In-Touch Science: Foods & Fabrics

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In-Touch Science: Foods & Fabrics

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Acknowledgments

In-Touch Science: Foods & Fabrics was developed as part of an interdisciplinary Cornell Cooperative Extension education and research project. It was field-tested in selected school-age child care programs and 4-H clubs with children aged 8 to 11. The project was supported by grants from the Statewide Research/Extension Initiative, Cornell University, and the New York State 4-H Foundation.

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The authors thank Kassandra Weidner and Ai Le, undergraduate students at Cornell University, for their assistance in pretesting experiments and doing many other tasks essential to the pilot project. We thank Joy Swanson in the Division of Nutritional Sciences for her technical assistance in developing food experiments. We also thank P&G Food Markets and Cornell University Dining Services for donating food supplies.

Special appreciation is extended to all 4-H volunteer leaders, teen leaders, and school-age child care staff in Monroe, Onondaga, and Tompkins Counties who participated in the pilot project during the spring of 1995. We are indebted to their commitment to improving educational opportunities for children.

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Introducing the Program

*In-Touch Science: Foods & Fabrics* is a science program developed by Cornell Cooperative Extension to help children aged 8 to 11 (grades 3 to 5) learn more about foods and fabrics. Ten experiments let children observe how similar science concepts relate to both foods and fabrics. The program 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 5 to 10 children. A ratio of one adult to six children is ideal.

The teaching style emphasizes the fun of manipulating supplies and engaging in the scientific process of discovery. Both adults and children are active participants. Together they will share "I wonder..." statements that could lead to more science exploration. This program encourages children to think about their everyday encounters with foods and fabrics and to learn about the science of it all.

*In-Touch Science: Foods & Fabrics* was successfully field-tested with more than 100 children from diverse socioeconomic backgrounds in 4-H clubs and school-age child care programs. It is also appropriate for use in summer camps, the Expanded Food and Nutrition Education Program (EFNEP), Boy Scout or Girl Scout programs, science centers, and other community programs serving children and families. Although this program is intended to promote greater opportunities for children in nonclassroom settings, it could be adapted for use in school science programs.

**Overview of Experiments**

The 10 experiments in *In-Touch Science: Foods & Fabrics* are organized into 5 one-hour sessions. Each session includes the same segments and flow of delivery:

<table>
<thead>
<tr>
<th>Segment:</th>
<th>Focus</th>
<th>Fabric Experiment</th>
<th>Transition</th>
<th>Focus</th>
<th>Food Experiment</th>
<th>Closure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time (min.):</td>
<td>5</td>
<td>20</td>
<td>5</td>
<td>5</td>
<td>20</td>
<td>5</td>
</tr>
</tbody>
</table>

The fabric and food experiments in each session are linked by a common science concept. To allow children to experience how similar concepts apply to two different disciplines, start with experiment 1A and follow the sequence through experiment 5B. The two experiments in session 5 combine several concepts introduced in previous sessions.
Each session can be broken into two half-hour sessions. To create 10 half-hour sessions, alternate fabric and food experiments. Each experiment requires about 20 minutes but could take more or less time depending on the children’s skills, interest, and efficiency in organizing and cleaning up work areas. To ensure a fun, relaxed experience you may want to allow extra time, especially the first time you use the program.

**What's in Each Session**

The first page of each session introduces the science concepts and corresponding experiments. The subsequent pages include the following:

- **Things to Think About during the Experiment.** This page gives the flow of activity for each experiment. Read it along with the experiment page to prepare for working and talking with the children.

- **Focus.** You will introduce each experiment by doing a focus activity as a group. This activity introduces the general theme of the experiment and helps children relate what they know to what they will observe. You can substitute other props or questions, but avoid telling the children too much about what you will be doing.

- **Experiments.** Each session includes a fabric experiment and a food experiment. Each experiment page includes setup information, step-by-step directions, and sample questions to help stimulate conversation. The time to talk about the concepts and observations is during and after experimenting. You and the children will make a list of “I wonder...” statements about the experiment. Introduce and use science terms, but only after the children have spent time experimenting and talking about their observations.

By creating your own work station, you can easily demonstrate procedures and encourage conversation. You are facilitating the children’s experience, but you are also a participant. Each child should have his or her own work station with enough materials and space to work comfortably. To ensure a safe experience, review with the children all safety precautions noted with each experiment. No tasting should be done during the food experiments. Tasting should be done as a separate activity, away from the work area or after supplies have been cleaned up.
Transition. If you are doing only one experiment in a session, this is the time to have children clean up their work stations. The "I wonder..." statements should be reviewed. If you are doing two experiments in one session, this is the time to clean up from the first experiment and create work stations for the second experiment.

Closure. This is the time to think about how the two experiments are linked together. Collect the children's thoughts and ideas and compare the "I wonder..." statements. This will help you evaluate the experience and perhaps plan additional related experiments or activities.

Supplies and Preparation. This page provides a supply checklist for both the focus activity and the experiment and includes additional information to help you collect supplies and organize individual work stations. Some alternative supplies are described.

Behind the Scenes Science. The page at the end of each experiment provides more information about the underlying scientific concepts. It gives the adult or teen who is working with the children a broader context for rather simple experiments. Several concepts are introduced in the 10 experiments with the intent that each one probably needs to be explored more fully for children to achieve understanding.

An extra dose of information may help you relax and enjoy the science experience. Please avoid trying to convey everything you know to the children, and don't expect them to grasp the details of each concept. You don't need to know all of facts to have an exciting science experience with children. Genuine curiosity and a willingness to explore are the real keys to success.

A Way of Teaching and Learning

In-Touch Science: Foods & Fabrics was designed using the Learning Cycle, a teaching method that engages children in active investigative science experiences. The Learning Cycle gives children time to make their own discoveries, stressing the process of science as a way of learning.

The Learning Cycle embodies a sequence of exploration, concept introduction, and concept application (see "Learning Cycle Checklist," page 6). It allows children to experience a concept by using such process skills as observation and comparison before being given vocabulary or information about the concept.
Because this method is a cycle, which means there is no distinct endpoint, the “I wonder...” statements can be the springboard for continuing the cycle’s three phases. Thorough understanding of a concept is not expected from doing just one experiment.

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 (food/fabric).
- Children are encouraged to wonder more about the experience, generating ideas for continued exploration and repetition of the cycle.


The 10 experiments were written based on the Learning Cycle. For example, here’s how it applies to experiment 1B, “Starchy Discoveries”:

**Exploration phase.** Exploration begins as children find out what happens with water, cornstarch solution, and iodine.

**Concept introduction.** The concepts of starch and chemical reaction are introduced as you discuss what happens during the initial exploration.

