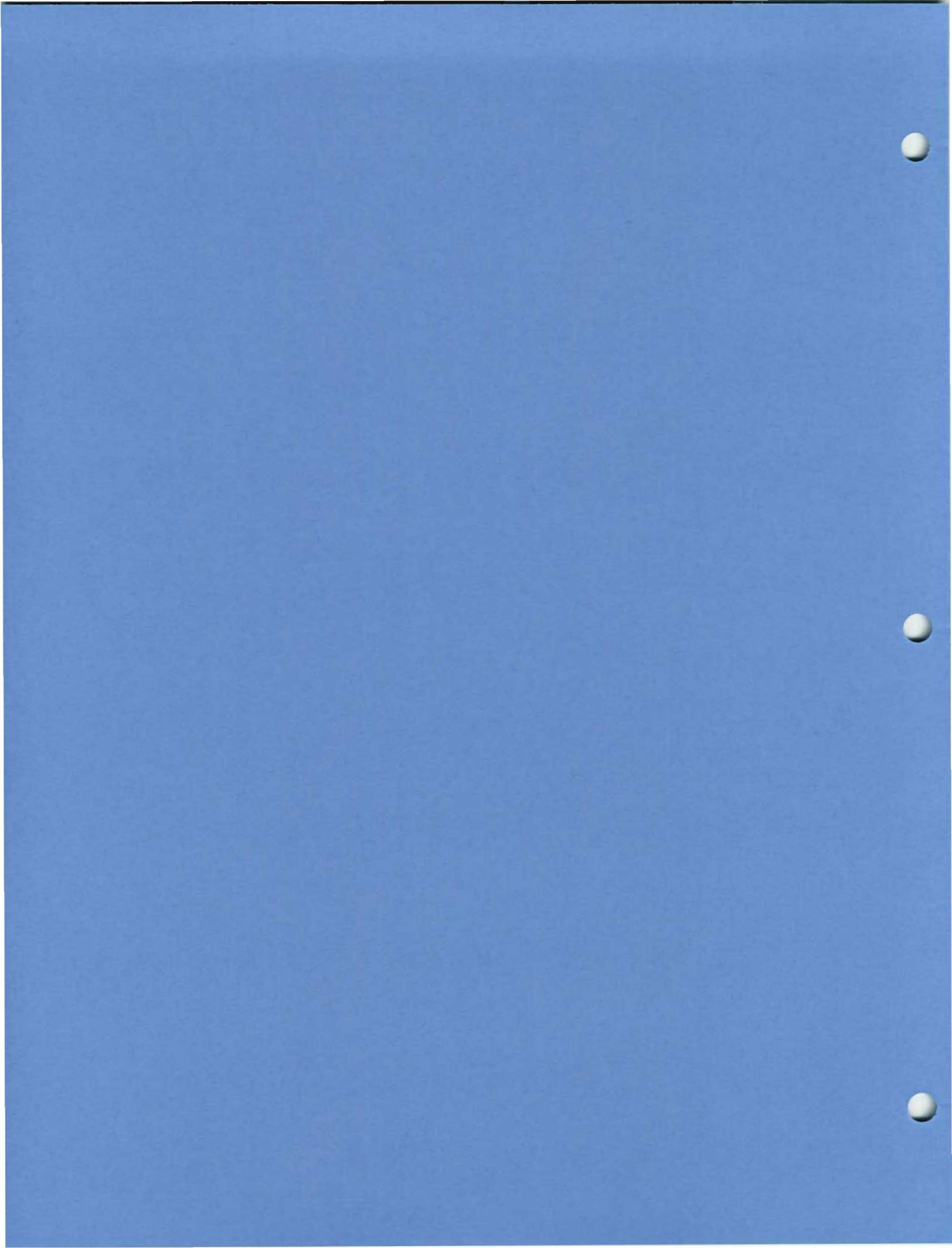


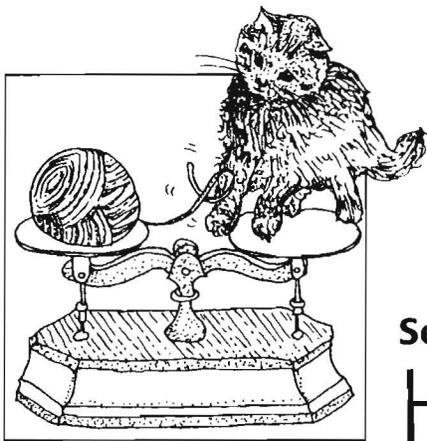
Staying Warm



Heat
Transfer







Session 3

Heat Transfer

Heat transfer results in the raising or lowering of temperature or a change in phase such as melting ice or boiling water. Materials that slow the transfer of heat are good insulators. Insulating materials are found in houses, sleeping bags, clothing, refrigerators, and even animals. They help people, animals, soup, and hot chocolate stay warm; they help keep ice cream, juice, and ice cubes cold.

In Activity 3A, *Keeping Cool*, children build an insulating container from fibrous materials. They explore the insulative properties of different materials and the effect of air trapped between layers of materials.

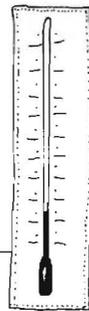
In Activity 3B, *Staying Warm*, children experience the lowering of body temperature as they explore some of the ways that animals keep warm in cold environments. They understand that people wear coats stuffed with polyester fiberfill, whales rely on layers of blubber, birds capture air among their feathers, and sheep snuggle in their personal wool blankets.

Session at a Glance

- Leader's Guide, pages 50, 56
- Special Hints, page 50, 56
- Science: Behind the Scenes, pages 51, 57
- Supplies and Preparation, pages 52, 58
- Focus, pages 53, 59
- Activity, pages 53, 59
- Transition or Closure, pages 54, 60
- A Step Beyond, pages 55, 61



Keeping Cool



Leader's Guide

What's the point?

Children build a cooler and observe that ordinary materials can slow the melting of ice cubes by insulating them from heat. The terms *heat*, *heat transfer*, and *insulation* are introduced. Heat is energy that is transferred from a warmer area to a colder one. Heat transfer may cause a change in temperature or a change in phase such as the melting of ice. Thermal insulation is any material that slows the flow of heat into cold things and out of warm things.

For additional information, read Science: Behind the Scenes (page 51).

What's the plan?

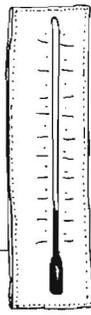
1. Read the activity (page 53).
2. Gather the supplies (page 52).
3. Try the activity.
4. Note special hints (see below).

What's my role?

- Guide the children through the activity by doing the procedures with them.
- Encourage conversation about what they are doing and observing. Use the conversation questions as a guide, not a script to be followed.
- Listen for and summarize "I wonder..." statements the children make during the activity. (See "I wonder..." statements, page 10, Monitoring Success, page 13, and Evaluation Form, page 107.)
- Help the children relate this activity to their daily experiences.

Special Hints

- If a child needs help, let him or her take the lead while an adult assists.
- If children cannot move easily around the table, build coolers on a tray or a piece of cardboard and pass around the tray while the children sit still.



Activity 3A

Keeping Cool

Science: Behind the Scenes

Do not use this material as a lecture. It is intended to increase your background knowledge and comfort level with the subject. Allow the children to explore.

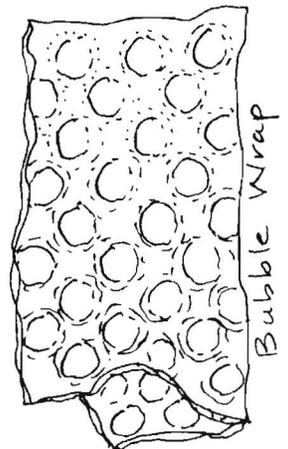
Insulators are materials that slow or prevent the movement of heat, electricity, or sound. Session 3 demonstrates heat or thermal insulators—materials that slow the flow of heat into cold things and out of warm things. We use wall and ceiling insulation to keep the inside of a house cool in summer and warm in winter. Plastic foam cups keep an iced drink cold or a hot drink warm.

Heat is energy that is transferred from one material to another when the materials are at different temperatures. Heat always moves from a warmer area to a colder one. The effect of heat transfer may be a change in temperature or a change in phase such as the melting of ice cubes or the boiling of water.

A refrigerator keeps cool inside by transferring heat to the outside. A special fluid called a refrigerant evaporates (accepts heat) in pipes inside the refrigerator and condenses (gives off heat) when it flows to pipes outside the refrigerator.

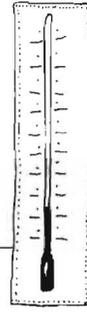
This activity compares the ability of different materials to insulate ice cubes and keep them cold. The speed and ease of heat movement depends on the makeup of the material. Fibrous materials are good insulators because they are poor conductors of heat and they trap air. Rubber, cellulose fibers (such as cotton, linen, and rayon), wood, cork, and plastics resist the transfer of heat. In contrast, most metals transfer heat well. The heat flow through aluminum, for example, is about 1,000 times greater than the heat flow through an equal thickness of textile fibers.

Although some materials are better insulators than others, all materials insulate better if they are built to trap air. The fibers and yarns in paper or fabric divide the space into small, discrete pockets. If these pockets are less than $\frac{1}{4}$ inch across, the air becomes static (nonmoving) or “dead.” Air is also bound to the fabric surface by friction. This boundary-layer air is denser, thus more insulative than air that is farther from the cloth. Air trapped inside and on the surface of the material is the reason that fabric insulates well, but several layers of fabrics insulate better. Plastic sheeting is a good insulator, but bubble wrap is even better.



Activity 3A

Keeping Cool



Supplies and Preparation

Focus Supplies

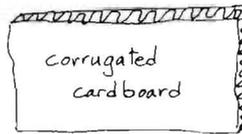
The focus item can be shared by the group.

- thermometer

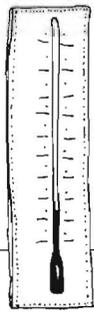
Activity Supplies

Activity supplies are listed for individuals unless otherwise noted; multiply as needed.

- insulation materials¹
- masking tape
- scissors
- cooler or freezer to keep ice cubes, for group
- ice cubes, 2 each
- resealable plastic bag
- medicine measuring cup or narrow tube



¹Fibrous insulation materials include newspaper, paper towels, paper bags, tissues, cardboard, small boxes, egg cartons, carpet scraps, carpet padding, foam, Styrofoam peanuts, bubble wrap, fabric, clothing, batting, and plastic bags. **Gather a wide variety to increase the children's interest.**



Activity 3A

Keeping Cool

Focus

Display a thermometer. Ask, “What is this? What can it tell us? If this thermometer were outside and it read 38°F, would the air feel hot or cold to you? Do you like to feel cold? Can you think of some things that should be kept cold or cool?”

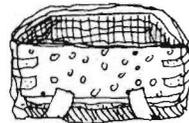
Activity

1. Allow 10 to 15 minutes for children to construct an insulating container or “cooler” from the materials provided. The cooler should be no larger than a school lunchbox. Leave an opening large enough to insert two ice cubes.

2. Place two ice cubes in a resealable plastic bag. Press out the air. Seal the bag securely.



3. Place the bag of ice cubes inside the cooler. Close or seal the cooler.



4. The leader should have a bag of ice cubes without a cooler to demonstrate the difference between heat transfer with and without insulation.
5. Place hands over the cooler to warm it. Count to 60.
6. Rotate clockwise—each person moves to the left one space to the next cooler.
7. Repeat steps 5 and 6 until participants return to their own cooler. The warming and rotation should take about 5 minutes.
8. Extract the bag of ice cubes. Do not open it yet.

I wonder...

Keep track of “I wonder...” statements you and the children express while doing the activity. Children might wonder

if the plastic bag helps keep the ice cubes from melting.

if every child’s hands are the same temperature.

Conversation

Questions You Might Ask

Do you recognize the materials you are using for your cooler? Describe those materials—are they soft, hard, thick, or thin?

Are you using just one kind of material or many different kinds?

How many layers of materials are you using?

Are you wrapping the materials tightly or loosely?

Can you feel the cold of the ice through the plastic bag?

Do you think your hands are warm enough to make the ice cubes melt quickly?

Did your ice cubes melt more or less than your friend’s?

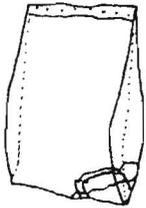
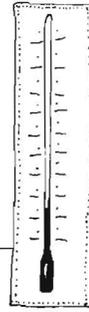
How did your cooler work compared to the leader’s unprotected ice?

Could you measure the water from the melted ice cubes?

Do you have a cooler at your house? Can you describe it? Does it work well?

Activity 3A

Keeping Cool



9. Observe how much water is in the bag. Compare your results with others.
10. Try to measure the amount of water by carefully pouring it into a medicine measuring cup or a narrow tube.



Transition or Closure

If you are doing only Activity 3A, review the “I wonder...” statements. Say, “We discovered that some materials are good heat insulators. They helped the ice cubes stay frozen by keeping out the warmth from our hands. Can you think of other ways to keep things cold?” If you are doing Activities 3A and 3B together, summarize the fiber activity and shift the children’s attention to the animal activity.

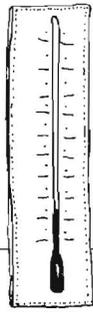
I wonder...

Keep listening for “I wonder...” statements after the activity. Children might wonder

what other materials are good insulators.

why layers of materials insulate well.

how refrigerators and freezers work.



Activity 3A

Keeping Cool

A Step Beyond

I wonder if more layers of a material provide better insulation.

Repeat Activity 3A using only one flexible material such as plastic bags or denim fabric. Ask students to wrap their ice cubes in a different number of layers. Compare the results.

I wonder if the same insulation will keep water from freezing.

Reverse the activity. Use a thermometer to measure the temperature of tap water. Pour 3 tablespoons of water (approximate volume of water in two ice cubes) into a resealable plastic bag and seal securely.

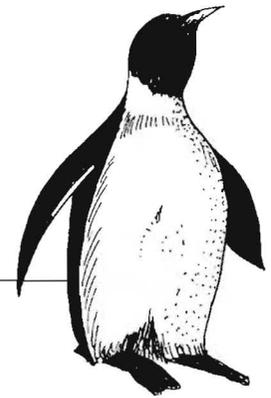
Insert the bag in the cooler you built for the activity. Place the cooler in the freezer or outdoors in winter.

Check the temperature of the water at 30-minute intervals and note the time of freezing. Do you think your cooler works as well to keep water warm as it does to keep ice frozen?

Time (min.)	0	30	60	90	120	150	180
Temperature (°F or °C)							

Activity 3B

Staying Warm



Leader's Guide

What's the point?

Children cover their fingers with different materials before putting them in ice water. They compare the insulative value of air, fat, and fibrous materials that animals use to keep warm.

The terms *blubber*, *fiberfill*, and *fleece* are introduced. The activity also reinforces the terms *down* and *wool* from earlier sessions. Blubber is a thick layer of fat that helps penguins, polar bears, and whales stay warm. Fiberfill is a synthetic material (polyester) used to insulate sleeping bags, coats, and comforters. Fleece is the wool of any animal, usually a sheep.

For additional information, read Science: Behind the Scenes (page 57).

What's the plan?

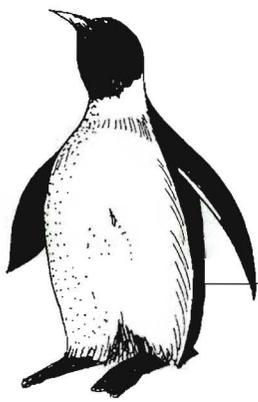
1. Read the activity (page 59).
2. Gather the supplies (page 58).
3. Try the activity.
4. Note special hints (see below).

What's my role?

- Guide the children through the activity by doing the procedures with them.
- Encourage conversation about what they are doing and observing. Use the conversation questions as a guide, not a script to be followed.
- Listen for and summarize "I wonder..." statements the children make during the activity. (See "I wonder..." statements, page 10, Monitoring Success, page 13, and Evaluation Form, page 107.)
- Help the children relate this activity to their daily experiences.

Special Hints

- If a child cannot extend a single finger, place a plastic glove or plastic bag on the child's fist.
- Be aware of some children's (and adults') sensitivity to latex.



Staying Warm

Science: Behind the Scenes

Do not use this material as a lecture. It is intended to increase your background knowledge and comfort level with the subject. Allow the children to explore.

When the air is colder than skin temperature, animals lose body heat. Heat loss can be slowed by covering the body with insulating materials. Heat can be replaced by generating energy from food.

All warm-blooded animals, including humans, survive in a very narrow range of internal body temperatures. An unclothed human begins to shiver at 73° F (23° C). English Channel swimmers grease themselves before plunging into the cold sea, but most people maintain body temperatures by covering themselves with clothing, sleeping bags, and comforters. These items are commonly stuffed with fiberfill (polyester), cotton, foam, wool, or down feathers.

Penguins, polar bears, whales, and other marine mammals rely on blubber, a thick layer of fat between the skin and the muscles, to keep them warm. Polar bears also have a dense undercoat covered with long, transparent guard hairs that allow sunlight to reach and warm their black skin.

Penguins use a variety of strategies to keep warm. One strategy is having many feathers—up to 300 feathers per square inch of their bodies. These oil-coated feathers are stiff and hooked at the tip, forming a tight, interlocking coat that traps air near the skin and keeps out water. Downlike fluff at the base of each feather adds more insulation. Penguins also have a special system of blood vessels that carries warm blood to and cold blood from their feet.

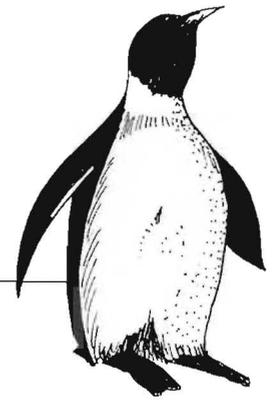
Air is the main ingredient in most stay-warm strategies. It is the best heat insulator available. That's why the air-filled balloon keeps the children's fingers warmer than the balloon without air. Animals incorporate air into their insulation by fluffing their fur and shaking their feathers. Polar bears, Arctic foxes, and reindeer even have air-filled cells in their outer layer of hair. People use yarns and fabrics engineered to hold air. Some yarns have air channels and a fuzzy texture. Some fabrics are layered, constructed with a fuzzy front and back, or treated with finishes that resist wind and rain.

The insulative value of materials changes with conditions. Oil stiffens wool or feathers to seal out moisture and create air spaces that increase warmth. Dirt clogs air spaces and moisture clumps materials to decrease warmth. Wool socks and down sleeping bags are familiar examples of warm items that turn cold when wet.



Activity 3B

Staying Warm



Supplies and Preparation

Focus Supplies

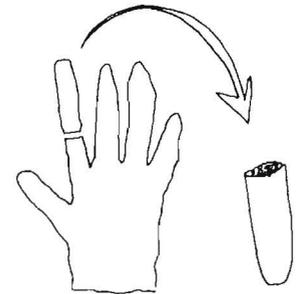
Focus item can be shared by the group.

- garment for warmth such as a cap or mitten

Activity Supplies

Activity supplies are listed for individuals unless otherwise noted; multiply as needed.

- plastic cloth, for table
- dishpans for ice water, 1 for 4 children
- ice cubes, at least 2 cups per dishpan
- cooler or freezer to keep ice cubes, for group
- tub of hot, soapy water, for group
- balloon¹
- scissors
- fingers cut from plastic glove²
- fiberfill, fur, wool fleece, or feathers,³ 1 handful per child
- masking tape
- lard or shortening⁴
- plastic cups to distribute lard
- spoon for lard, 1 for group
- paper towels, for group

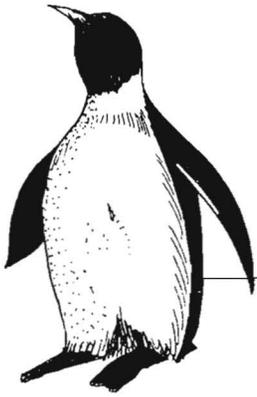


¹Test the balloons first. If they are too small, the children have difficulty stretching them over their fingers. If they are too large, the air is hard to remove.

²Purchase inexpensive plastic gloves such as those sold for washing dishes. Thinner “surgical gloves” are not recommended because they fit too snugly. Clean to reuse. Plastic wrap or small plastic bags can be substituted.

³Polyester fiberfill is available at craft and fabric stores. Try fur if you have it or want to mail order. Wool fleece may be ordered by mail or purchased through local spinning guilds or sheep producers. Lamb’s wool, available in the foot care department of the pharmacy, is a good but expensive substitute. Feathers are difficult to use, so allow extra time. Feather pillows and feather dusters are good sources.

⁴Lard reinforces the animal theme, but vegetable shortening works fine.



Activity 3B

Staying Warm

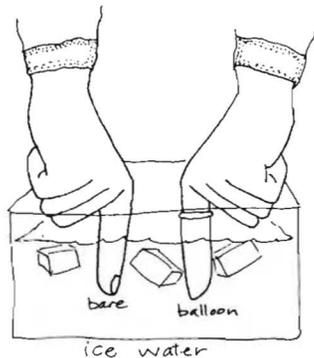
Focus

Display a warm article of clothing like a cap or glove. Say, "What is this? Do you own one of these? When do you wear it? Does it keep you warm? Do you like to be outdoors in the winter? Can you name some animals that live in the snow and cold? Do you wonder how they keep warm?"



Activity

1. Cover the table with a plastic cloth.
2. Fill dishpans with *cold* water. Add ice cubes.
3. Prepare a dishpan of warm, soapy water.
4. Cover one index finger with a balloon. Squeeze out as much air as possible. Ask a friend to help if necessary.
5. Place the covered finger and the index finger on the other hand into the ice water. Close your eyes and compare how they feel. Remove fingers from the ice water.



6. Point the balloon-covered finger downward and blow a little air into the balloon.
7. Repeat step 5. Remove the balloon from the finger.

I wonder...

Keep track of "I wonder...." statements you and the children express while doing the activity. Children might wonder

what their mittens are made of.

whether a house pet would grow more hair if left outside all winter.

Conversation

Questions You Might Ask

How did your unprotected finger feel when you put it in the ice water? Did the balloon help your finger stay warm?

Describe the difference between the effect of the balloon alone and when it contained air. Can you think of ways that animals use air to keep warm?

What happened when you lined the glove finger with wool fleece? polyester fiberfill? feathers?

Do you have a wool blanket or wool mitten? Describe them.

What do you wear to stay warm in winter? What are those garments made of?

What did you observe when you covered your finger with shortening?

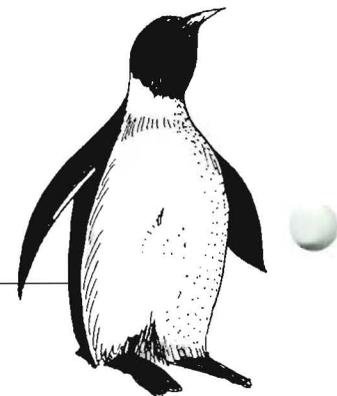
Do you think a thin layer of shortening would keep you as warm as a thick layer?

Which insulating material worked best for you?

Can you think of reasons why a desert animal might have thick hair or fur?

Activity 3B

Staying Warm



8. Place some polyester fiberfill, fur, wool fleece, or feathers in a finger cut from a plastic glove. Try to distribute the material evenly inside the finger.
9. Insert index finger into the “lined” glove finger. Ask a friend to secure the opening with masking tape.
10. Repeat step 5. Remove tape and lined glove finger.
11. Cover the index finger with about $\frac{1}{4}$ to $\frac{1}{2}$ inch of shortening or lard.
12. Repeat step 5.
13. Clean shortening from finger with warm, soapy water and towels.

Closure: Connecting Fibers and Animals

If you are doing only Activity 3B, review the “I wonder...” statements. Say, “We learned that animals depend on good insulators like fur, blubber, feathers, and wool to keep their body heat close to them in winter. Can you think of other ways that animals keep warm?” If you are doing Activities 3A and 3B together, review the “I wonder...” statements for both and ask the children to think about the similarities between keeping yourself warm and keeping the ice cubes cold. Ask, “Do you think the materials that kept the ice cold could also help animals stay warm?”

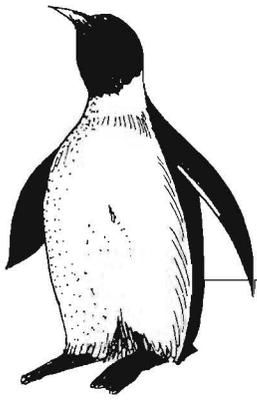
I wonder...

Keep listening for “I wonder...” statements after the activity. Children might wonder

whether humans with more hair stay warmer.

if fat cats are warmer than skinny cats.

if a layer of lotion on the skin can protect from the cold.



Staying Warm

A Step Beyond

I wonder if wet animals stay as warm as dry animals.

Repeat steps 8, 9, and 5 of the activity using wet polyester fiberfill, fur, wool fleece, or feathers. Compare the performance of the wet and dry insulating materials.

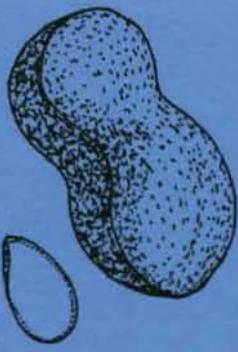
I wonder if all fleece is the same.

Collect and compare information about the fleece of desert sheep and mountain sheep. Do they have the same kind of wool? Is the wool the same color? Is their skin the same color? How do their body coverings relate to their environment?

Visit a fabric shop and examine the “fleece” fabrics (any fabric with a thick, dense surface that resembles the wool sheared from sheep). Note the fiber content, thickness, softness, and care instructions. Are any of these fabrics made from sheep’s wool? Can you figure out why fleece fabrics keep you warm?







Threads of Life

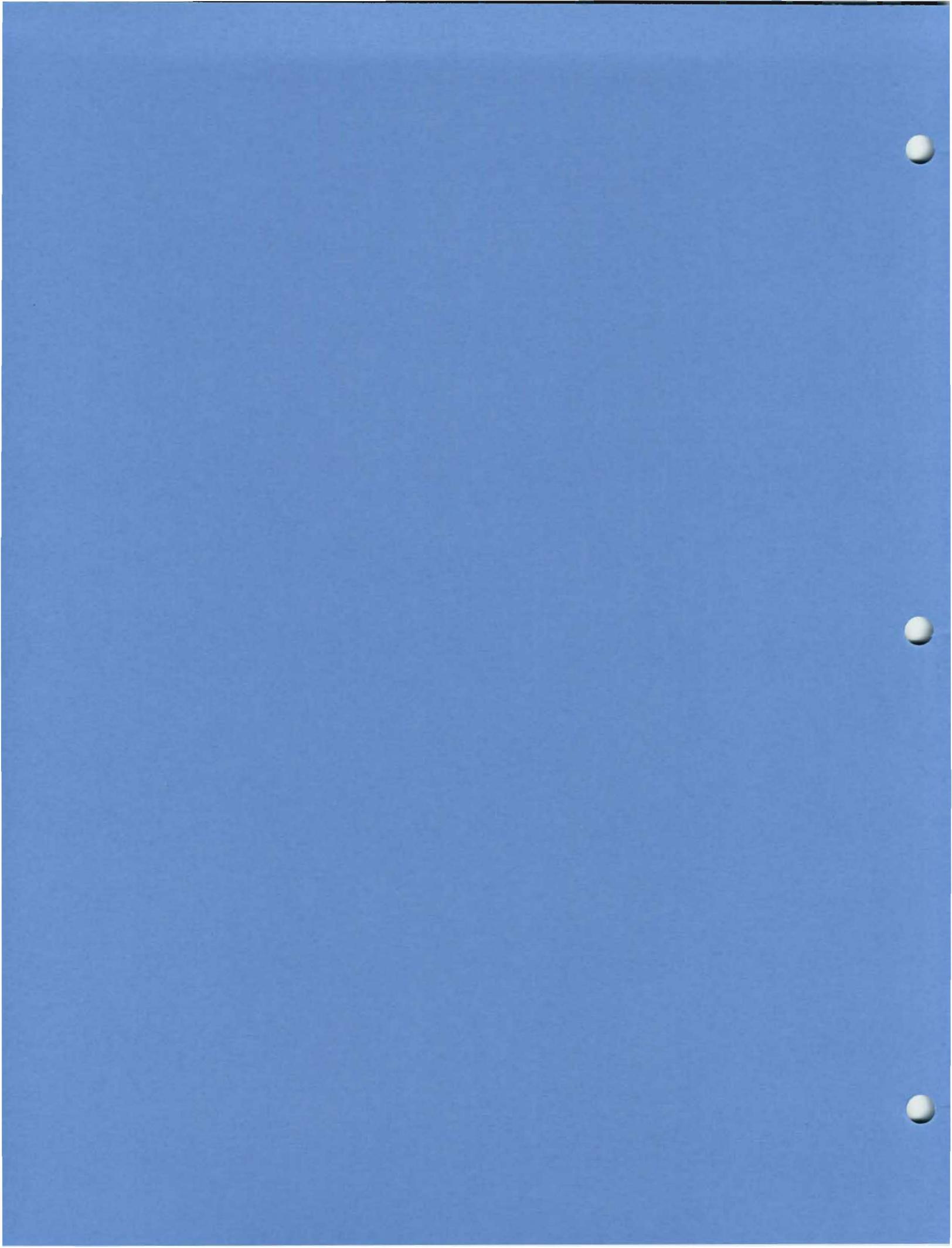


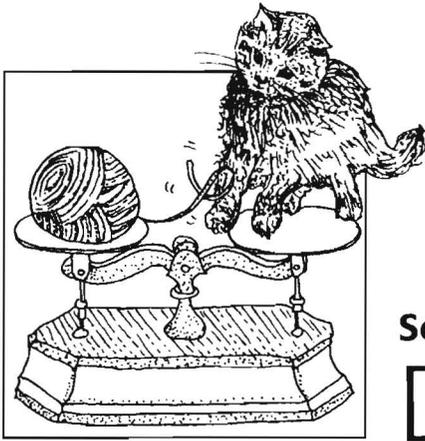
Rot the String
Out of It



Digestion







Session 4

Digestion

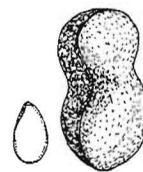
Digestion is the process of breaking down materials into smaller pieces that the body can absorb as food. Many animals eat and digest plants. They absorb the nutrients and discard the hard-to-digest plant fiber. Textile workers use digestion to get rid of the soft plant tissue while saving the hard-to-digest textile fibers. These fibers are used to make cloth, rope, and baskets. Together the two activities encourage children to use familiar household items to explore their world and to see connections between animal nutrition and the manufacture of textiles.

In Activity 4A, *Threads of Life*, children use baby shampoo to remove the contents of plant cells and leave the less digestible fiber behind. This shows how cows digest plant foods and how scientists measure the dietary fiber in the foods we eat and feed our animals.

In Activity 4B, *Rot the String Out of It*, children observe retting, a process in which bacteria rot the digestible tissue, leaving behind useful textile fibers. This is the traditional way linen was prepared from the flax plant. Children search for fibers in corn husks, milkweed stems, palm leaves, bamboo leaves, pineapple leaves, and other regional fiber plants.

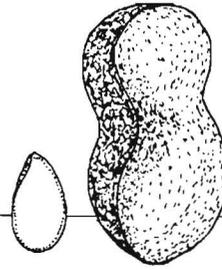
Session at a Glance

- Leader's Guide, pages 66, 72
- Plan Ahead, pages 67, 72
- Science: Behind the Scenes, pages 67, 73
- Supplies and Preparation, pages 68, 74
- Focus, pages 69, 75
- Activity, pages 69, 75
- Transition or Closure, pages 70, 76
- A Step Beyond, pages 71, 77



Activity 4A

Threads of Life



Leader's Guide

What's the point?