**Concept application.** This occurs when children test several foods and again when they discuss their experiences.

“I wonder...” statements generated from the “Starchy Discoveries” experiment could lead to further exploration. For example, one child in the field-test program wondered if meat has starch in it. Allowing the children to
continue experimenting with other foods would enable comparisons beyond fruits and vegetables. Another child wondered if there are different kinds of starch. An opportunity to read food and laundry product labels could stimulate a discussion about starch. Other experiments or cooking activities could illustrate the thickening properties of starch.

**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.

It's important to 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 to communicate what they observe, and challenge them to make relationships among observations. The ability to state relationships gives evidence of children's own understanding of reality in contrast to memorizing facts.

Each experiment contains a highlighted box, "Questions You Might Ask." The questions are intended as a guide, not a script to be followed. 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 use certain types of phrases. Thinking about questions in relation to specific science processes will promote conversation that is focused on the child's experience (see table). The 10 experiments rely heavily on basic science processes. Doing additional experiments and activities to answer "I wonder..." statements would lead to greater use of complex science processes.
## Developing Science Process Skills by Talking and Experimenting with Children

### Basic Science Processes

<table>
<thead>
<tr>
<th>Observing</th>
<th>Using the senses to gather information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Classifying</td>
<td>Ordering or grouping observations</td>
</tr>
<tr>
<td>Communicating</td>
<td>Exchanging information</td>
</tr>
<tr>
<td>Questioning</td>
<td>Raising uncertainty</td>
</tr>
<tr>
<td>Predicting</td>
<td>Stating future cause-effect relationships</td>
</tr>
<tr>
<td>Using Numbers</td>
<td>Expressing with numbers rather than words</td>
</tr>
<tr>
<td>Measuring</td>
<td>Using instruments to quantify observations</td>
</tr>
</tbody>
</table>

### Experimenting and Talking

<table>
<thead>
<tr>
<th>Observing</th>
<th>How would you describe...?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Classifying</td>
<td>Which ones contain...?</td>
</tr>
<tr>
<td>Communicating</td>
<td>How are these alike? different?</td>
</tr>
<tr>
<td>Questioning</td>
<td>I wonder why...?</td>
</tr>
<tr>
<td>Predicting</td>
<td>What do you think will happen?</td>
</tr>
<tr>
<td>Using Numbers</td>
<td>How many...?</td>
</tr>
<tr>
<td>Measuring</td>
<td>Fill the bag one-quarter full.</td>
</tr>
</tbody>
</table>

### Complex Science Processes

| Interpreting Data | Finding patterns or meaning among sets of data |
| Controlling Variables | Manipulating factors that could influence results |
| Designing Experiments | Planning data-gathering procedures to test ideas |
| Inferring | Providing explanations for events based on limited facts |

| Interpreting Data | What happened before...? after? |
| Controlling Variables | Use the same amount of force for each stroke |
| Designing Experiments | Try testing “What would happen if...?” |

| Controlling Variables | Try answering, “This happened because...” using observable data. |
Organizing Supplies

The science experiences will be more enjoyable if you have a plan for collecting, cleaning, storing, and restocking supplies. Each experiment has a “Supplies and Preparation” page that lists the items needed for that experiment, explains any preparation procedures, and suggests alternate supplies. 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. Often a trade-off was made. For example, using an old peanut butter jar instead of a resealable plastic bag would reduce the cost and potential mess of ruptured bags, but 10 plastic bags are less bulky to store than 10 jars. You are encouraged to adapt the supply lists, substituting equipment and foods that better suit your situation.

The supplies for *In-Touch Science: Foods & Fabrics* are reusable or consumable (perishable and nonperishable). Most can be purchased at local food, drug, discount, and fabric stores. See “Guide to Ordering Supplies” on page 69 for mail order sources.

*Reusable supplies* are tools that can be used several times. Examples are magnifying lenses and paring knives. Sturdy plastic spoons, knives, and cups that might be considered disposable are intended to be reused in this program. Sturdy 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, paper towels, cotton swabs, and sandpaper. Purchase fresh fruits and vegetables within a few days of doing each experiment. You will need to refrigerate or freeze some of them. If you have storage space, you may want to buy nonperishable products such as baking soda, ketchup, and coffee filters in quantity. For assistance in purchasing and preparing the yarns and fabrics, refer to the eight color-coded fabric cards at the end of this publication.
Supply Kits

Because the self-discovery nature of this program is most effective with small groups, instructions for assembling supply kits are based on 10 participants. The “Checklist for Assembling Supply Kits” on page 65 lists all of the supplies needed for doing the 10 experiments with 10 participants.

The “Checklist for Assembling Supply Kits to Loan” on page 67 excludes perishable items and groups other supplies so that you can quickly assemble a “basic” kit with only tools and fabric samples, an “extended” kit with tools, fabrics, and reusable items, 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 an older child, 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.

- Store iodine in opaque bottles.

- Use a protective covering for knives and corers.

- 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 each kit.
Monitoring Success

Adults who use the *In-Touch Science: Foods & Fabrics* program will be giving children an opportunity to explore the science of foods and fabrics 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 foods and fabrics. The 10 experiments 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 to both foods and fabrics.

The field testing showed that children were engaged by the hands-on, fun aspects of the experiments, which they readily discussed with the adults and other children. Based on their questions and "I wonder..." statements, most children connected the experiments to the science in their daily lives. Many "I wonder..." statements could be used to plan additional experiments.

Examples from the field testing included

- "I wonder if we could test foods for vitamins."
- "I wonder if this fabric has plastic in it."
- "I wonder if all detergents with enzymes have the same kind."
- "I wonder if ripe foods have more water than unripe ones."

The evaluation form on page 71 is designed to monitor the effectiveness of the teaching material. Copy as needed, using a separate form for each session. The form provides a way for you to collect both quantitative and qualitative data about the participants and activities.

The evaluation emphasizes conversation both between children and adults and among children. Participants are challenged to think about what they have observed by creating lists of "I wonder..." statements. Children may make comments about personal experiences and relationships to other events ("Oh yeah, this is like what I saw on TV," or "This is what happened to my lunch"). Or they may talk about something they plan to do ("I'm going to show my dad what happened," or "I'm going to try this with a green pepper"). Try to capture a sampling of these comments on the evaluation form.
A Preprogram Activity

If you decide to use all of the material in *In-Touch Science: Foods & Fabrics* 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. Before you start, it might be interesting to collect their ideas about science and their experiences with food and fabric.

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 might collect their ideas of how foods and fabrics (or preparing foods and wearing clothes) are related to science.

You could conclude an introductory activity by saying, “Science is part of almost everything we do. Every day we get dressed and we eat. Yet we rarely think of these routine activities as involving science. We will be doing a series of 10 experiments to find out more about the science of foods and fabrics.”
Session 1

Discovering Fibers
Starchy Discoveries

These two experiments introduce the idea of components—parts of a whole. Both fabric and food have components that are important to their use and enjoyment.