Children use a neutral detergent (baby shampoo) to rinse away the completely digestible portion of some foods or feeds. Then they compare the amount of dietary fiber (cell walls) left behind.

Important terms include *plant fibers*, *dietary fibers*, *cell walls*, *digestion*, and *herbivores*. Plant fibers come from the cell walls that give the plant its structure. They are tough and hard to digest (break down into a form that the body can use). Dietary fiber is the part of a plant that cannot be digested by mammalian enzymes. Herbivores (animals that eat only plants) such as cows and horses have helpful bacteria in their digestive tracts that break down the fiber for them. Dietary fiber is important for all animals because it moves food swiftly through our digestive tracts and helps prevent colon cancer.

For additional information, read Science: Behind the Scenes (page 67).

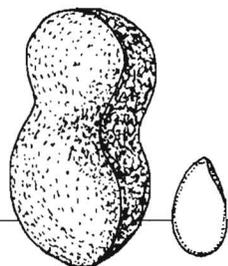
What's the plan?

1. Read the activity (page 69).
2. Gather the supplies (page 68).
3. Do advance preparation (page 67) and try the activity.
4. Note safety measures (in ***bold italics***).

What's my role?

- Guide the children through the activity by doing the procedures with them.
- Encourage conversation about what they are doing and observing. Use the conversation questions as a guide, not a script to be followed.
- Listen for and summarize "I wonder..." statements the children make during the activity. (See "I wonder..." statements, page 10, Monitoring Success, page 13, and Evaluation Form, page 107.)
- Help the children relate this activity to their daily experiences.

Threads of Life

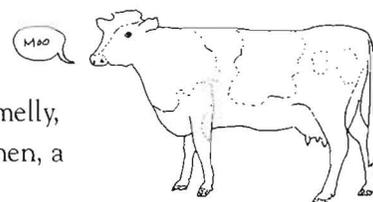


Science: Behind the Scenes

Do not use this material as a lecture. It is intended to increase your background knowledge and comfort level with the subject. Allow the children to explore.

Many animals depend on plants for all or part of their food. They absorb this food after digestion or fermentation. Digestion occurs when enzymes in the stomach and mouth change food into an absorbable form. When fermentation occurs, bacteria in the digestive tract change food into an absorbable form. Mammalian enzymes cannot digest plant fiber, but bacteria can.

The stomachs of ruminants—mammals that chew their cud—have several compartments. One of these, the rumen, is a large fermentation vat filled with bacteria. These bacteria break down parts of the plant fiber to yield volatile, smelly, but valuable fatty acids that mammals can absorb as energy. Thanks to her rumen, a cow gets much more nutrition from plant fiber than humans do.



Humans do not have rumens. Instead, friendly bacteria in our intestines, especially in the large intestine (colon), help us ferment and absorb some fiber. Horses and donkeys do not have rumens, but they have very large colons. Fermentation in this large colon helps them to obtain food energy from fiber.

Although humans cannot digest fiber, it is important to our digestive health. Diets high in fiber may help prevent colon cancer in humans. This is because fiber binds carcinogens (cancer-causing agents) and prevents their absorption; speeds the passage of food through the digestive tract so that carcinogens have less time to interact; and ferments to form volatile fatty acids that regenerate the intestinal lining.

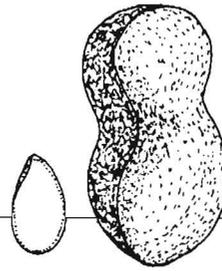
USDA chemists discovered that pH-neutral detergents could be used to measure dietary fiber in foods. This method is called “neutral detergent fiber analysis,” and it relies on detergents similar to those now found in “no-tears” baby shampoo to dissolve everything but the insoluble fiber.

Plan Ahead

- Locate a kitchen stove, hot plate, or Coleman stove and make sure you know how to use it.
- Recruit a helper to watch the boiling pot.
- Be aware that you move back and forth between Activities 4A and 4B. If you are not doing them together, provide alternate activities while the foods in 4A boil.

Activity 4A

Threads of Life



Supplies and Preparation

Focus Supplies

Focus items can be shared by the group.

- peanuts
- peanut hulls

Activity Supplies

Activity supplies are listed for individuals unless otherwise noted; multiply as needed.

- plastic cloth, for table
- two 7-inch squares of fabric¹
- a wide variety of feeds and foods with a mix of high- and low-fiber food²
- measuring tablespoon, 1 for every 4 children
- two 8-inch pieces of string or thread
- waterproof marking pens, 1 for every 4 children
- two small index cards
- pencils or pens, 1 for every 4 children
- 2-quart saucepan or glass casserole with lid, for group
- water for boiling and rinsing
- liquid measuring cup, for group
- pH-neutral “no tears” baby shampoo,³ for group
- kitchen stove, hot plate, or Coleman stove,⁴ for group
- hot pads, for helper
- scissors, 1 pair for every 4 children

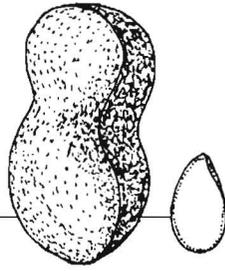
¹Fabric should be fairly porous. Cloth bags used for boiling spices work well. Cheesecloth can be used but is sometimes too porous, requiring two layers. Prewash all fabrics to remove starch sizing.

²Pairs of high- and low-fiber foods include Shredded Wheat/Rice Krispies; spaghetti squash/pumpkin; celery/lettuce; rolled oats or granola/baked tortilla chips; straw/hay; alfalfa hay/alfalfa leaf meal; alfalfa cubes or alfalfa meal/pelleted grain; and wheat bran/cracked corn.

³Sodium lauryl sulfate is the key ingredient.

⁴A kitchen stove is preferred.

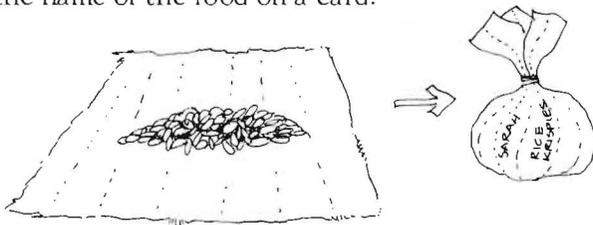
Threads of Life

**Focus**

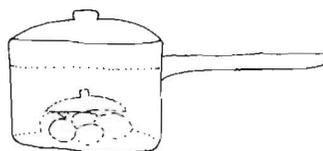
Pass around peanuts and peanut hulls. Ask, "What plant do these come from? When we digest something our bodies absorb it for food. Fiber is very hard for us to digest. Do you think both of these things are digestible and nutritious? Can you guess which one is more digestible? Which one has more fiber? Today we are going to find out how much fiber is in different foods."

Activity

1. Cover the table with a plastic cloth.
2. Measure *carefully* 2 tablespoons of one food and place it in the center of a fabric square.
3. Bring the edges of the cloth together to form a sack and tie with string. Write the name of the food and your initials on the outside of the sack with a waterproof marker. Write the name of the food on a card.



4. Repeat steps 2 and 3 using a different food.
5. Help your group measure two to three cups of water into a pan. Add one tablespoon of baby shampoo per cup of water and mix well.
6. Place all sacks in the pan. Make sure all are covered by the shampoo solution. Cover the pan.

**I wonder...**

Keep track of "I wonder..." statements you and the children express while doing the activity. Children might wonder

why some foods are soft and some are hard.

whether they like foods with lots of fiber.

Conversation

Questions You Might Ask

What plant foods do people eat? What plants do animals eat?

Describe the foods you are testing. Have you ever eaten them? How did they taste?

Which one do you think will have the most fiber? Why?

What things can soap help dissolve from your hands?

Can you guess why baby shampoo helps dissolve part of the plants?

What color is the boiling water mixture? How does your food look after boiling?

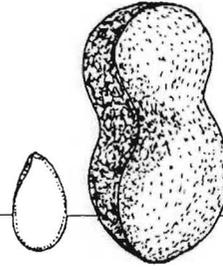
Which foods have the most left over after they've been boiled?

Can you guess which foods would be easiest to digest if you ate them?

Have you seen information about fiber content on cereal boxes?

Activity 4A

Threads of Life



7. Place the filled pan on the stove and rapidly bring to a low, steady boil. Maintain the boil at least 30 minutes (an hour if convenient). Ask a helper to add water as needed to maintain the level of liquid in pan. **Caution! Hot water, shampoo solution, and steam can burn skin.**
8. Begin Activity 4B.
9. Remove (*an adult, please*) the pan from the heat. **Carefully** rinse the sacks in water until soap is removed and set aside.
10. **When the sacks are cool**, squeeze to remove the liquid and untie. You may need scissors to cut the knot.
11. Lay open sacks on the table next to their identifying cards. Compare the amounts of fiber.

Transition or Closure

If you are doing only Activity 4A, review the “I wonder...” statements. Say, “We saw that the cell walls of plants do not dissolve in the baby shampoo solution. They provide dietary fiber for our diets. We also observed that some plants have more fiber than others. Do you have other questions about plant fiber?” If you are doing Activities 4A and 4B together, review the “I wonder...” statements for both. Discuss the relationship between the dietary fiber that the body casts away (4A) and the fiber that the textile workers retain (4B).

I wonder...

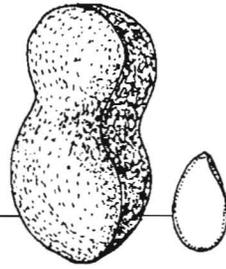
Keep listening for “I wonder...” statements after the activity. Children might wonder

what other ways we can get fiber from plants.

why we need to eat fiber.

why cows can digest grass and hay better than we can.

Threads of Life



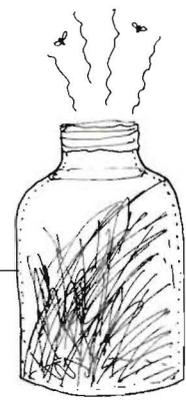
A Step Beyond

I wonder if we could measure exactly how much fiber is in a food.

Activity 4A is a *qualitative* test. Students can tell which foods have more fiber than others but not exactly how much they have. If an accurate balance or analytical scale is available, students can do a *quantitative* analysis and find out exactly how much fiber is present. To do this, weigh *exactly* 1 gram of a dry food or feed. Then boil it as before in *exactly* one cup of water per tablespoon of baby shampoo for *exactly* one hour. After rinsing, dry the fiber overnight in a warm (about 160° F) oven. Weigh the dry fiber *exactly* to the closest $\frac{1}{10}$, $\frac{1}{100}$, or $\frac{1}{1000}$ of a gram. Multiply that result by 100. This is the percent fiber in the food. Try contrasting stems and leaves, grass and clover, or various pet foods.

Activity 4B

Rot the String Out of It



Leader's Guide

What's the point?

Children scrape fibers from fresh and retted plants. They observe that microbes can break down digestible plant parts and some of the fiber. They understand that the more resistant fiber can be used to make thread, yarn, rope, or fabric.

New terms are *retting*, *cellulose*, and *lignin*. Retting is the process of allowing a plant to rot in water until only the toughest fiber remains. This insoluble plant fiber contains cellulose, lignin, and other compounds. Cellulose is the stringy, pliable fiber component used for making thread and cloth. Lignin is more rigid and is very hard for bacteria to break down. We choose plants for retting that are high in cellulose and low in lignin.

For additional information, read Science: Behind the Scenes (page 73).

What's the plan?

1. Read the activity (page 75).
2. Gather the supplies (page 74).
3. Do advance preparation and try the activity.
4. Note safety measures (in ***bold italics***).

What's my role?

- Guide the children through the activity by doing the procedures with them.
- Encourage conversation about what they are doing and observing. Use the conversation questions as a guide, not a script to be followed.
- Listen for and summarize "I wonder..." statements the children make during the activity. (See "I wonder..." statements, page 10, Monitoring Success, page 13, and Evaluation Form, page 107.)
- Help the children relate this activity to their daily experiences.

Plan Ahead

Gather Focus and retting materials a week before the activity (Supplies and Preparation, page 74).

Rot the String Out of It

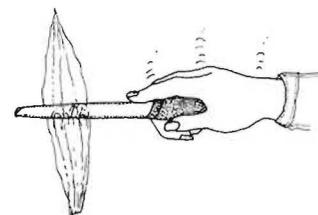


Science: Behind the Scenes

Do not use this material as a lecture. It is intended to increase your background knowledge and comfort level with the subject. Allow the children to explore.

Fibers can be extracted from some plants by retting (rotting in water until only the toughest fiber remains). Bacteria in the water ferment the plant tissues. They dissolve the inside of the plant cells, then they work on the tougher cell walls, or fiber. If the plants are removed from the water at the correct time, the cellulose (a stringy, pliable component of fiber) will be intact and suitable for spinning into yarn. Other fiber components are hemicellulose and lignin.

Traditionally, linen was made by softening and fermenting flax in vats of warm water. The long, useful fiber was then removed and made into thread and eventually cloth. Chemists, however, discovered that by boiling flax in an acid followed by a base, one could do much the same thing in less time with a lot less odor. This became the standard method for processing linen fibers.



Early food and feed scientists adopted this acid-base boiling as a way of determining the fiber content of foods and feeds. This method became known as “crude fiber analysis” and was the standard for more than 100 years.

Scientists later observed that feeds that contained the same amount of crude fiber did not appear to supply the same amount of food energy or calories. Chemists discovered that the acid used in the crude fiber method was dissolving the hemicellulose component of the fiber while the base was dissolving the lignin. This method was ideal for linen making where the goal is to dissolve away everything but the cellulose, but it did not accurately indicate the portion of a feed that could be digested by mammalian enzymes. This led to the use of pH-neutral detergents to measure dietary fiber as you did in Activity 4A.

Activity 4B

Rot the String Out of It



Supplies and Preparation

Focus Supplies

Focus item can be shared by the group.

- Vase containing week-old flowers with leaves drooping into the water

Activity Supplies

Activity supplies are listed for individuals unless otherwise noted; multiply as needed.

- plastic cloth, for table
- various stems, leaves, and bark from plants that produce long fibers¹ (fresh and for retting)
- quart-size glass jars (canning or mayonnaise jars for holding plants)
- jar covers
- masking tape
- waterproof marking pens
- old washcloths or rags
- small hammer or rubber mallet
- serrated plastic knife
- dishpan filled with cold water
- dishpan for discarding rotted plant tissue



serrated knife has "teeth"

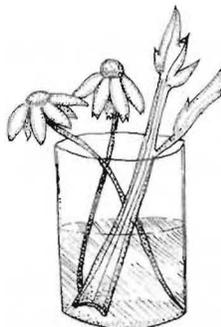
¹Gather or purchase fresh plants such as celery, corn husks, snowpea pods, banana leaves, ginger root, palm tree leaves, lily and gladioli leaves, bamboo leaves, pineapple leaves, yucca leaves, wild flax stems, milkweed stems, inner layer of basswood bark, cedar bark, coarse grasses like saw grass and reed canary, large tree leaves, and coarse vines such as Virginia creeper. Each region has its own distinctive fiber sources—explore your area. To ret plants, submerge in covered glass jars of lukewarm water, label, and leave at room temperature or warmer for two days to a week.

Rot the String Out of It

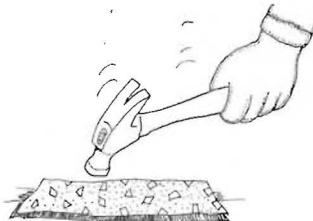
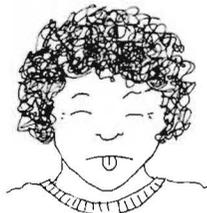
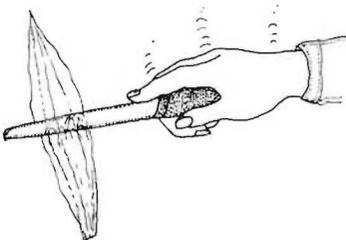


Focus

Hold up the flowers that you have had in water for a week. Ask the children to smell the flowers that were out of the water and the stems and leaves that were in the water. Ask, "How do the flowers, leaves, and water smell? What happened to the wet leaves? Today we are going to try a method that people have used since ancient times to separate stringy fiber from plants. This method is called retting. Retting means letting a plant rot in warm water until only the fiber remains."



Activity

1. Cover the table with a plastic cloth.
2. Choose a fresh plant.
3. Place the plant between two pieces of cloth and hammer on it gently until it is partially crushed. 
4. Scrape the plant with your serrated plastic knife to see what fibers you get.
5. Select the same kind of plant from a jar of retted plants (*they stink!*). 
6. If odor is a concern, rinse retted plants ahead of time.
7. Gently scrape the retted plant with your serrated knife. 

I wonder...

Keep track of "I wonder..." statements you and the children express while doing the activity. Children might wonder

why the flower stems and leaves in the vase smell bad.

which plants have fiber.

how much fiber you need to make clothes.

Conversation

Questions You Might Ask

Describe the plant you selected.

Can you scrape fibers from the fresh plants?

Do you see any bubbles in the retting jars? If so, what do you think might be in these bubbles?

Can you guess why the water stinks?

Can you think of other things that smell like the water in the jars?

How do the plants that have been in the water for a week compare to the fresh samples? How do they look? feel? smell?

What would happen if we left the plants in the jars forever?

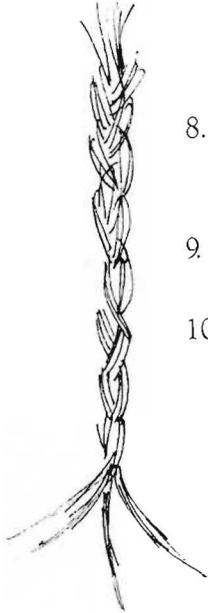
Is it easier to separate fiber from the retted plants or the unretted plants?

Which plant gives the most fiber?

What sort of things can you make with fiber?

Activity 4B

Rot the String Out of It



8. Compare the amount and appearance of the retted fiber to the fiber you extracted without retting in step 4.
9. Compare your observations to those of others who used different plants.
10. Return to Activity 4A, step 11.

Children should wash their hands after handling retted fiber and before handling food. Adults should dispose of retting water, rinse water, and unwanted plant tissue.



Closure: Connecting Fibers and Animals

If you are doing only Activity 4B, review the “I wonder...” statements. Say, “We retted fiber from plants. Do you have other ideas about the process? What other plants would you like to explore?” If you are doing Activities 4A and 4B together, clean up your workstations while the baby shampoo mixture finishes boiling and proceed to Activity 4A, step 11.

I wonder...

Keep listening for “I wonder...” statements after the activity. Children might wonder

why when we burp it smells like rotting plants.

how early textile makers put up with the smell.

why growing plants like seaweed and water lilies don't rot in water.

Rot the String Out of It



A Step Beyond

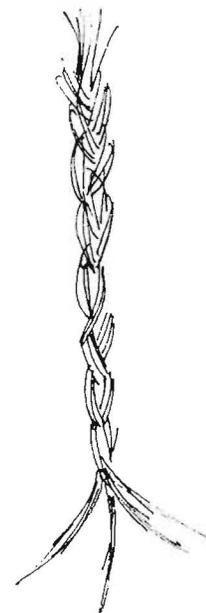
I wonder what other plants have useful fibers.

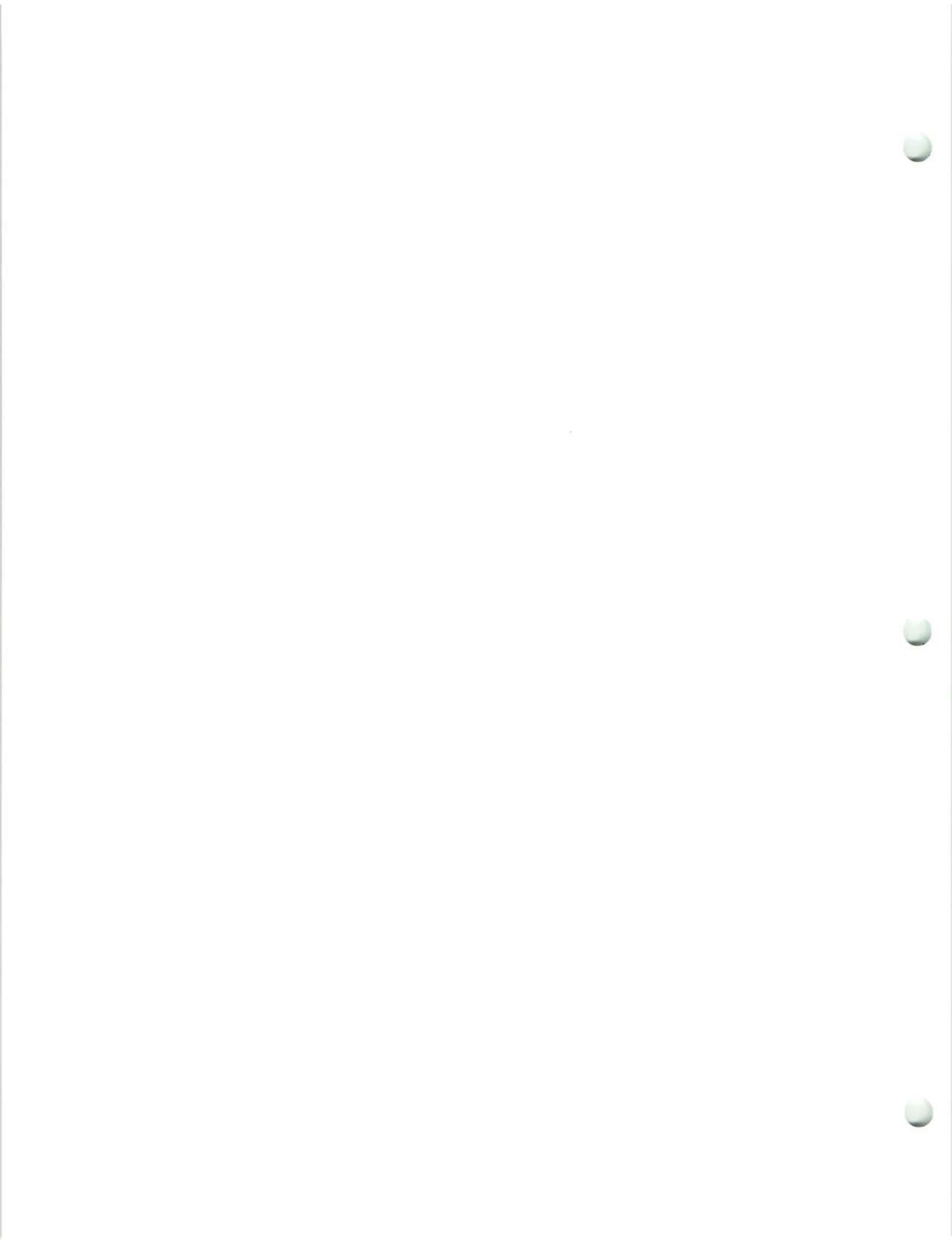
Explore your neighborhood for plants whose fibers may be useful. Look all over—at roadsides, in gardens, in woods, and at streamsides. Try to remove fibers from the leaves and stems by scraping and retting.

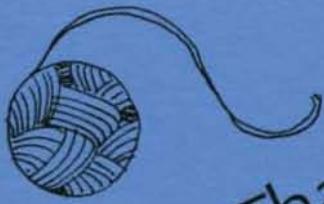
Identify the species names for the most promising plants by referring to plant manuals, the Internet, or resources at your local Cooperative Extension office.

If you find a plant in your region that is good for this exercise, please contact Extension Staff, Department of Textiles and Apparel, MVR Hall, Cornell University, Ithaca, NY 14853.

If you find a plant that is particularly well suited for making fiber, contact the U.S. Patent Office and find out if you have discovered an idea for a new industry.







Name That
Flame

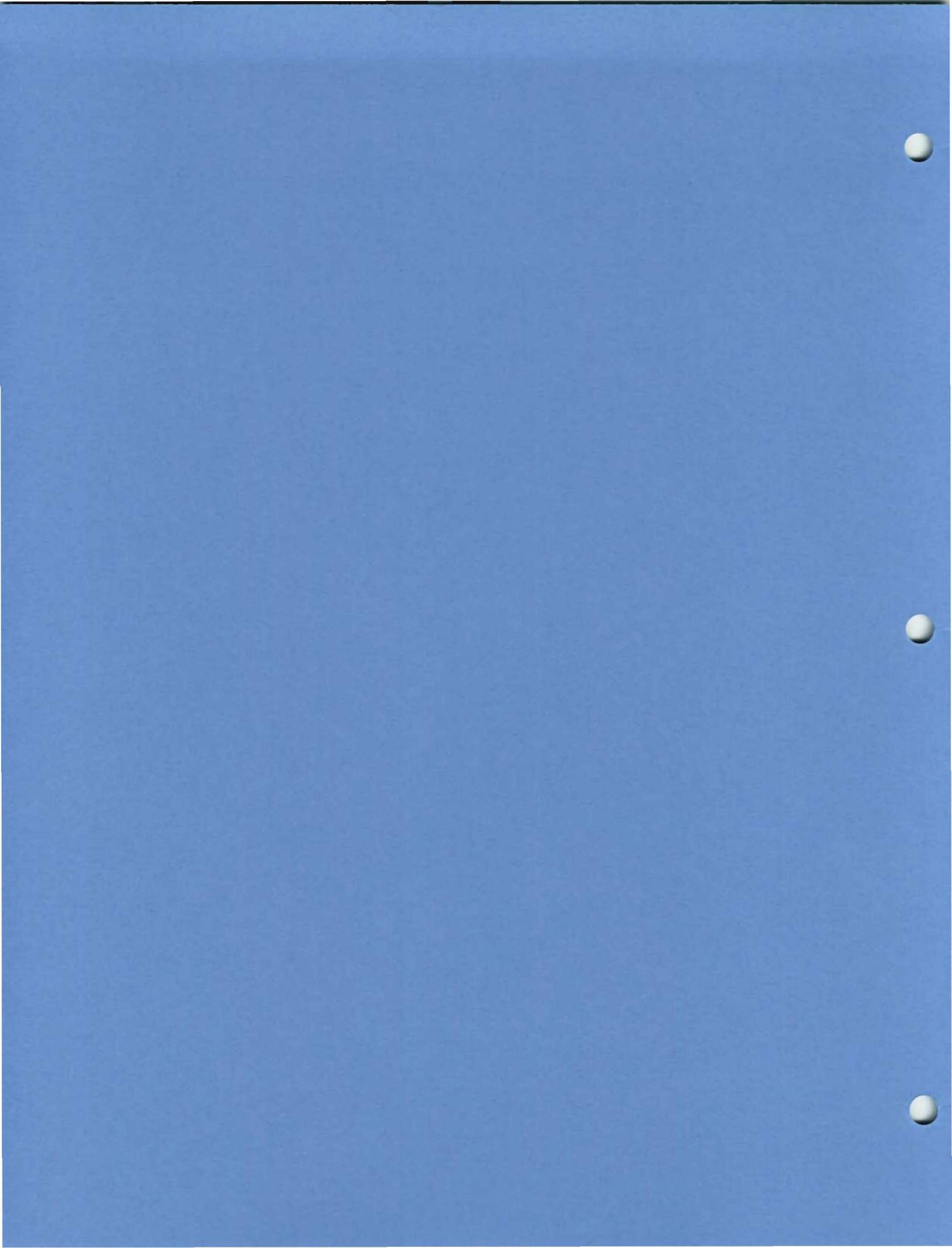


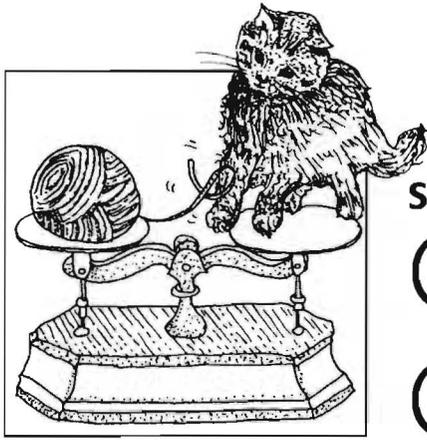
Milky Ways



Chemical Composition







Session 5

Chemical Composition

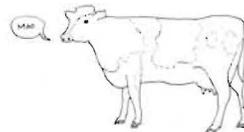
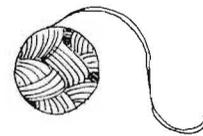
You can learn about the chemicals that make up a substance by watching, smelling, touching, or listening to how it behaves when you make chemical and physical changes. In this session, children experiment and observe what happens to an animal product, milk, and several fibers used in clothing when they are treated in different ways. These two activities bring together chemical analysis, textile safety, and dairy food processing. Children learn that what they see may be controlled by chemicals that they cannot see. They use controlled treatments of unknown materials to identify chemical content.

In Activity 5A, *Name That Flame*, children ignite three fibers—a cellulose (cotton), a petroleum-based synthetic (nylon), and a protein (wool) and observe differences in the way they burn. They repeat the procedure to identify three “mystery” cloths. Children form guesses based on previous observations and then test those guesses.

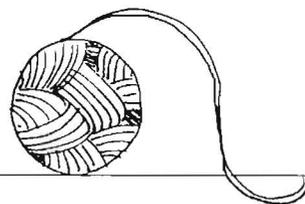
In Activity 5B, *Milky Ways*, children shake, heat, and add acid to milk. They are pleased when they make butter and cheese and surprised to know that these results help them identify milk components such as fat and proteins.

Session at a Glance

- Leader’s Guide, pages 82, 88
- Special Hints, pages 82, 88
- Plan Ahead, pages 83, 89
- Science: Behind the Scenes, pages 83, 89
- Supplies and Preparation, pages 84, 90
- Focus, pages 85, 91
- Activity, pages 85, 91
- Transition or Closure, pages 86, 92
- A Step Beyond, pages 87, 93



Name That Flame



Leader's Guide

What's the point?

Children test and observe the appearance, flammability, and odor of different fibers and use that information to identify unknown fabrics. The ideas of fire safety, chemical content of fibers, and analytical testing are discussed.

New terms are *petroleum*, *synthetic*, and *hydrocarbon*. Plant fibers such as cotton and linen are made of the carbohydrate cellulose, which contains carbon, hydrogen, and oxygen. Animal fibers such as wool are proteins. Synthetic fibers such as nylon and polyester are made from petroleum and contain hydrogen and carbon (hydrocarbons). Each has unique ways of burning.

For additional information, read Science: Behind the Scenes (page 83).

What's the plan?

1. Read the activity (page 85).
2. Gather the supplies (page 84).
3. Do advance preparation (page 83) and try the activity.
4. Note safety measures (in ***bold italics***) and special hints (below).

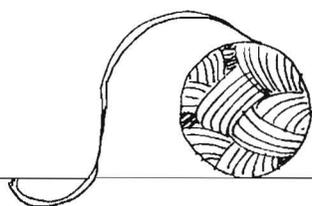
What's my role?

- Guide the children through the activity by doing the procedures with them.
- Encourage conversation about what they are doing and observing. Use the conversation questions as a guide, not a script to be followed.
- Listen for and summarize "I wonder..." statements the children make during the activity. (See "I wonder..." statements, page 10, Monitoring Success, page 13, and Evaluation Form, page 107.)
- Help the children relate this activity to their daily experiences.

Special Hint

Children who have respiratory problems (e.g., asthma or cystic fibrosis) may not be able to tolerate the fumes generated by the burning fabrics.

Name That Flame



Science: Behind the Scenes

Do not use this material as a lecture. It is intended to increase your background knowledge and comfort level with the subject. Allow the children to explore.

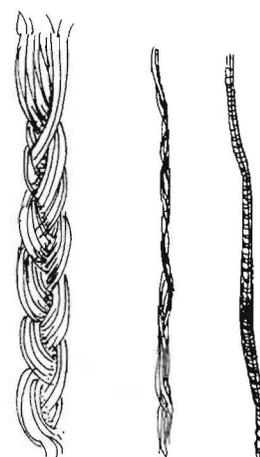
Fibers respond to flames according to their chemical makeup. Plant fibers such as cotton and linen are made of a carbohydrate called cellulose, which contains carbon, hydrogen, and oxygen, as does wood. Plant fibers burn easily, leave little ash, and smell like a wood fire or burning marshmallows.