In experiment 1A, "Discovering Fibers," children examine fibers as components of fabrics. Fibers are knotted or twisted to make yarns, which are woven or knitted into fabrics. Fibers can also be pressed together to make nonwoven fabrics such as felt. Fibers are used to make clothing, carpets, tires, ski poles, and other textile products.

In experiment 1B, "Starchy Discoveries," children examine nutrients as components of foods. The human body needs nutrients to grow and be healthy. The six types of nutrients we get from food are proteins, carbohydrates, fats, vitamins, minerals, and water. Starch, a carbohydrate, is a main component of many plant foods. A healthy diet includes many plant foods—fruits, vegetables, and grains.

The two experiments encourage children to be more curious about what's in the clothes they wear and the food they eat.
Experiment 1A
Discovering Fibers

Things to Think About during the Experiment

Work together
Guide the children through the experiment by demonstrating procedures and encouraging conversation about what they are doing and observing. Use the questions as a guide, not a script to be followed.

I wonder...
Encourage children to wonder about what happened or didn’t happen while doing the experiment. For example, you might wonder

-if fibers can be scraped from the leaves of other plants.
-how many pineapple fibers it takes to make a shirt.
-how fibers are made into yarns.

Make a list of all the "I wonder..." statements that you and the children can think of together. Save the list to talk about again after completing the experiment(s).

Talk about
This experiment introduces the term "fiber." Fibers come from several sources, including plants. Fibers are knotted or twisted to form yarns, which are made into fabrics.
Focus
Show the pineapple. Say,
"Tell me something about this fruit. Describe the different parts. How are they used? Can you make anything from the leaves? Hidden in the leaves is something useful for making clothes and other textile products. Let's find out what it is."

Getting Ready to Experiment
• Remove a fresh leaf from the pineapple and soak it in warm water for at least 5 minutes.
• Work on a hard surface. Use newspaper or a plastic tablecloth to protect the work area.
• Pour water into a dishpan for rinsing leaves.

Experiment
1. Remove a fresh leaf from the pineapple and examine it.
2. Compare the fresh, dry leaf to the one that has been soaked in water.
3. Hold the base of the soaked leaf with one hand and place it on a hard surface. Scrape from the base toward the leaf tip using a plastic serrated knife.
4. After a few scrapes, rinse the leaf in water. Continue scraping and rinsing until clean, separate fibers are exposed. Examine these raw fibers and set them aside.
5. Examine one of the commercial yarns. Try to pull the yarn apart at one end. Compare the fibers with the pineapple fibers.
6. Examine, compare, and sort other commercial yarns. Compare with and without a magnifying lens.

Conversation
Questions You Might Ask
Tell me something about the leaf.
How does soaking change the leaf?
What happens when it is scraped?
What part of the leaf is revealed?
Can you bend, twist, or knot the fibers?
Tell me something about this commercial yarn.
What happens when one end is pulled apart?
How are the commercial yarns alike? different?
Can you guess if the yarn is from a plant? animal? manufactured?

Transition or Closure
If you are doing only experiment 1A, remember to review the "I wonder..." statements.
If you are doing experiments 1A and 1B together, have the children help clean up their work areas. Then shift their attention to the food experiment.
Experiment 1A
Discovering Fibers

Supplies and Preparation
Individual items are listed. Multiply as needed for total supplies. Only one pineapple is needed for both focus activities and experiments.

Focus
- fresh pineapple

Experiment
- pineapple leaf, presoaked
- pineapple leaf, fresh
- yarn, single
- yarns, various
- knife, plastic serrated
- magnifying lens
- container of warm water for soaking leaves
- dishpan of water for rinsing leaves
- newspaper or plastic tablecloth

- Be sure to buy a pineapple that has fresh, green leaves.
- Select the longest leaves from the pineapple (one leaf per person) for soaking. Keep the remaining leaves on the pineapple for children to remove, examine, and compare with the soaked leaves. Use the pineapple fruit in “Starchy Discoveries.”
- Choose one yarn for everyone to examine first. It's important to choose a yarn such as wool that separates easily into fibers (see fabric cards located in the back of this publication).

- Collect at least four or five yarns for additional comparisons. It's not important to identify them by name or origin, but be sure to provide a range of fibers, colors, sizes, and textures. Consider wool, cotton, polyester, nylon, rayon, sisal, alpaca, linen, and acrylic. Also consider string, rope, mops, knitting or weaving yarn, and crochet or sewing thread.
- Cut each of the yarns into 3-inch pieces.
- A serrated plastic knife is a good scraping tool, but any firm object will work.
Individual textile fibers can be extracted from pineapple leaves. Although these fibers are not widely known, they are used in traditional Filipino dress and in some household textiles.

Pineapple fibers are natural plant fibers. Other fibers from plants are cotton, flax (linen), ramie, jute, sisal, and abaca (Manila hemp). They are all composed of cellulose, a carbohydrate made of long chains of glucose.

Natural fibers also come to us from animals. Wool from sheep and specialty wools from rabbits (angora), goats (mohair and cashmere), alpacas, camels, and other animals have a protein structure. Silk, which comes from silkworm cocoons or spiders, is also a protein fiber.

Some fibers are manufactured from chemicals in laboratories or factories. They may be composed of cellulose, protein, synthetic polymers, or inorganic compounds. Examples are rayon, nylon, polyester, acrylic, and fiberglass.

Fibers are knotted or twisted to make yarns, which are knitted or woven into fabrics. Fibers can also be pressed together (bonded) to make nonwoven fabrics such as felt. Fabric performance properties such as durability, water absorption, and dyeability are affected by the fiber’s physical and chemical components.
Things to Think About during the Experiment

Work together
Guide the children through the experiment by demonstrating procedures and encouraging conversation about what they are doing and observing. Use the questions as a guide, not a script to be followed.

I wonder... Encourage children to wonder about what happened or didn’t happen while doing the experiment. For example, you might wonder

- what other foods contain starch.
- why raw and cooked carrots were different.
- how your body uses starch.

Make a list of all the “I wonder...” statements that you and the children can think of together. Save the list to talk about again after completing the experiment(s).

Talk about
This experiment introduces the term “starch.” Iodine is an indicator for starch, which is a major component of many plant foods. Both starch and sugar are carbohydrates, a nutrient our bodies need for good health.
Focus
Show the pineapple again. Ask,

"Have you ever eaten fresh pineapple? What do you think is in pineapple that your body uses? How are fruits and vegetables alike? different? Let's do an experiment to identify a major component of many plant foods."

Getting Ready to Experiment
• Use newspaper or a plastic tablecloth to protect the work area.
• Know safety precautions for handling iodine:
  Iodine is poisonous—Do not taste any foods. Discard all samples.
  Iodine will stain—Protect the work area, and handle iodine with care.
• Know how to handle sharp knives safely.
• Identify and compare the units of measure on a medicine measuring cup.
• Practice using the eyedropper with water.