Proteins in animal fibers such as wool and mohair contain not only carbon, hydrogen, and oxygen but also nitrogen and often phosphorous and sulfur. (Sulfur gives rotten eggs their awful odor!) Although wool, human hair, mohair, and other protein fibers ignite easily, they may stop burning when the source of the flame is removed. This natural fire resistance made wool the fiber of choice for military battlefield uniforms for centuries. Proteins also give off many more odors and leave more ash than cellulose fibers because of their additional components.

Petroleum-based fibers such as nylon and polyester are made of long chains of hydrocarbons. They contain little or no oxygen and tend to melt rather than burn. Once they start to burn, however, they burn very hot!

Differences in flammability can be used to group and identify fibers. It may not be possible to differentiate linen from cotton because both are made of cellulose but it is possible to separate cellulose fibers from protein or petroleum-based fibers.

Textile researchers have developed fibers that are heat resistant. They are used in tents and carpets and in protective clothing for firefighters, welders, and pilots.

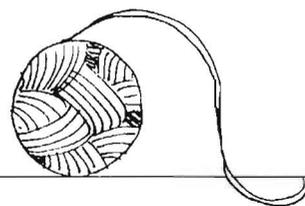


Plan Ahead

- Make the self-supporting wire rod and test it for stability.
- Recruit an extra adult to supervise igniting the yarns and fabrics.
- Locate a site with good ventilation.
- Be aware of the presence of smoke detectors.

Activity 5A

Name That Flame



Supplies and Preparation

Focus Supplies

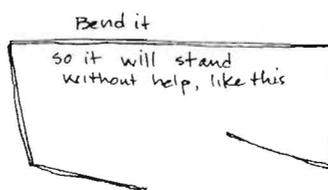
Focus items can be shared by the group.

- cotton yarn, string, twine, or rope
- nylon yarn, rope, or thick monofilament
- wool yarn

Activity Supplies

Activity supplies are listed for a group of three to four children; multiply as needed.

- self-supporting wire stand¹
- flat aluminum container
- water for container
- jug of water for safety
- 6 paper clips
- 2 pieces each of 3-in. lengths of cotton, wool, and nylon yarn²
- 4 pairs of goggles or safety glasses²
- liquid gas lighter or long fireplace matches
- 4 magnifying lenses
- 2 pieces each of 1 1/2-in. squares of cotton, wool, and nylon fabrics³
- 2 markers
- Lysol

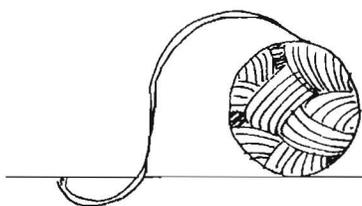


¹To make the wire stand, bend a wire hanger or a piece of wire as shown.

²Yarns and fabrics should be made from the same fibers. Two pieces of each allows for retesting. Cotton, wool, and nylon are recommended because they are widely available. You may select others if they represent the following fiber groups: a. Plant (cellulose): cotton, linen, ramie, jute, hemp, sisal, coir, kapok, abaca, henequen, b. Animal (protein): sheep's wool, mohair, silk, camel, llama, alpaca, hair, angora, c. Synthetic (petroleum-based): nylon, polyester, acrylic, olefin (polypropylene and polyethylene). Purchase at craft, hobby, hardware, grocery, discount, fabric, and department stores or order by mail.

³Before reuse, disinfect goggles in a solution of 1 1/4 oz. Lysol in 1 gallon of water. Rinse well and air-dry.

Name That Flame



Focus

Pass around the three yarn samples. Ask, "How are these yarns alike? different? One comes from animals, one from plants, and one is made from crude oil and natural gas. Can you guess which is made from each? If these yarns have different chemicals inside, they may burn differently. What should we watch for when the yarns burn?"

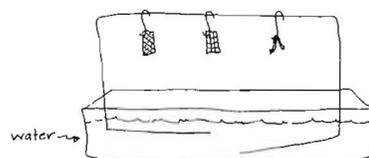
Activity

1. If you are doing Activities 5A and 5B together, start heating the milk for Activity 5B before you begin Activity 5A.

2. Organize children into groups of three to four with at least one adult. **State clearly that each will have the opportunity to handle the materials and equipment but they must cooperate and take turns. Emphasize that the adult controls the lighter between ignitions.**



3. Place the wire stand in an aluminum container **half filled with water.**



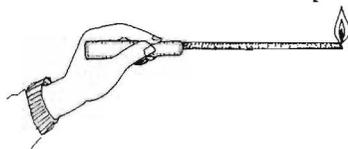
4. Use paper clips to attach yarn or rope samples to the wire stand. Identify the samples by name (e.g., cotton, wool).



5. **Put on goggles or safety glasses.**

6. **The leader ignites the first piece of yarn, demonstrating proper technique.**

- a. Turn on liquid gas lighter (do not pull the lever yet).
- b. Hold lighter beneath yarn and pull the lever.
- c. Extinguish lighter and remove from the sample as soon as the yarn flames.



I wonder...

Keep track of "I wonder..." statements you and the children express while doing the activity. Children might wonder

if the yarns can be identified by touching them.

why some fibers burn and others melt.

Conversation

Questions You Might Ask

Describe the yarns. Are they smooth, fuzzy, hard, or soft?

Which yarn is easiest to ignite? Did the yarn continue to burn when you removed the flame?

What color are the flames?

Which yarn gives off the most smoke?

Describe the odors. Do they remind you of something?

Which yarn takes the longest to burn?

How are the flames alike? different?

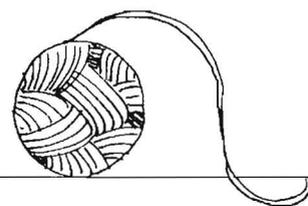
Do the ashes all look the same? What do they remind you of?

Describe the mystery fabrics. Do they look like the yarns you burned?

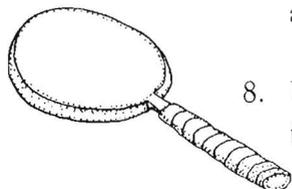
Did the fabrics burn as you expected?

Activity 5A

Name That Flame



7. One by one the children ignite the remaining pieces of yarn while their partners observe ease of ignition, burning time, flame size, flame colors, odors, amount of smoke, melting, and ashes.



8. Use a magnifying lens to compare the unknown fabrics to the yarns. Guess which fabric is cotton (C), wool (W), and nylon (N) and label with a marker.
9. Repeat steps 4–7 using the mystery fabrics.
10. Compare the burning behavior of the fabrics to that of the yarns and try to identify the fabrics.

Transition or Closure

If you are doing only Activity 5A, review the “I wonder...” statements. Say, “You discovered that fibers burn in different ways because of their chemical makeup. We can use this information to help identify an unknown fiber or fabric. We also learned that some fibers are safer around open flames than others. What else did you learn or do you still wonder about?” If you are doing Activities 5A and 5B together, summarize the fiber activity as you and the children clean up the work areas. Then shift their attention to the animal activity.

I wonder...

Keep listening for “I wonder...” statements after the activity. Children might wonder

what material is most dangerous to wear near a flame.

how to tell if a sweater is made from wool or acrylic.

if smog comes from burning things.

Name That Flame

A Step Beyond

I wonder if the chemical makeup of a fiber is the only thing that influences its flammability.

How easily a fabric burns depends not only on its fiber content but also on its construction. Fuzzy, loose fabrics burn more easily than smooth, firm items.

Repeat the burning test with three different wool fabrics: a thick felt, a loose knit, and a medium-weight weave. Compare their response to flames.

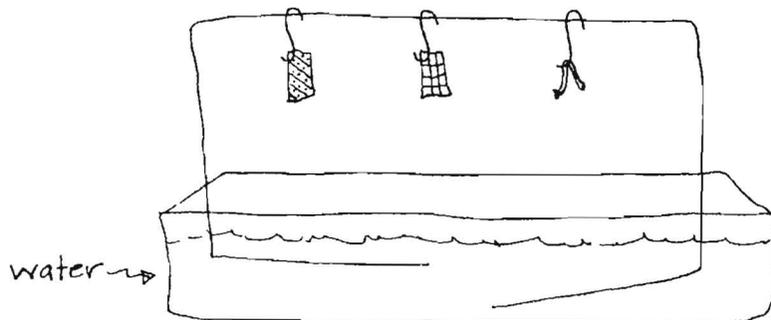
I wonder if you can use the flame test to identify a fabric that has more than one kind of fiber.

Fabrics are sometimes made of more than one fiber to take advantage of the best qualities of each. These fabrics are called blends. For example, a wool-nylon fabric has the warmth and resilience of wool and the durability of nylon. A cotton-polyester shirt has the comfort of cotton and the easy care of polyester.

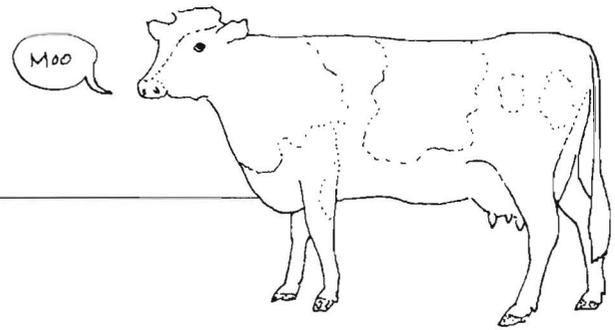
Repeat the flammability test with these known yarns and unknown fabrics:

known yarns: cotton, polyester, wool, nylon

unknown fabrics: cotton, polyester, cotton-polyester blend, wool, nylon, and wool-nylon blend



Milky Ways



Leader's Guide

What's the point?

Children use acid, heat, and/or shaking to change milk into cheese and butter. They share a tasty snack and learn that, although milk looks like one substance it is actually made up of many different components.

New terms include *curd*, *whey*, and *coagulate*. Milk contains water, fat, proteins, carbohydrates, minerals, and vitamins. These components can be identified because they react differently when subjected to different treatments. For example, shaking cream divides it into butter and buttermilk. In cheese making, we curdle (coagulate) some of the proteins in milk with acid to form solid curds and leave whey and other proteins in the liquid.

For additional information, read Science: Behind the Scenes (page 89).

What's the plan?

1. Read the activity (page 91).
2. Gather the supplies (page 90).
3. Do advance preparation (page 89) and try the activity.
4. Note safety measures (in ***bold italics***) and special hints (below).

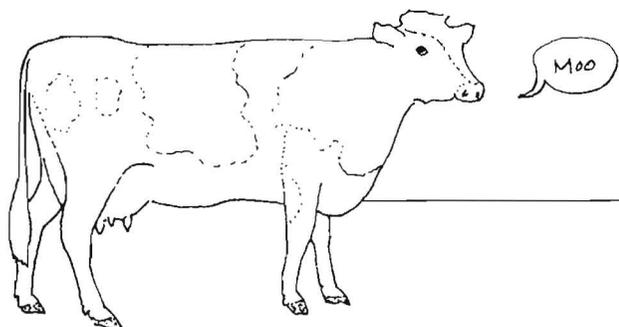
What's my role?

- Guide the children through the activity by doing the procedures with them.
- Encourage conversation about what they are doing and observing. Use the conversation questions as a guide, not a script to be followed.
- Listen for and summarize "I wonder..." statements the children make during the activity. (See "I wonder..." statements, page 10, Monitoring Success, page 13, and Evaluation Form, page 107.)
- Help the children relate this activity to their daily experiences.

Special Hint

If a child has a visual impairment, allow him or her to touch the cream frequently during the shaking to feel the changes.

Milky Ways



Science: Behind the Scenes

Do not use this material as a lecture. It is intended to increase your background knowledge and comfort level with the subject. Allow the children to explore.

Milk fat or cream is made up of fat globules each surrounded by a thin membrane. The fat globules in cow's milk are relatively large and tend to clump together when chilled. Because cream is lighter than skimmed milk, these clumps readily float on top of the milk. In contrast, the fat globules in goat's milk tend to be small and resist clumping when chilled and rise more slowly. They remain dispersed throughout the milk.

Whole cow's milk from the store does not develop a cream layer. It has been "homogenized"—the fat globules have been broken up mechanically into such tiny pieces that they remain distributed throughout the milk. Butter is made by shaking the cream skimmed off of unhomogenized cow's milk. Shaking incorporates air into the clumps of fat globules to form whipped cream. If you continue shaking, the globule membranes break and the fat oozes out. This liquid fat coats the air bubbles and collapses them. The fat sticks together to form butter. The liquid or "buttermilk" that remains has a somewhat sweet taste. It contains proteins, milk sugar, minerals, and vitamins.



In the old days, it would often take a week for a farm family to collect enough milk from their cows to make a batch of butter. By this time the milk would be starting to sour, i.e., the lactose-eating bacteria that occur naturally in milk would have converted much of the lactose (milk sugar) to lactic acid. Thus the buttermilk would have a sour or yogurt-like taste. The buttermilk sold in stores today tries to mimic this taste. It is made by reintroducing lactose-eating bacteria into pasteurized skim milk.

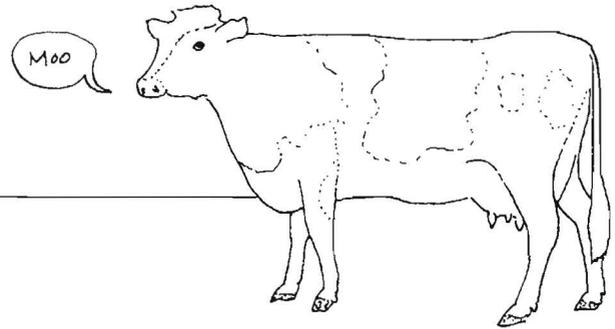
Cheese is made by curdling milk (altering some of the milk proteins and making them insoluble). Casein proteins curdle when the milk reaches a certain acidity (pH 4.6) or when exposed to an enzyme called rennet. Rennet occurs naturally in the stomachs of all suckling mammals. It can also be manufactured by certain molds and bacteria. Coagulation by rennet causes the casein proteins to form smoother curds than those formed by acid coagulation alone. The cheese in this activity is a whole milk ricotta made using vinegar (acid) and heat coagulation. It contains both casein and whey proteins because whey proteins coagulate at high temperatures (180° F). The remaining liquid whey contains only milk sugar (lactose), vitamins, and minerals. Most U.S. cheeses are made using lactose-eating bacteria (produce lactic acid) and rennets at temperatures too low to recover the whey proteins.

Plan Ahead

Try to use a kitchen stove rather than a hot plate or Coleman stove to heat the milk. Otherwise, allow more time for heating.

Activity 5B

Milky Ways



Supplies and Preparation

Focus Supplies

Focus items can be shared by the group. They are also used in the activity.

- large enamel or stainless steel pot
- one gallon of chilled cow's or goat's milk¹

Activity Supplies

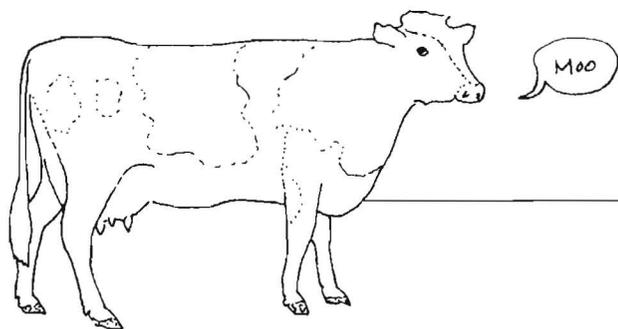
Activity supplies are listed for pairs of children unless otherwise noted; multiply as needed.

- kitchen stove, hot plate, or Coleman stove, for group
- thermometer that reads from room temperature to 200° F, for group
- slotted spoon, spatula, or ladle, for group
- hot pads, for adult
- chilled, pasteurized cow's cream (heavy or whipping cream), 1 pint per 16 children
- small jar with lid (baby food jars work well)
- white, distilled vinegar (1/4 cup per gallon of milk)
- liquid measuring cup, for group
- 1 18-inch square of cotton cloth or tightly woven cheesecloth (a clean piece of sheet or handkerchief works well), for group
- large colander, for group
- large bowl or basin, for group
- 3 plastic cups
- 2 plastic spoons
- pinch of baking soda
- pinch of salt
- cold water and dishpan for rinsing butter, for group
- 2 plastic knives
- crackers



¹Two percent or whole milk makes a nice cheese. Fresh, clean milk straight from the dairy also can be used because it is heated to a temperature higher than needed for pasteurization.

Milky Ways

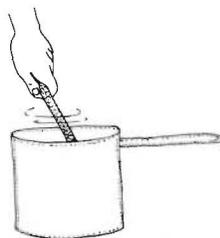


Focus

Ask the children to help pour the gallon of milk into the pot. Say, "Describe the milk. Does it look like just one thing? Can you divide milk into different parts? What foods are made from milk? We will test milk to see if it is made of just one thing or of many chemical compounds."

Activity

1. **An adult should heat** a gallon of milk to 180°–200° F, stirring regularly to avoid scorching. Children take turns reading the thermometer.



2. While the milk is heating, find a partner and put 1/4 cup of pasteurized cow's cream in a small jar. Seal it tightly with a lid.
3. Take turns with your partner shaking the jar. Observe the changes. When cream becomes butter, pour buttermilk into a cup and set aside.



4. Rinse the butter in the small jars with ice cold water until it rinses clear.
5. As the milk heats, one pair of children pours vinegar into a measuring cup.
6. When the milk reaches 200° F, **an adult removes** it from the stove. Children gather around as one child slowly pours in the vinegar.



7. Take turns observing how the milk has changed by lifting the curds with a slotted spoon or a soup ladle.

I wonder...

Keep track of "I wonder..." statements you and the children express while doing the activity. Children might wonder

if things that we cannot see are dissolved in milk.

why we are heating the milk.

Conversation

Questions You Might Ask

What nutrients are in milk?

How does shaking change the cream? Describe how it looks, sounds, and feels.

When the cream separates, describe its components.

What happens to the hot milk when we add the vinegar?

How does the milk look when curdled?

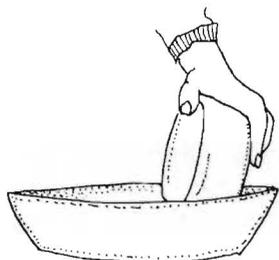
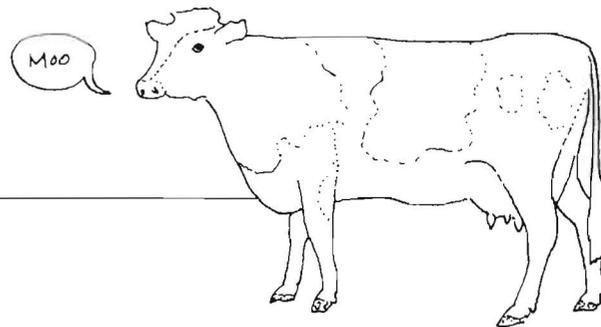
What color is whey? Does it look like skim milk? How does it taste?

Does the butter taste different from store-bought butter?

Does the cheese taste different from store-bought cheese?

Activity 5B

Milky Ways



8. Spread the cloth over a colander inside a bowl or plastic dishpan.
9. After the milk has cooled 15 minutes, ladle cheese curds into the colander and strain them. Place the liquid (whey) and curds in plastic cups. Let the next pair of children use the colander and cheesecloth.
10. Add a pinch of salt and baking soda (counteracts the acidity of vinegar) to the cheese curds.
11. Taste the buttermilk and whey. Spread the butter and the cheese on crackers.
Enjoy!

Closure: Connecting Fibers and Animals

If you are doing only Activity 5B, review the "I wonder..." statements and say, "We found that milk has many parts and that we can separate these parts to make other products." If you did Activities 5A and 5B together, review the "I wonder..." statements from both. Talk to the children about how different treatments (burning, adding acid, heating, and shaking) help you identify the different chemicals in the yarns and milk. Ask, "Can you think of other things we can do to test for chemicals in fibers and milk?"

I wonder...

Keep listening for "I wonder..." statements after the activity. Children might wonder

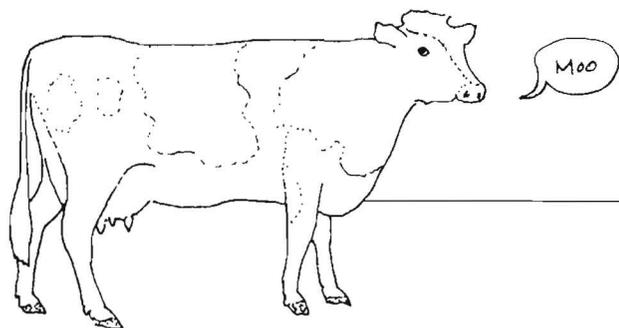
what else besides vinegar can curdle milk.

how to make the soft cheese into a hard one.

why whey is different from water.

how to make ice cream.

Milky Ways



A Step Beyond

I wonder how we can make the soft cheese into a hard cheese.

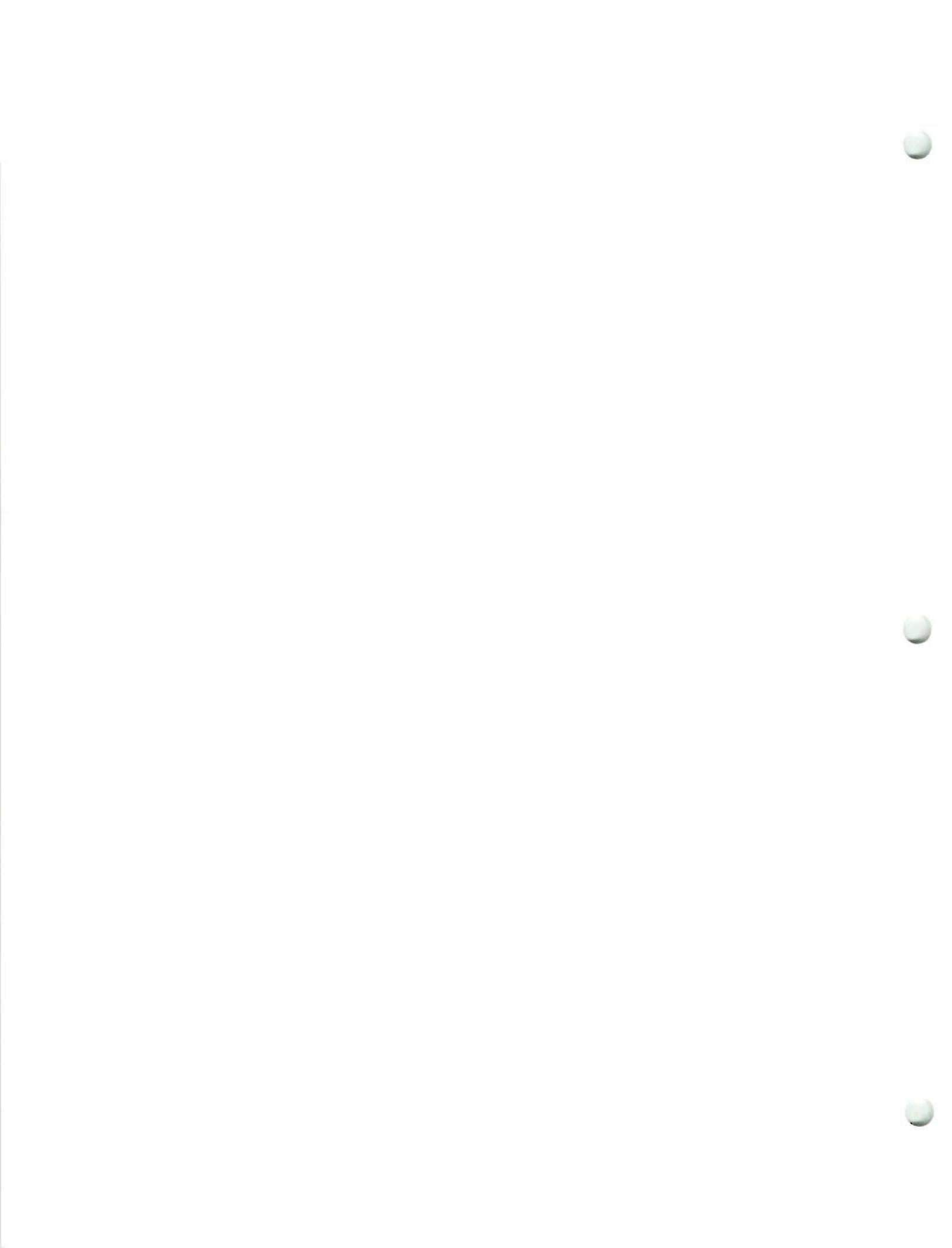
An excellent Mexican hard cheese called queso blanco can be made from the ingredients left over from Activity 5B. It is also known as farmer's cheese. Group together all the curds from making the whole milk ricotta. Add about 1 1/2 teaspoons of salt. Mix well. Wrap in a piece of cheesecloth or cotton sheet that has been soaked in salt water to prevent sticking. Tie the opposite ends of the cloth together to form a firm ball of curds. Smooth out any wrinkles. Place the bag of curds between two clean boards. On the top board place a couple of bricks, big books, heavy stones, or a small bucket of water to form a press. Leave at room temperature overnight. Much of the liquid will be squeezed out of the cheese curds. In the morning you can wrap the cheese in plastic wrap or foil and refrigerate. It has a shelf life of about one to two weeks.

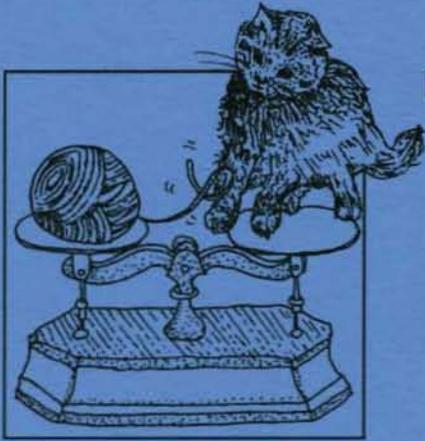
I wonder what other things we can make from milk.

The cheese curds made in Activity 5B can also be made into casein glue. Add to the curds a tablespoon of baking soda and 1/4 cup of water per measuring cup of curds. Stir until smooth and then use it to paste together two pieces of the paper.

Cajeta is a milk candy popular in Mexico. Traditionally, it is made with goat's milk. This recipe is easy to use with a group. Use a can opener to poke two holes in an 8-oz. tin of sweetened condensed milk. Place the tin in a partially filled saucepan of water (don't let the water get inside the tin can). Boil vigorously for one hour. Remove from heat and cool. Open lid completely with a can opener and spoon out the cajeta. The caramelization of the lactose and the additional sweeteners combine to give this milk candy its delicious taste. It is excellent on ice cream!

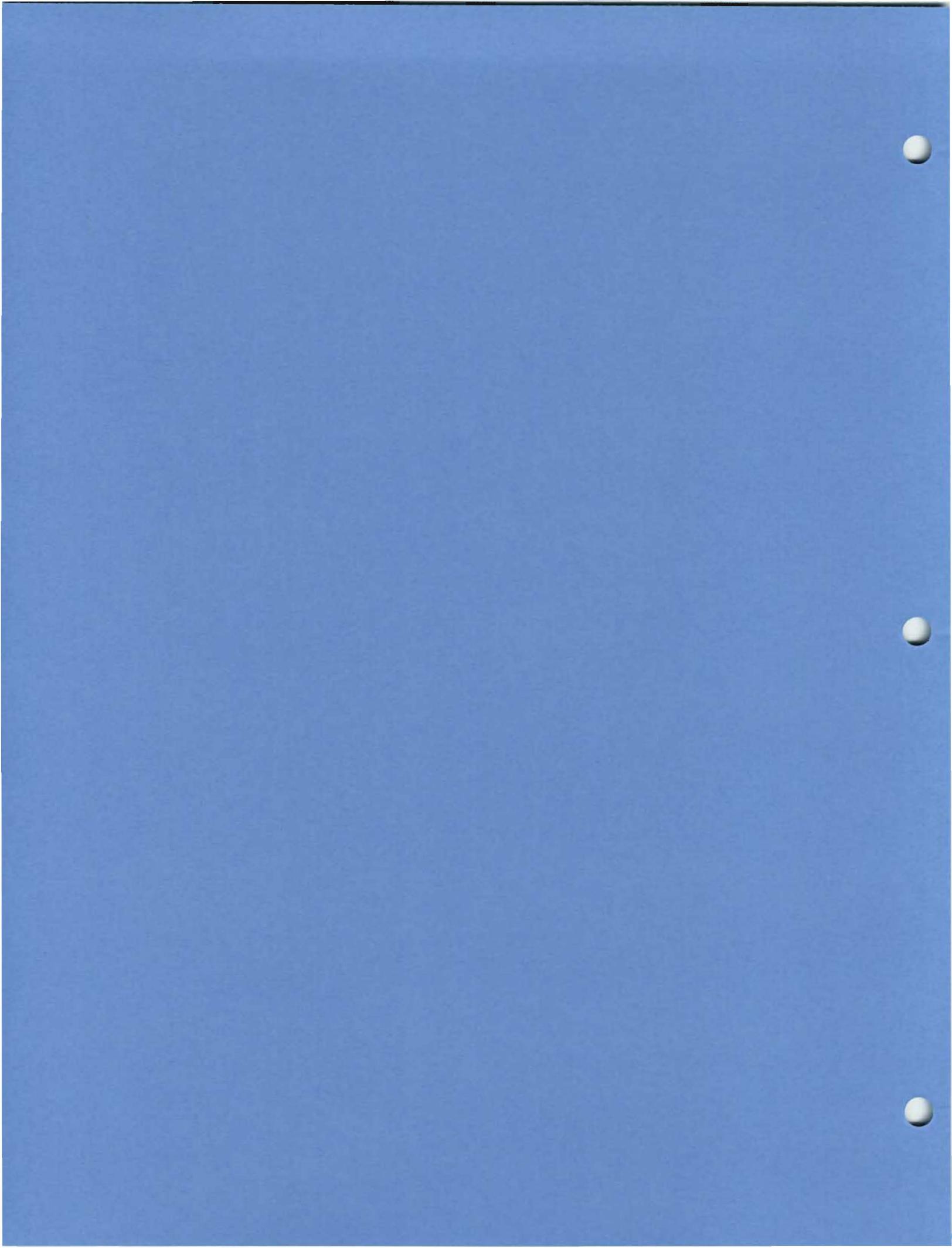


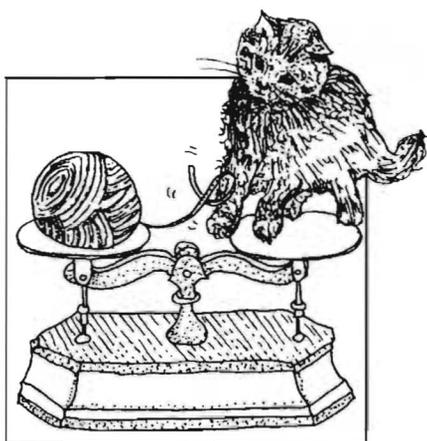




In-Touch Science: Fibers & Animals

Resources and Management





In-Touch Science: Fibers & Animals

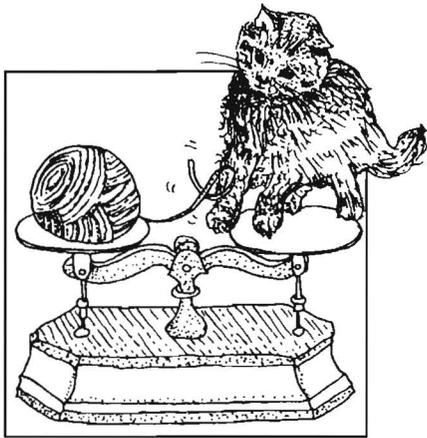
Checklist for Assembling Supply Kits

The supplies listed at right are needed to assemble a kit. Supplies are grouped as reusable tools and supplies, consumable supplies, and perishable food. The "quantity" column indicates amounts needed for ten participants to complete all ten activities. It is assumed that reusable supplies will serve several sessions. The "activity" column indicates when the items are used.