Experiment
1. Prepare iodine solution: Fill a medicine measuring cup about one-third full (10 ml) with water. Add about five drops of iodine; mix well by stirring with an eyedropper. Set aside until steps 3 and 4 are completed.
2. Fill two medicine measuring cups about one-third full (10 ml) with water.
3. Add a pinch of cornstarch to one cup, swirling to mix.
4. Add two to three drops of iodine solution to each cup, observing what happens.
5. Cut a small sample of a fruit or vegetable to test with iodine.
6. Put one or two drops of iodine on the food sample, observing what happens.
7. Sample, test, and compare other foods.

Conversation
Questions You Might Ask
What color is the water? cornstarch solution?
What happens when you add iodine?
Why did the color change?
How could you find out if a food contains starch?
Tell me something about this food.
Do you think it contains starch?
What happened when you added iodine?
Does waiting a few seconds make any difference?
Do all parts of the food give the same results?

Closure: Connecting Food and Fabric
If you are doing only experiment 1B, review the “I wonder” statements. If you do both experiments in one session, talk with the children about how the experiments helped them to think about what’s in fabric and what’s in food. Ask, “What did you enjoy about these experiments? What did you learn about fabrics and food?”

Show the list of “I wonder...” statements for both experiments. Say, “Often when scientists do experiments, they come up with lots of new ideas or questions. Which one is the most interesting to you? How could you find out more about it?”
Experiment 1B
Starchy Discoveries

Supplies and Preparation

Individual items are listed. Multiply as needed for total supplies. Only one pineapple is needed for both focus activities and experiments.

Focus

- fresh pineapple (same one as used in experiment 1A)

Experiment

- fruits and vegetables
- iodine
- cornstarch
- pitcher of water
- newspaper or plastic tablecloth
- cups, 3 medicine measuring
- eyedropper
- knife, plastic serrated
- knife, paring
- can opener

- Purchase one of each item: apple, banana, carrot, cucumber, parsnip, potato, and a small can of mixed vegetables (any mixture that includes carrots). This selection allows children to compare a variety of fruits and vegetables, as well as fresh and cooked vegetables. It’s okay to modify the selection, but focus on comparing fruits and vegetables. Additional experiments could include other foods.

- To prepare the iodine solution in advance, skip step 1 of the experiment. Mix 10 milliliters iodine with 100 milliliters water (or about 2 teaspoons iodine with 1/4 cup water) to have enough solution for 10 people. Pour about 10 milliliters of iodine solution into a medicine measuring cup for each person.

- A dropper bottle is a good substitute for the cup and eyedropper if the mess of handling iodine is a concern. Dropper bottles are easy for children to use, but you will need to allow time for filling and cleaning them. Opaque dropper bottles minimize exposure of the iodine to light. Use the prepared solutions within two to three weeks.

- Allow children to cut their own samples of food, but be sure that everyone knows how to handle sharp knives safely.

- Half-gallon milk or juice containers are inexpensive pitchers. Fill them about half full to allow children to pour water easily.
This experiment gets children thinking about chemical components in food called nutrients. The six types of nutrients we get from food are protein, carbohydrate, fat, vitamins, minerals, and water. The body needs nutrients to function properly.

All plant foods contain carbohydrates. Some contain mostly starch; others contain mostly sugar. A starch molecule such as cellulose is a long chain of glucose molecules. Glucose is a sugar used by the body for energy. The body can break down starch but not cellulose, which has glucose linked in a different way.

Eating plenty of vegetables, fruits, and grain products is important for good health. Because starch is in many of these plant foods, it's a big part of a healthy diet.

A simple way to encourage children to think about carbohydrates in foods is to observe a chemical reaction with starch. When starch is combined with iodine, a chemical change occurs, causing the complex to become bluish-black in color. Thus iodine is an indicator for detecting the presence of starch.

During the ripening of fruit, enzymes break starch down to sugar. Many fruits continue this part of the ripening process after they are picked; other fruits such as melons, citrus, and pineapple do not store starch, so starch is converted to sugar only on the tree or vine. Testing unripe and ripe bananas with the iodine indicator is a good way to demonstrate the change from starch to sugar during ripening.

Simply cutting some raw foods is enough to disrupt cell walls and release starch. Other starchy foods must be soaked or heated before starch is released. A good comparison is a raw and canned carrot, a dry bean and a soaked or cooked bean, or unpopped and popped popcorn.
Session 2
Wear and Tear
Core Comparisons

These two experiments provide an opportunity to explore the relationship between structure and change in foods and fabrics.

In experiment 2A, "Wear and Tear," children examine the resistance of fabrics to abrasion. The chemical and physical structure of fibers and the way fibers or yarns interlace influence the durability of a fabric. One part of durability is resistance to abrasion. This is the ability of a fabric to resist wear caused by rubbing against other surfaces.

In experiment 2B, "Core Comparisons," children examine the resistance of the components in fruit to mashing. The physical and chemical structure of fruits determine their composition, texture, and digestibility. Fruits contain many parts: peels, seeds, pits, cores, juice, and fleshy tissue. Cell walls and water inside cells strengthen plant tissues and influence how easily they can be cut, mashed, and chewed.

The two experiments encourage children to be more curious about changes in fabrics and foods when wearing clothes and preparing or eating foods.

Session at a Glance
- Things to Think About during the Experiment
- Focus
- Experiment
- Transition or Closure
- Supplies and Preparation
- Behind the Scenes Science
Experiment 2A

Wear and Tear

Things to Think About during the Experiment

Work together
Guide the children through the experiment by demonstrating procedures and encouraging conversation about what they are doing and observing. Use the questions as a guide, not a script to be followed.

I wonder...
Encourage children to wonder about what happened or didn't happen while doing the experiment. For example, you might wonder

- if the diagonal patterns of the yarn make fabric durable.
- if heavy fabrics are always sturdy.
- how long jeans usually last.

Make a list of all the "I wonder..." statements that you and the children can think of together. Save the list to talk about again after completing the experiment(s).

Talk about
This experiment introduces the terms "abrasion" and "durable." Fabric that forms a hole easily when abraded is not very durable. Usually we want durable clothes. Except for a few fashion fads—like jeans with holes—we try to buy clothes that will stand up to rough work and play.
Focus
Show a raincoat, umbrella, or other article of clothing associated with repelling water. Ask,

"When might you wear this? How is it different from your T-shirt or jeans? Cotton fabric is used in lots of clothing. Let's do an experiment to find out how two cotton fabrics react to water."

Getting Ready to Experiment
- Work on a flat surface. Use newspaper or a plastic tablecloth to protect the work area.
- Identify and compare the units of measure on a medicine measuring cup.
- Practice using the eyedropper with water.

Experiment

1. Prepare the colored water solution: Fill a medicine measuring cup about one-third full (10 ml) with water. Add about five drops of food coloring; mix well by stirring with an eyedropper. Set aside until steps 2 and 3 are completed.