To keep small items organized, you may want to place them in resealable bags or envelopes labeled with item name, quantity, and activity number. For safety, place sharp implements in a box or other container.

<i>Item</i>	<i>Quantity</i>	<i>Activities</i>
Reusable Tools and Supplies		
<input type="checkbox"/> coffee cans	10	2B
<input type="checkbox"/> colander, large	1	5B
<input type="checkbox"/> cotton garment	1	1A
<input type="checkbox"/> cups, plastic, 6 oz.	20	1B, 3B, 5B
<input type="checkbox"/> dishpan	4	1A, 3B, 4B, 5B
<input type="checkbox"/> fabric, porous	2 yd.	4A, 5B
<input type="checkbox"/> felt, item or fabric	1	1A
<input type="checkbox"/> flashlights	5	2A, 2B
<input type="checkbox"/> goggles or safety glasses	10	5A
<input type="checkbox"/> hammer or mallet	4	4B
<input type="checkbox"/> highlighter	10	2A
<input type="checkbox"/> hot pads	2	4A, 5B
<input type="checkbox"/> jars, quart, with lids	5	4B
<input type="checkbox"/> jars, small, with lids	5	5B
<input type="checkbox"/> knife, Exacto, or single-edge razor blade	1	1A
<input type="checkbox"/> knife, plastic serrated	10	4B, 5B
<input type="checkbox"/> lighter, liquid gas	1	5A
<input type="checkbox"/> magnifying lens	10	1A, 1B, 5A
<input type="checkbox"/> markers, waterproof	5	4A, 4B, 5A
<input type="checkbox"/> measuring cup, liquid	1	4A, 5B
<input type="checkbox"/> measuring spoons	4	4A
<input type="checkbox"/> medicine droppers	10	1A, 1B
<input type="checkbox"/> medicine measuring cup	10	3A
<input type="checkbox"/> pan, flat, approx. 9 x 13 in.	3	5A
<input type="checkbox"/> pan, 2-quart with lid	1	4A
<input type="checkbox"/> paper clip	20	2B, 5A
<input type="checkbox"/> patterns for eyes	5 oval; 5 round	2B
<input type="checkbox"/> pencil	10	2B, 4A
<input type="checkbox"/> photo or magazine clipping	1	2A
<input type="checkbox"/> pot, large enamel or stainless steel	1	5B
<input type="checkbox"/> tablecloths, plastic	2	1A, 3B, 4A, 4B
<input type="checkbox"/> ruler	10	2B
<input type="checkbox"/> scissors	10	1B, 2A, 2B, 3A, 3B, 4A
<input type="checkbox"/> spoon, plastic	10	3B, 5B
<input type="checkbox"/> spoon, large slotted	1	5B

<i>Item</i>	<i>Quantity</i>	<i>Activities</i>
<input type="checkbox"/> stones, 2–3-in. circumference	10	1A
<input type="checkbox"/> thermometer	1	3A, 5B
<input type="checkbox"/> visual aids with small print	5	2B
<input type="checkbox"/> washboard, small	3	1A,
<input type="checkbox"/> wire stand	3	5A
<input type="checkbox"/> wool garment	1	1A, 3B
Consumable Supplies		
<input type="checkbox"/> baking soda	small box	5B
<input type="checkbox"/> balloons	10	3B
<input type="checkbox"/> cloth utility tape (nonreflective), 1-in. wide, 2 colors	16 ft.	2A
<input type="checkbox"/> construction paper, black	22 sheets	1B, 2B
<input type="checkbox"/> cotton batting or rolled cotton	1/2 lb.	1A
<input type="checkbox"/> fabric, cotton	1/8 yd.	5A
<input type="checkbox"/> fabric, nylon	1/8 yd.	5A
<input type="checkbox"/> fabric, wool	1/8 yd.	5A
<input type="checkbox"/> feathers, down (pure)	10	1B
<input type="checkbox"/> feathers, flight	10	1B
<input type="checkbox"/> feathers, miscellaneous	10	1B
<input type="checkbox"/> fiberfill, polyester	1 lb.	3B
<input type="checkbox"/> foods and feeds		4A
<input type="checkbox"/> glove, plastic	2	3B
<input type="checkbox"/> glue stick	5	1B, 2A
<input type="checkbox"/> index cards	20	4A
<input type="checkbox"/> insulation materials	various	3A
<input type="checkbox"/> Lysol	small bottle	5A
<input type="checkbox"/> masking tape	6 rolls	2B, 3A, 3B 4B
<input type="checkbox"/> newspaper	several	1B
<input type="checkbox"/> paper, graph	10 sheets	2A
<input type="checkbox"/> paper towels	2 rolls	1A, 3B
<input type="checkbox"/> peanuts with shells	1 cup	4A
<input type="checkbox"/> plant materials	various	4B
<input type="checkbox"/> plastic bags, resealable snack or pint	10	3A
<input type="checkbox"/> reflective tape, 1-in. wide, 2 colors, 16 ft. of each color		2A
<input type="checkbox"/> salt	small shaker	5B
<input type="checkbox"/> shampoo, baby “no tears”	small bottle	4A
<input type="checkbox"/> shortening or lard	1/2 lb.	3B
<input type="checkbox"/> soap, bar or liquid	1 small	1A, 3B
<input type="checkbox"/> square grid, photocopies	10	2A
<input type="checkbox"/> string	1 1/2 yds.	4A
<input type="checkbox"/> vinegar	1 pint	5B
<input type="checkbox"/> wool fleece	2 lb.	1A, 3B
<input type="checkbox"/> yarn, cotton	1 yd.	5A
<input type="checkbox"/> yarn, nylon	1 yd.	5A
<input type="checkbox"/> yarn, wool	6 yds.	1A, 5A
Perishable Food		
<input type="checkbox"/> crackers	1 box	5B
<input type="checkbox"/> cream, pasteurized heavy or whipping	1 pint	5B
<input type="checkbox"/> milk, whole or 2% cow’s or goat’s	1 gallon	5A



In-Touch Science: Fibers & Animals

Checklist for Assembling Supply Kits to Loan

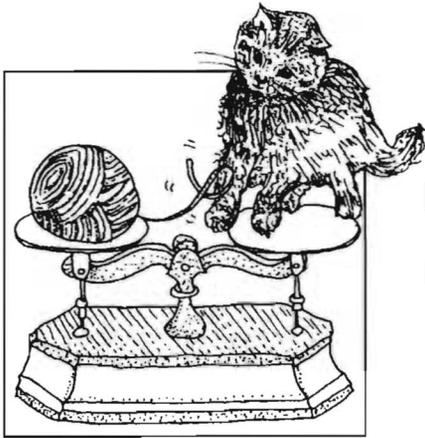
These are basic kits. Perishable items or items usually found around the home or school are not included. Wash and repack.

<i>Item</i>	<i>Quantity</i>
Labeled in Bags or Boxes	
<input type="checkbox"/> cups, plastic, 6 oz.	20
<input type="checkbox"/> dishpan	4
<input type="checkbox"/> fabric, porous	2 yd.
<input type="checkbox"/> felt, item or cloth	1
<input type="checkbox"/> goggles or safety glasses	10
<input type="checkbox"/> jars, quart	5
<input type="checkbox"/> jars, small	5
<input type="checkbox"/> knife, Exacto, or single-edge razor blade	1
<input type="checkbox"/> knife, plastic serrated	10
<input type="checkbox"/> lighter, liquid gas	1
<input type="checkbox"/> magnifying lens	10
<input type="checkbox"/> measuring cup, liquid	1
<input type="checkbox"/> measuring spoons	4
<input type="checkbox"/> medicine droppers	10
<input type="checkbox"/> medicine measuring cup	10
<input type="checkbox"/> patterns for eyes	5 oval; 5 round
<input type="checkbox"/> photo or magazine clipping	1
<input type="checkbox"/> ruler	10
<input type="checkbox"/> scissors	10
<input type="checkbox"/> spoon, plastic	10
<input type="checkbox"/> thermometer	1
<input type="checkbox"/> visual aids with small print	5
<input type="checkbox"/> washboard, small	3
<input type="checkbox"/> wire stand	3
Replace as Consumed	
<input type="checkbox"/> bags, resealable snack or pint	10
<input type="checkbox"/> baking soda	small box
<input type="checkbox"/> balloons	10
<input type="checkbox"/> cloth utility tape (nonreflective), 1-in. wide, 2 colors	16 ft. each color
<input type="checkbox"/> construction paper, black	22 sheets
<input type="checkbox"/> cotton batting or rolled cotton	1/2 lb.
<input type="checkbox"/> fabric, cotton	1/8 yd.
<input type="checkbox"/> fabric, nylon	1/8 yd.

<i>Item</i>	<i>Quantity</i>
<input type="checkbox"/> fabric, wool	1/8 yd.
<input type="checkbox"/> feathers, down (pure)	10
<input type="checkbox"/> feathers, flight	10
<input type="checkbox"/> feathers, miscellaneous	10
<input type="checkbox"/> fiberfill, polyester	1 lb.
<input type="checkbox"/> glove, plastic	2
<input type="checkbox"/> glue stick	5
<input type="checkbox"/> highlighters	10
<input type="checkbox"/> index cards	20
<input type="checkbox"/> markers, waterproof	5
<input type="checkbox"/> masking tape	6 rolls
<input type="checkbox"/> paper clips	20
<input type="checkbox"/> pencil	10
<input type="checkbox"/> reflective tape, 1-in wide, 2 colors	16 ft. each color
<input type="checkbox"/> salt	small shaker
<input type="checkbox"/> shampoo, baby "no tears"	small bottle
<input type="checkbox"/> shortening or lard	1/2 lb.
<input type="checkbox"/> soap, bar	1 small
<input type="checkbox"/> string	1 1/2 yds.
<input type="checkbox"/> vinegar	1 pint
<input type="checkbox"/> wool fleece	2 lb.
<input type="checkbox"/> yarn, cotton	1 yd.
<input type="checkbox"/> yarn, nylon	1 yd.
<input type="checkbox"/> yarn, wool	6 yds.

Supplies Not Provided

<input type="checkbox"/> coffee cans	10
<input type="checkbox"/> colander, large	1
<input type="checkbox"/> cotton garment	1
<input type="checkbox"/> crackers	1 box
<input type="checkbox"/> cream, pasteurized heavy or whipping	1 pint
<input type="checkbox"/> flashlights	5
<input type="checkbox"/> foods and feeds	various
<input type="checkbox"/> grid, photocopies	10
<input type="checkbox"/> hammer or mallet	4
<input type="checkbox"/> hot pads	2
<input type="checkbox"/> insulation materials	various
<input type="checkbox"/> Lysol	small bottle
<input type="checkbox"/> milk, 2% whole cow's or goat's	1 gallon
<input type="checkbox"/> newspaper	several
<input type="checkbox"/> pan, large enamel or stainless steel	1
<input type="checkbox"/> pan, flat, approx. 9 x 13 in.	3
<input type="checkbox"/> pan, 2-quart with lid	1
<input type="checkbox"/> paper, graph	10 sheets
<input type="checkbox"/> paper towels	2 rolls
<input type="checkbox"/> peanuts with shell	1 cup
<input type="checkbox"/> plant materials	various
<input type="checkbox"/> tablecloths, plastic	2
<input type="checkbox"/> spoon, large slotted	1
<input type="checkbox"/> stones, 2–3-in. circumference	10
<input type="checkbox"/> wool garment	1



In-Touch Science: Fibers & Animals

Guide to Ordering Supplies

Most of the supplies used in *In-Touch Science: Fibers and Animals* can be purchased at local food, fabric, garden, discount, or office supply stores. The following or similar mail order sources may be useful if you are assembling several supply kits or have difficulty finding supplies.

American Science and Surplus

3605 Howard Street

Skokie, IL 60076

847-982-0870

www.sciplus.com

Magnifying lenses, eyedroppers, and other basic science equipment

American Sheep Industry Association

6911 S. Yosemite Street

Englewood, CO 80112-1414

Write for list of breed associations and members who sell fleece.

Central Restaurant Supply

642 N. Salina Street

Syracuse, NY 13208

800-244-6848

Knives, cups, measuring utensils

Crazy Crow Trading Post

P.O. Box 847

Pottsboro, TX 75076-0847

800-786-6210

Scissors, feathers, fur, felt

Delta Education

Hands-On Science K–8 catalog

P.O. Box 3000

Nashua, NH 03061-3000

800-442-5444

<http://www.delta-ed.com/>

Magnifying lenses, eyedroppers, medicine measuring cups, and other basic equipment

Earth Guild

33 Haywood Street

Asheville, NC 28801

800-327-8448

Drop spindles and wool

Frostline Kits

2525 River Road

Grand Junction, CO 81505

800-548-7872

seweasy@frostlinekits.com

Down, nylon fabrics, and polyester "fleece"

Lab Safety Supply, Inc.

P.O. Box 1368

Jamesville, WI 53547-1368

800-356-0782

Fax: 800-543-9910

www.labsafety.com

Reflective and nonreflective tapes

Nasco

901 Janesville Avenue

P.O. Box 901

Fort Atkinson, WI 53538-0901

800-558-9595

www.homeschool-nasco.com/

Glue, scissors, trays, measuring spoons and cups, felt, and magnifying lenses

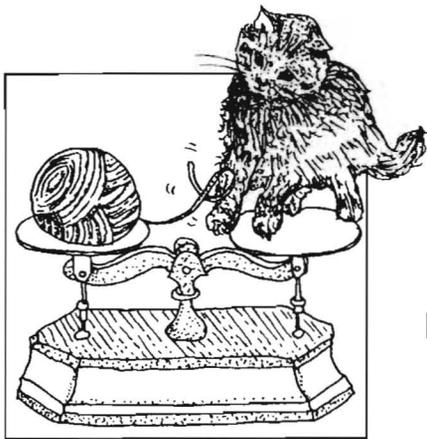
Wakeda Trading Post

P.O. Box 19146

Sacramento, CA 95819-0146

916-485-9838

Goose quills, fur, feathers



In-Touch Science: Fibers & Animals Parent Letter

You may want to introduce *In-Touch Science* to the parents of the children in your group. This is especially helpful if your group has not previously worked on science projects or if you want to encourage parent volunteers. Complete the form below and duplicate as needed.