2. Examine the two cotton fabrics (2-x-2-inch swatches).

3. Lay a strip of aluminum foil (about 12 x 6 inches) on the work surface. Place the fabrics side by side (but not touching) on the foil.

4. Use the eyedropper to place only one drop of colored water in the center of each fabric sample. Do not disturb the drop after it touches the fabric.

5. Gently place the edge of a paper towel (about 4-x-1-inch strip) against the water drop on each fabric. Do not press down. Observe what happens.

6. Gently lift each piece of fabric. Observe or touch the aluminum foil to see if any water passed through the fabric.

7. Place a second drop of water on each fabric, checking the foil for moisture. Repeat until moisture appears on the foil beneath one fabric.

Conversation

Questions You Might Ask
Tell me something about the fabrics.
How do you think the fabrics are different?
Predict what will happen.
What did you observe with one drop of water?
What happened to the paper towels?
Did any water pass through the fabric?
What did more drops of water do?
How are the fabrics different?
Which one do you think has a water-repellent finish?
How might each fabric be used?

Transition or Closure
If you are doing only experiment 3A, remember to review the "I wonder..." statements. If you are doing experiments 3A and 3B together, have the children help clean up their work areas. Then shift their attention to the food experiment.
Experiment 3A
Drop by Drop

Supplies and Preparation
Individual items are listed. Multiply as needed for total supplies.

Focus
- rain gear

Experiment
- cotton fabric without water-repellent finish
- cotton fabric with water-repellent finish
- food coloring
- pitcher of water
- cup, medicine measuring
- eyedropper
- aluminum foil
- paper towel strips (2 per person)

- Choose identical cotton fabrics, one with and one without a water-repellent finish. If you can’t obtain water-repellent fabric, apply Scotchgard, Zepel, or another water-repellent finish to the fabric. Follow all safety instructions on the product label. Cut fabrics into 2-x-2-inch swatches (see fabric cards located in the back of this publication).

- Colored water is easier to observe on fabrics than plain water. Although any color will work, red is not recommended because it looks like blood.

- To prepare the colored water in advance, skip step 1 of the experiment. Mix 10 milliliters of food coloring with 100 milliliters of water (or about 2 teaspoons food coloring with ½ cup water) to have enough for 10 people.

- A dropper bottle is a good substitute for the cup and eyedropper if the mess of handling food coloring is a concern. Dropper bottles are easy for children to use, but allow time for filling and cleaning them.

- Consider using liquid paste color (available from cake decorators) instead of food coloring if you plan to repeat the experiment with several groups of children. This more concentrated form is often less expensive. Mix 2 milliliters of liquid paste color with 100 milliliters of water to have enough for 10 people.
Behind the Scenes Science

Absorbency is the ability of fibers to soak up water or moisture such as perspiration. Absorbency depends mostly on fiber content. Natural fibers are usually more absorbent—and thus more comfortable—than manufactured fibers. That's why we wear cotton T-shirts in the summer and sweatsuits when we exercise.

The absorbency of a fabric can be decreased by a water-repellent finish, a chemical treatment of the yarn or fabric that makes the fabric resistant to wetting. Water dropped onto the finished fabric will form a bead on the fabric's surface. The finish prevents the water from spreading and penetrating the fabric. Water-repellent fabrics are not waterproof. Large amounts of water or water that falls forcefully can eventually penetrate the fabric.

Manufacturers use trade names on clothing labels when a finish has been applied to a fabric. Some trade names for water-repellent finishes are Cravanette, Zelan, Zepel, and Scotchgard. The label will also give care instructions so that the finish will remain on the fabric.
Experiment 3B
Water Attraction

Things to Think About during the Experiment

Work together
Guide the children through the experiment by demonstrating procedures and encouraging conversation about what they are doing and observing. Use the questions as a guide, not a script to be followed.

I wonder...
Encourage children to wonder about what happened or didn’t happen while doing this experiment. For example, you might wonder

- if cooked carrots have as much water as fresh carrots.
- if anything other than salt can pull water out.
- if water can go back into food.

Make a list of all the "I wonder..." statements that you and the children can think of together. Save the list to talk about again after completing the experiment(s).

Talk about
This experiment introduces the terms “cells” and “concentration.” Plants are made up of billions of cells. Water is a major component of cells that contributes to the texture of fruits and vegetables. Water moves in and out of plant cells. One influence on the movement of water is the concentration of certain substances inside and outside the cell. Water moves from inside the fruit or vegetable to the salt on the cut surface where the concentration of salt is greater.
Focus
Show two pieces of celery—one that was left out of the refrigerator overnight and one that wasn’t. Say,

"Tell me something about these pieces of celery. How are they different? What happened to make them different? How do you think it could have happened? Water is a major component of many foods. Do you think all fruits and vegetables contain water? Let’s find out about the water in some of these foods by doing an experiment."

Getting Ready to Experiment
- Use newspapers or a plastic tablecloth to protect the work area.
- Know how to handle sharp knives safely.

Experiment
1. Choose a fruit or vegetable to test.
2. Cut two samples of the food and place them side by side.
3. Sprinkle a pinch of salt on the cut surface of one sample. Leave the other sample alone.
4. Repeat for each food to be tested. Compare results.

Conversation
Questions You Might Ask
- Tell me something about this food.
- Do you think it contains water?
- What happens to the salt?
- What happens after a few more seconds? a minute?
- Describe the two samples.
- Where did the water come from?
- Compare several foods.
- Which released more water?
- Which released water fastest?
- What happens if you put salt on the peel?
- What happens if you squeeze a sample?

Closure: Connecting Food and Fabric
If you are doing only experiment 3B, review the “I wonder” statements. If you do both experiments in one session, talk with the children about how the experiments helped them to think about the interactions of water with food and fabric. Ask, “What did you enjoy about these experiments? What did you learn about fabrics and food?”

Show the list of “I wonder…” statements for both experiments. Say, “Often when scientists do experiments, they come up with lots of new ideas or questions. Which one is the most interesting to you? How could you find out more about it?”
Experiment 3B
Water Attraction

Supplies and Preparation
Individual items are listed. Multiply as needed for total supplies.

Focus
- celery, crisp
- celery, wilted

Experiment
- fruits and vegetables
- salt
- knife, serrated plastic or paring
- newspaper

- Purchase one apple, banana, carrot, cucumber, and potato. This selection allows you to compare a variety of fruits and vegetables. Try to include one less familiar vegetable such as turnip or eggplant.

- Both salt and sugar work in this experiment. Using salt may decrease the temptation to eat the foods while experimenting.

- Allow children to cut their own samples of food. Be sure that everyone knows how to handle sharp knives safely.
Behind the Scenes Science

This experiment allows children to observe movement of water as a property of plant structure. Most plants contain a lot of water. Sometimes it's easily released such as when you squeeze a lemon or an orange. In other foods such as carrots water is less obvious because it is enclosed in many tightly packed cells that are not as easily disrupted.

Water molecules are small enough to pass in and out of cells through the wall membranes. Wilted lettuce or limp celery have lost water from their cells.

Putting salt or sugar on the surface of a plant food will draw moisture from the cells. The excess sugar outside the cells attracts water from inside the cells by a process called osmosis.

Water also moves in the reverse direction, as can be demonstrated with wilted vegetables. For example, a carrot stick left for several hours at room temperature will lose a significant amount of moisture, becoming limp. Crispness is restored when the carrot is placed in cold water. The cell contains salts, sugars, and other substances that help to attract water back into the cell. Again, osmosis is observed.
These two experiments provide an opportunity to explore how color is a part of both fabrics and foods.

In experiment 4A, “Color or Not,” children examine the process of dyeing fabric. Some fibers such as human hair come in a variety of natural colors, but others are colorless. Most fibers can be dyed to create a diverse palette of colored yarns and fabrics. The usefulness of a coloring substance to dye fabric depends on its chemical composition and the nature of the material being dyed.

In experiment 4B, “Color Changers,” children examine chemical reactions of color components in foods. Plant foods naturally contain many different chemicals that produce their varied colors. These colors change dramatically when chemicals in foods interact. Some of the chemicals that produce color in plant foods can be extracted to use as fabric dye.

The two experiments encourage children to be more curious about the colors they see in fabrics and foods.
Experiment 4A
Color or Not

Things to Think About during the Experiment

Work together
Guide the children through the experiment by demonstrating procedures and encouraging conversation about what they are doing and observing. Use the questions as a guide, not a script to be followed.

I wonder...
Encourage children to wonder about what happened or didn’t happen while doing this experiment. For example, you might wonder

if you could make the colors brighter.
why cotton became colored but nylon didn’t.
what other colors can be extracted from food.

Make a list of all the “I wonder...” statements that you and the children can think of together. Save the list to talk about again after completing the experiment(s).

Talk about
This experiment introduces the terms “dye” and “chemical reaction.” Fabrics are colored by allowing a dye to react chemically with the fibers. Not all fabrics can be colored by the same dye.
Focus
Show a plain white T-shirt and a piece of red cabbage. Ask,
"What color is the shirt? Tell me about the colors you are wearing. What color is the cabbage? Tell me about colors of foods you eat. Have you ever dyed fabric (tie-dyeing)? Do you think you could use the colors in foods to dye fabric? Let's do an experiment and find out what happens when we try to dye two different types of fabric using food."

Getting Ready to Experiment
• Work on a firm surface. Use newspapers or a plastic tablecloth to protect the work area.

Experiment
1. Tear or cut a few red cabbage leaves into small pieces. Place a handful (about 1/4 cup) into a resealable plastic bag.

2. Fill the bag about one-quarter full with hot tap water (about 1/4 cup).

3. Place one cotton and one nylon swatch (2 x 2 inches) in the bag. Push out the excess air while closing the bag. Ensure that the seal is secure.

4. Swirl and agitate for at least 5 minutes.

5. Remove the fabric from the bag and pour the dye solution into an extra container. The dye solution will be used in experiment 4B.

6. Rinse the fabric in the dishpan of cold water. Air dry on paper towels.

7. Place a handful (about 1/4 cup) of blueberries in a second resealable bag. Push out the excess air while closing the bag. Ensure that the seal is secure.

8. Crush the berries.

9. Repeat steps 2–6 for the second fabric.

Conversation
Questions You Might Ask
Tell me something about the color of the food.
What color of dye do you think the food will make?
Predict what color the fabrics will be.
How are the fabrics alike? different?
What happens as you handle the bag?
What would happen if you didn’t crush the food?
What would happen if you used cold water?
What color is the fabric before rinsing? after rinsing?
Describe how the color compares to your prediction.

Transition or Closure
If you are doing only experiment 4A, remember to review the "I wonder..." statements. If you are doing experiments 4A and 4B together, have the children help clean up their work areas. Then shift their attention to the food experiment.
Experiment 4A
Color or Not

Supplies and Preparation

Individual items are listed. Multiply as needed for total supplies.

Focus
- white T-shirt or fabric
- piece of red cabbage

Experiment
- red cabbage
- blueberries or cranberries
- cotton fabric (2 per person)
- nylon fabric (2 per person)
- plastic bags, resealable (2 per person)
- pitcher of hot water
- dishpan of cold water
- containers for saving dye solutions
- knife (optional)
- newspaper or plastic tablecloth
- paper towels

- Blueberries (or cranberries) can be fresh or frozen. Canned cranberry sauce works, but the color is less vibrant; reduce water to 1 tablespoon.
- Cut 2-x-2-inch swatches of 100 percent cotton and 100 percent nylon fabrics. See the fabric cards in the back of this publication for examples.
- Smaller pieces of food release colors more quickly than larger pieces. You may prefer to have an adult shred the cabbage with a grater, knife, or blender and give each child a portion.
- Cut leftover cabbage into wedges and freeze for additional experiments; use within six months.
- Food storage bags are usually sturdier than sandwich bags and will withstand strong agitation. The type with a color-change closure makes it easy to tell when the bags are sealed. Keep the bags over the work area.
- Peanut butter jars or other containers with tight-fitting lids are good substitutes for the bags.
- Hot water releases the food pigment faster than cooler water. It may help if an adult pours the hot water into each child's bag.
- If your facility does not have hot water, bring it in a thermos or heat cold water using a hot pot, electric kettle, or hot plate. **Do not use boiling water.**
- Half-gallon milk or juice containers work well as water containers.
- One dishpan serves four or five people for rinsing fabrics.
- The dye solutions saved for experiment 4B can be refrigerated or frozen. If refrigerated, use within one week; if frozen, use within one month.
Behind the Scenes Science

Most fabrics obtain their color from dyes, which are extracted from plants, animals, and minerals or manufactured from chemicals. Dyes react chemically with fibers, diffusing into the fibers’ interior. If the chemicals in the dyes do not connect with the chemicals in the fibers, the color will wash out of the cloth. Because fibers and dyes have many different chemical compositions, only some classes of dyes will react and color certain types of fibers. And no two batches of natural dyes are ever identical in color and strength.

A natural plant dye is called a pigment when it’s still inside the plant. Plants contain three types of pigments: carotenoids, chlorophylls, and flavonoids. An example of each is the orange of carrots, the green of spinach, and the blue of blueberries.

Only flavonoids can be extracted easily with water from the plant cells. Of the many types of flavonoids, the anthocyanins are the most colorful. They are the red, purple, or blue pigments in many fruits and vegetables, such as blueberries, cherries, red apples, and the dark purple skin of eggplant.

The location and chemical structure of plant pigments influence how easily they can be extracted. Red cabbage, for example, gets its color from the anthocyanin in the cells on the leaf’s surface. The pigment is easily extracted in warm water to become a fabric dye.