_____ (Agency name)

_____ (Agency address)

_____ (Date of letter)

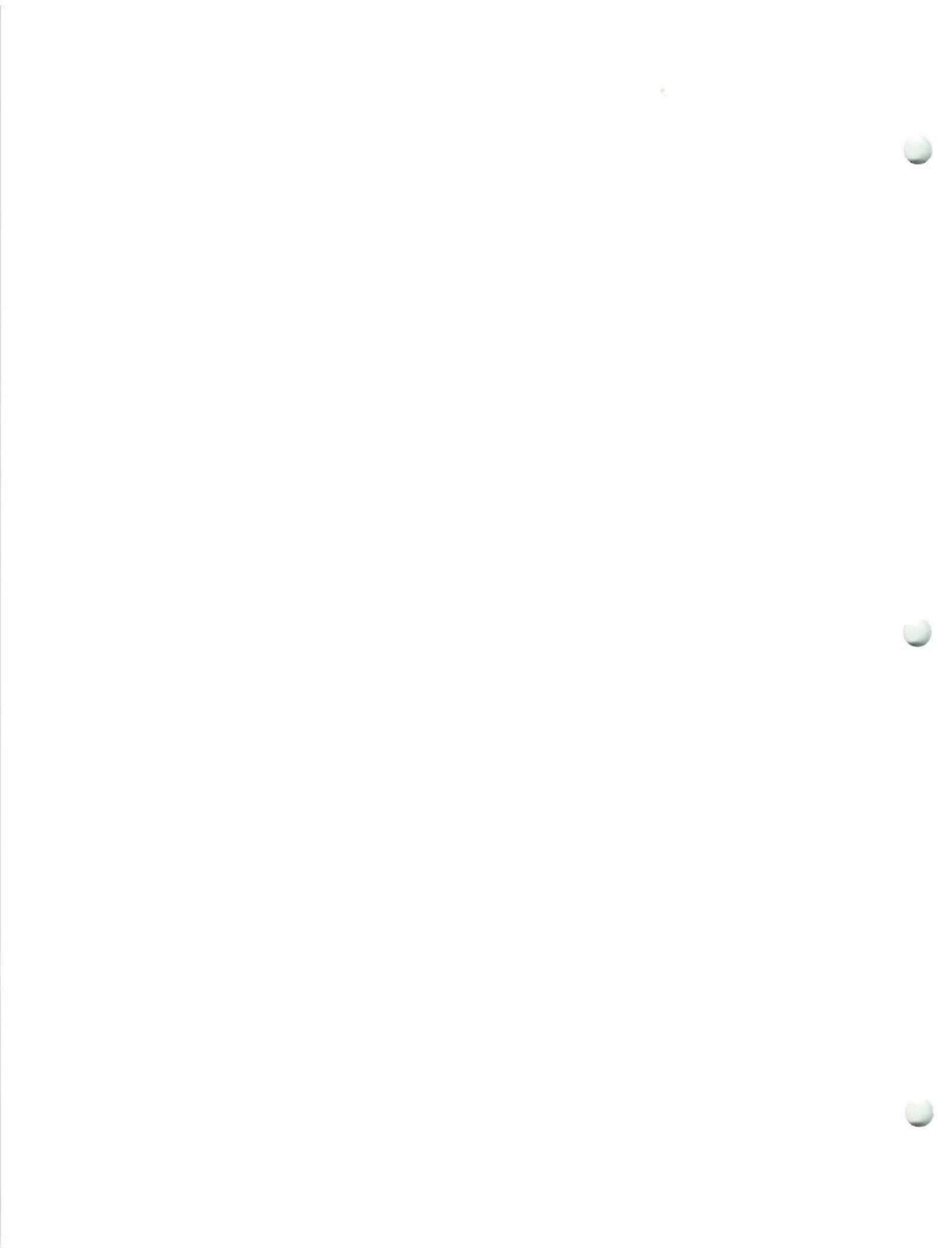
Dear Parent/Guardian:

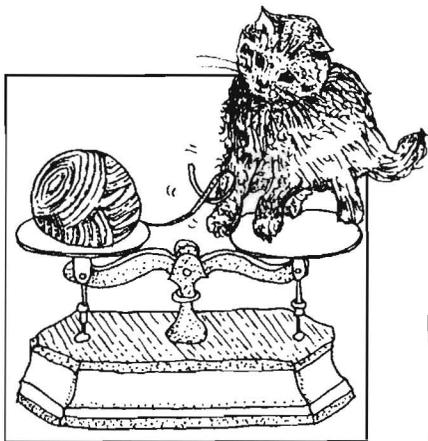
The _____ (name of your group) will be exploring and having fun with *In-Touch Science* on _____ (program dates). *In-Touch Science* is a hands-on science program that encourages children to examine everyday items, to talk about their observations, and to connect what they learn to what they do in daily life. Your children will occasionally bring home something they made. More often, you will need to ask them to tell you what they did. The program was developed by Cornell University with funding from the National Science Foundation.

Signed: _____

Position: _____

Agency: _____





In-Touch Science: Fibers & Animals

Model Release

You may want to take photographs for local publicity or to share with Cornell University as part of the national *In-Touch Science* evaluation. In either case, you need to obtain permission to use these images. Adults can sign individual model release forms; parent/legal guardians should sign for children under 18 years of age. Complete the form below and reproduce as needed.

Model Release

Please check all that apply:

_____ (your agency)

___ In-Touch Science Team and Cornell Media and Technology Services, Cornell University, 239 Martha Van Rensselaer Hall, Ithaca, NY 14853-4401

The agencies indicated above are hereby granted the right to record and use any images (including, but not limited to, videotape, photographs, film, and audiotape) in which I, my child or children have participated as part of *In-Touch Science*.¹ I further understand that this authorization shall extend to their grantees, lessees, or licensees in perpetuity.

Model's Name (please print): _____

Model's Signature (if model is adult): _____

Parent/Guardian Signature (if model is a minor): _____

Home Address: _____

Telephone: _____

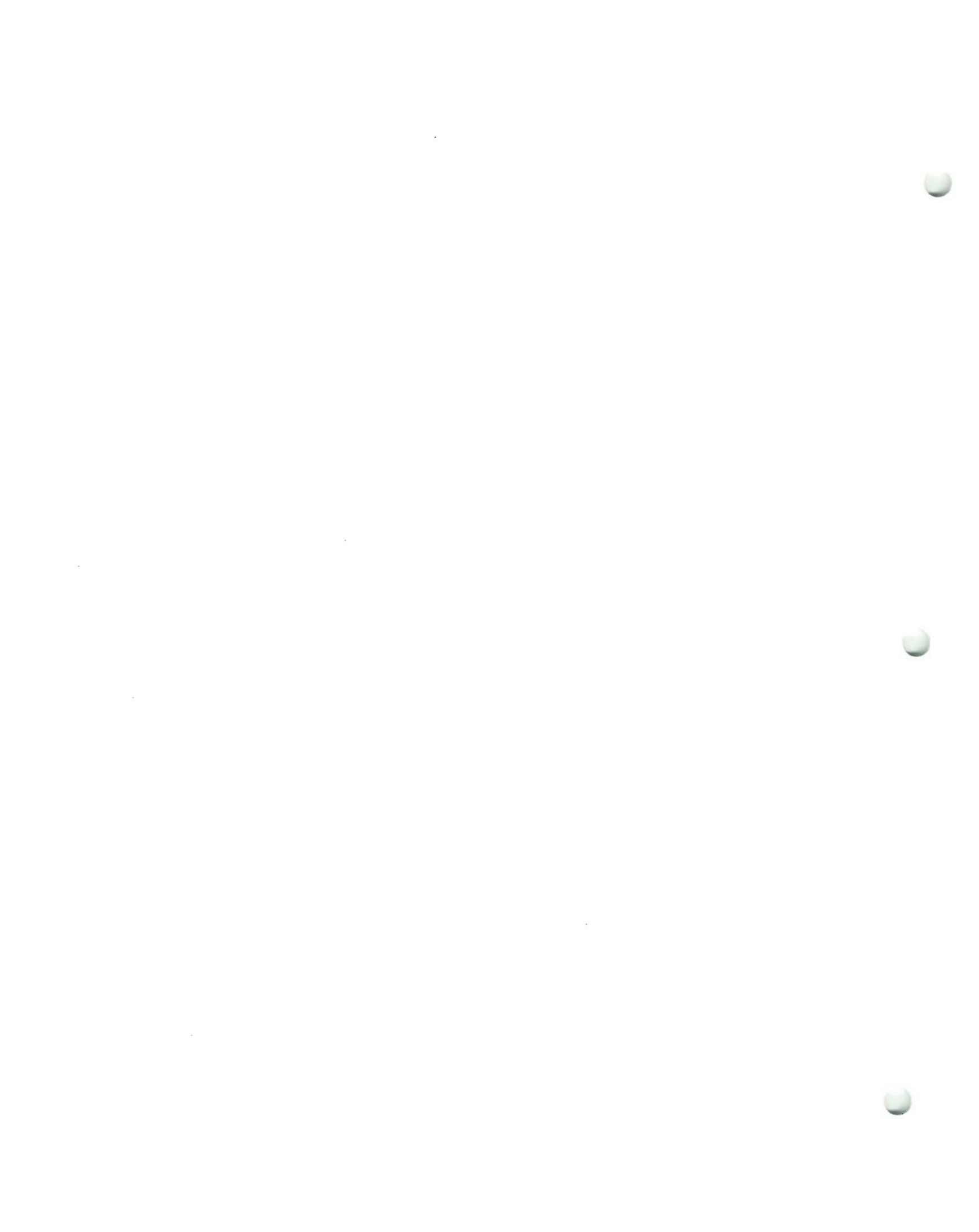
Email: _____

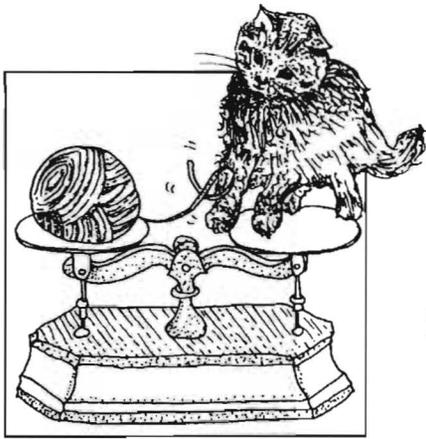
Date Signed: _____

Location and Description of Event: _____

Date of Event: _____

¹*In-Touch Science* is a hands-on science program for youth. Centered at Cornell University and funded by the National Science Foundation, it emphasizes exploration, conversation, and application to everyday experiences.





In-Touch Science: Fibers & Animals

Evaluation Form

Copy as needed, using separate forms for each session.

Sessions and Activities

- 30-minute session with one activity
- 60-minute session with two activities
- Other _____
- Session 1 1A Fuzzy Fibers • 1B Fantastic Feathers
- Session 2 2A Light Up the Night • 2B Night Views
- Session 3 3A Keeping Cool • 3B Staying Warm
- Session 4 4A Threads of Life • 4B Rot the String Out of It
- Session 5 5A Name That Flame • 5B Milky Ways

Participation

Number of participants:

Children _____

Adults _____

Description of children:

Age(s) _____

Ethnic group(s) _____

Gender _____

Additional information _____

Description of adults:

Age(s) _____

Ethnic group(s) _____

Gender _____

Position _____

Education _____

Teaching experience _____

Setting

School-age child care program

4-H club

EFNEP

Parenting program

Other _____

Community youth program

Camp

Museum

Children's Interest and Conversation

Level of interest	(low)	1	2	3	4	5	(high)
Amount of conversation among children	(low)	1	2	3	4	5	(high)
Amount of conversation with you	(low)	1	2	3	4	5	(high)

Children's Ideas and Comments

List sample "I wonder..." statements:

Other comments:

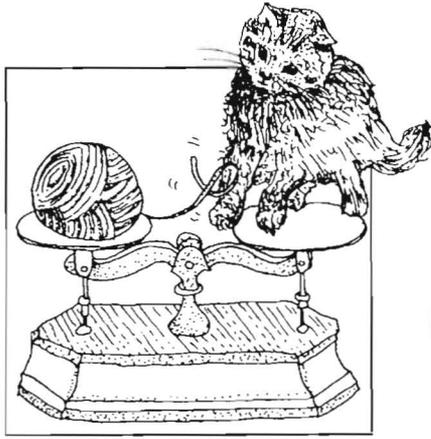
Adults' Ideas and Comments

Prior knowledge of this session's topic	(low)	1	2	3	4	5	(high)
Comfort level using this teaching approach	(low)	1	2	3	4	5	(high)
Age appropriateness of materials/procedures	(low)	1	2	3	4	5	(high)
Difficulty managing noise and disruptions	(low)	1	2	3	4	5	(high)
Level of support (site, parents, volunteers)	(low)	1	2	3	4	5	(high)
Amount of time for preparation/cleanup	(low)	1	2	3	4	5	(high)
Would you use this activity again?	Yes	No					

Other comments:

Return to:

Extension Staff
Cornell University
Department of Textiles and Apparel
239 MVR Hall
Ithaca, NY 14853-4401



In-Touch Science: Fibers & Animals

Glossary

Airfoil

The “teardrop” shape of feathers and airplane wing cross sections that creates lift

Barb

Small branches from the main shaft of a feather that make up the vanes

Barbule

The thousands of tiny, parallel fringes coming off the barbs of feathers

Blend

A fabric or yarn that contains two or more different fibers

Butterfat

The fat in milk

Casein

Proteins in milk that congeal when exposed to acidity of pH 4.6

Cellulose

Stringy, pliable fiber in plants

Cheese

A solid food made from curdling milk

Coagulate

Congea

Cone

One of the cone-shaped cells in the retina of the eye, effective at producing high-resolution images in intense light

Curd

The portion of milk that congeals when the milk is soured or heated

Curdle

To sour milk, causing the proteins in the milk to congeal

Digestion

The process by which food is broken down into particles and substances that the body can absorb

Down feathers

The soft, innermost feathers of birds used for insulation

Felt

A thick, nonwoven wool cloth; the process by which heat, moisture, and pressure act on wool fibers to make felt

Fermentation

Digestion in the absence of oxygen

Fiber, dietary

The part of a plant that cannot be broken down by mammalian digestive enzymes. It includes complex carbohydrates such as cellulose, lignin, pectin, and hemicellulose.

Fiber, textile

A natural or manufactured material that has an extremely small diameter and a length at least 100 times this diameter. It is made into yarn that is made into fabric.

Fiberfill

Polyester used to insulate clothing and bedding

Fleece

Coat of a sheep that has been sheared or fabrics made to imitate animal fleece

Flight feathers

Strong, smooth wing and tail feathers essential to a bird's flight

Fluorescent

Any substance that gives off light (i.e., glows) when light strikes it

Heat

A form of energy

Heat transfer

Movement of heat from a warmer area to a colder area

Herbivore

An animal that feeds only on plants

Homogenize

Break the fat globules in milk into such small pieces that they are evenly dispersed

Hydrocarbons

Compounds that consist of hydrogen and carbon

Insulation

Materials that slow the transfer of heat

Iris

The pigmented circle of membrane on the front of an eye

Lactose

A sugar found in milk

Lens

Curved, transparent materials that cause light rays to converge or diverge to form images

Lift

An aerodynamic force that pushes up on a bird or plane as it flies forward

Light

Electromagnetic radiation of any wavelength

Lignin

A noncarbohydrate that binds to cellulose fibers and strengthens cell walls of plants. Resists degradation.

Nocturnal

Animals that are more active at night than during the day

Petroleum-based

A manufactured textile fiber, such as nylon or polyester, derived from petroleum products

Phosphorescent

Substances that glow or give off light for a short time after they are removed from a light source

Protein

A compound synthesized by plants and animals that breaks into amino acids required for all life processes

Pupil

The opening in the center of the iris that controls how much light enters the eye

Reflection

The return of light, heat, or sound after striking a surface

Rennet

An enzyme from a calf's stomach that aids in cheese curd formation

Retina

The innermost layer of the back of the eye where visual messages are formed and sent to the brain

Retting

The removal by fermentation of an outer portion of a plant to gain access to resistant fibers

Rhodopsin

The pigment in rods that allows us to discern shapes even in the dark

Rod

One of the rod-shaped cells in the retina of the eye that provide information about the general shape of an object

Shaft

The hollow main stem or midrib of a feather

Synthetic

A textile fiber derived from petroleum

Tapetum

Mirrorlike patch found in the choroid of some animals that reflects light back through the retina

Vane

The halves of a feather on either side of the shaft

Whey

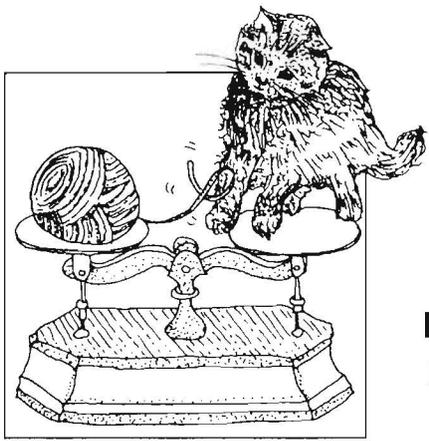
The portion of milk that remains liquid when milk is soured

Whey proteins

Milk proteins soluble at pH 4.6

Wool

Textile fiber from animals that is made of protein and has surface scales



In-Touch Science: Fibers & Animals

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