Dyeing conditions such as water temperature, length of exposure, and acidity or alkalinity of the dye bath all affect the color and color stability of the dyed fiber or fabric.
Experiment 4B
Color Changers

**Things to Think About during the Experiment**

**Work together**
Guide the children through the experiment by demonstrating procedures and encouraging conversation about what they are doing and observing. Use the questions as a guide, not a script to be followed.

**I wonder...**
Encourage children to wonder about what happened or didn’t happen while doing this experiment. For example, you might wonder

- what causes the colors to change.
- what causes the fizz with baking soda.
- if the color in purple grape drink and juice is the same.

Make a list of all the "I wonder..." statements that you and the children can think of together. Save the list to talk about again after completing the experiment(s).

**Talk about**
This experiment introduces the terms “chemical,” “chemical reaction,” and “acidity.” Fruits and vegetables contain chemicals that give them their characteristic colors. These chemicals can interact with other chemicals, producing a reaction that is observed as a new color.

The reaction is caused by the relative acidity of the interacting chemicals. All fruits and vegetables are at least slightly acidic, and this property affects color, flavor, and texture. Note: Do not expect children to develop an understanding of acidity from doing this experiment. Rather, the goal is to introduce the terms and let them realize that foods have components that can interact and cause chemical reactions.
Focus
Say,
“In the last experiment we extracted color from two foods and used them as fabric dyes. Because the coloring substances are chemicals, they interact with other chemicals to produce color changes. Let's experiment with food ingredients to see how that can happen.”

Getting Ready to Experiment
• Use newspapers or a plastic tablecloth to protect work area.
• Practice using the eyedropper with water.

Experiment
1. Pour 2 tablespoons of grape juice into a 9-ounce plastic cup.
2. Pinch the center part of the coffee filter and pull the rounded edges downward to form a cone. Set the rounded edges into the cup of grape juice. Set aside to allow the juice to penetrate the paper (at least 1 minute).
3. Prepare the following test solutions in 3-ounce plastic cups:
   a. 2 tablespoons (one medicine measuring cupful) of vinegar
   b. about half a plastic spoonful of baking soda in 2 tablespoons of water.
4. Pour water into a 3-ounce plastic cup for rinsing the eyedropper.
5. Remove the filter paper from the grape juice and spread it onto a paper towel.
6. Using an eyedropper, place one or two drops of baking soda solution on the purple paper. Rinse the eyedropper in water.
7. Place one or two drops of vinegar on the purple paper. Then place a drop on the baking soda spot.
8. Continue testing baking soda, vinegar, and grape juice on the filter paper, rinsing the eyedropper between solutions.
9. Using one of the dye solutions from experiment 4A, repeat steps 1 and 2. Then repeat steps 5–8.
10. Repeat step 9 with the second dye solution from experiment 4A.

Conversation
Questions You Might Ask
Tell me something about these solutions.
What color is the paper?
What happens if you add baking soda?
What happens if you add vinegar?
What happens if you add more grape juice?
Describe the color changes you observe.
What causes the color to change?
What could happen when you cook red cabbage?
What other juices or solutions could you try?

Closure: Connecting Food and Fabric
If you are doing only experiment 4B, review the “I wonder” statements. If you do both experiments in one session, talk with the children about how the experiments helped them to think about the colors of fabric and food. Ask, “What did you enjoy about these experiments? What did you learn about fabrics and foods?”

Show the list of “I wonder. . .” statements for both experiments. Say, “Often when scientists do experiments, they come up with lots of new ideas or questions. Which one is the most interesting to you? How could you find out more about it?”
Experiment 4B
Color Changers

Supplies and Preparation
Individual items are listed. Multiply as needed for total supplies.

Focus
no materials needed

Experiment

- purple grape juice
- dye solutions from experiment 4A
- water
- baking soda
- vinegar
- coffee filter paper
- eyedropper

- cups, 9-oz. plastic (3 per person)
- cups, 3-oz. plastic (3 per person)
- cup, medicine measuring
- plastic spoon
- newspaper or plastic tablecloth
- paper towels

- White grape juice or nonjuice drinks won't work because they don't contain the anthocyanin pigment.
- Round coffee filter paper is preferred, but other types can be substituted.
- Save about 1/4 cup of the juice for experiment 5A, "Stain Away".
This experiment lets children explore the chemical nature of colors in foods. The red, purple, or blue colors of the anthocyanin pigments change easily when their environment becomes more or less acidic.

The pigment in grape juice is purple because the grapes contain many naturally occurring acids. A solution of baking soda is not at all acidic and, in fact, reacts with acids to reduce the level of acidity. This reaction produces a color change. Vinegar is a very acidic solution. Because grape juice is also fairly acidic, you probably won’t observe much color change when vinegar and grape juice are combined.

The “Color Changers” experiment allows children to mix grape juice, vinegar, and baking soda in various ways to observe a chemical reaction. It can be continued using the red cabbage and blueberry solutions from the “Color or Not” experiment. Red cabbage is different from most fruits and vegetables because it is only slightly acidic. The vinegar (high acid) will produce pinks, and the baking soda (no acid) will produce blues and greens. Other foods that could be tested include cranberry, raspberry, blackberry, strawberry, cherry, and pomegranate.

Acids are chemicals that occur naturally in plant foods. All fruits and vegetables are at least slightly acidic. This property affects color, flavor, and texture of a food and its interactions with other foods during cooking.

Don’t expect children to develop a complete understanding of acid/base concepts from this experiment. Rather, they can begin to realize that foods have components that create chemical reactions.
These two experiments give children an opportunity to explore enzymes and their effects when laundering clothes and preparing foods. Both experiments integrate concepts introduced in previous experiments: parts of a whole, structure and change, properties of water, and chemical reactions.

In experiment 5A, “Stain Away,” children make food stains on cotton fabrics and then observe the action of enzymes by trying to remove the stains with different detergents. This logically follows experiment 4A because stains are simply misplaced dyes. In experiment 5B, “Gelling Discovery,” children observe the action of enzymes by making gelatin with different fruits.

Enzymes are substances that initiate many chemical reactions. They are components of many foods and laundry products. Using detergents that contain enzymes will make it easier to remove some stains. Using fruits that contain certain enzymes will prevent gelatin from setting.

The two experiments encourage children to be more curious about the many physical and chemical reactions that occur in foods and fabrics. These experiments are more challenging than the previous ones because each integrates several concepts and requires more manipulation of supplies.
Plan Ahead

This session requires more planning than the others. Separating the experiments into two sessions may make a better experience for some children, but you will need to plan conversation or an activity for the 10-minute waiting periods.

These two experiments can be done successfully in a one-hour session, but you may want to allow 15 to 20 extra minutes the first time you do it. You will need two work areas: one for the fabric experiment and one for the food experiment. Each experiment contains one 10-minute waiting period, so you will be making the following transitions during the hour:

Stop after step 3 of experiment 5A.
Go to step 1 of experiment 5B.
Stop after step 8 of experiment 5B.
Go to step 4 of experiment 5A.
Stop at the end of experiment 5A.
Go to step 9 of experiment 5B.

Things to Think About during the Experiment

Work together

Guide the children through the experiment by demonstrating procedures and encouraging conversation about what they are doing and observing. Use the questions as a guide, not a script to be followed.

I wonder...

Encourage children to wonder about what happened or didn't happen while doing this experiment. For example, you might wonder:

- why some stains didn't come out.
- if more washing would remove the stains.
- what would happen with hotter water.

Make a list of all the "I wonder..." statements that you and the children can think of together. Save the list to talk about again after completing the experiment(s).

Talk about

This experiment introduces the terms "stain," "detergent," "oxygen bleach," and "enzymes." A stain results when a substance reacts chemically with fabric to create a spot of unwanted color. All stains are difficult to remove. A detergent is a cleaning product that helps remove soils and stains from fabric. Enzymes and oxygen bleach in detergents enhance removal of some stains. Different stains require different treatments. Try to provide one or more detergent labels for children to read and compare.
Focus
Show a stained article of clothing or fabric. Say,

"Tell me something about this T-shirt. What might have caused this stain? What could you use to get out stains? We're going to make some food stains on cotton fabric. Then we'll do an experiment to try getting them out with different detergents."

Getting Ready to Experiment
• Use newspapers or a plastic tablecloth to protect the work area.

• Mark two cotton fabric samples (4-x-4-inch swatches) as shown. Each sample is divided into four parts, labeled K (ketchup), M (mustard), G (grape juice), and S (soy sauce).

• Know how to handle detergents safely.

Experiment
1. Using a cotton swab, apply a small amount of ketchup to each fabric sample. Rub the ketchup firmly into the fabric, making a stain about the size of a quarter.

2. Repeat step 1 using a clean swab for mustard, grape juice, and soy sauce.

3. Allow the stains to set for at least 10 minutes.

4. Prepare two "washing machines." Place about 1/2 teaspoon of a detergent that contains cleaning enzymes and oxygen bleach (such as Tide with bleach) in a resealable bag labeled "E & B." In an unlabeled bag place 1/2 teaspoon of a detergent that does not contain enzymes or bleach (such as Arm & Hammer).

5. Add hot tap water to fill one detergent bag about one-quarter full (about 1/2 cup). Place one stained fabric in the bag. Push out the excess air while closing the bag. Set aside and repeat with the second bag, adding the other stained fabric.

6. Check that the bag seals are secure. Squeeze, roll, or shake the bags gently for 5 minutes to simulate a washing machine. Keep the bags over your work area.

7. Open one bag and remove the fabric sample. Pour the detergent water into a sink or dump container.

8. Spread out the empty bag and lay a paper towel on top of it.

9. Rinse the fabric in a dishpan of cool water. Spread the fabric on the paper towel to dry. The empty bag under the towel reminds you which detergent was used.

10. Repeat steps 7–9 with the second bag and fabric sample.

Transition or Closure
If you are doing only experiment 5A, remember to review the "I wonder..." statements. If you do experiments 5A and 5B together, move to Focus 5B and the food experiment after step 3 of the fabric experiment (see "Plan Ahead" on page 54).
Supplies and Preparation

Individual items are listed. Multiply as needed for total supplies.

Focus

- stained piece of clothing or fabric

Experiment

- cotton fabric swatches (2 per person)
- permanent pen or marker
- ketchup
- grape juice
- mustard
- soy sauce
- cotton-tipped swabs
- resealable plastic bags (2 per person)
- detergent without enzyme and bleach
- detergent with enzyme and bleach
- plastic spoon
- pitcher of hot tap water
- dishpan of cool water (2 per group)
- paper towels
- newspaper or plastic tablecloth

- Cut 4-x-4-inch swatches of cotton plain weave fabric (see fabric cards located in the back of this publication).

- Have the children mark the fabric as described (p. 55). You may choose to provide premarked fabric.

- Individual packets of ketchup, mustard, and soy sauce are convenient.

- If children have difficulty handling both ends of the cotton swabs, cut the swabs in half.

- Food storage bags are usually sturdier than sandwich bags and will withstand enthusiastic agitation. The type with a color-change closure makes it easy to tell when the bags are sealed.

- Peanut butter jars or other containers with tight-fitting lids are good substitutes for bags.

- Choose two types of detergent, one without enzymes and bleach and one without. Tide with bleach and Dreft are examples of detergent with cleaning enzymes and oxygen bleach. Arm & Hammer, Ivory Snow, and All are examples of detergent without cleaning enzymes and oxygen bleach. Detergents with only cleaning enzymes include Wisk, Bold, Cheer, Tide, ERA, and Surf. A detergent with only oxygen bleach is Bright Water. Read labels carefully because ingredients change often.

- You may choose to prefill detergent bags. Each bag should contain about 1/2 teaspoon of detergent. Label one bag “E&B” (enzyme and bleach).

- Detergents may irritate the skin. Avoid extended contact with detergent, and rinse hands in clean water after the experiment. Disposable plastic gloves may be helpful for people with skin sensitivities.

- Half-gallon milk or juice containers work well for pouring warm water.
Staining is the unwelcome appearance of color on a fabric. Stains come from many sources, especially food. Different foods create stains of different colors and different degrees of tenacity. All stains are the result of a chemical reaction between the staining substance and the fabric. And all stains are a challenge to remove.

How much of a challenge depends on the chemical nature of the fiber and food, the length of time the stain has set, and the staining, storage, and cleaning conditions. The standard advice for removing stains is to follow the "three P's of stain removal"—promptness, patience, and perseverance. Using the correct cleaning product may mean that you can skimp just a little on the three P's.

Stains differ from common laundry soils, which do not react chemically with the fibers and are easier to remove. For example, rinsing in water will remove an ordinary water-soluble soil such as sugar. Soaps or detergents will remove soils that do not dissolve in water such as oil, clay, proteins, and some dyes. Soaps and detergents aid cleaning by lowering the water's surface tension. Decreased surface tension allows the water quickly to wet and penetrate the fabric. Detergents then loosen, emulsify, and suspend soils by forming a bridge between the water and the insoluble soils. As the wash water goes down the drain, it drags along the detergent and the detergent drags along the soil.

Stain removal requires stronger products such as cleaning enzymes, bleach, or specialty solvents. Cleaning enzymes are included in some detergents and presoak products. They break stains into simpler forms that can then be attacked by detergents. Chlorine and oxygen bleaches whiten, brighten, and loosen soils from fabrics. They break the connection between the stain and the fiber or they render the stain colorless through oxidation. Oxygen bleach is added to some detergents; it is also sold as a separate product (nonchlorine or all-fabric bleach). Chlorine bleach is not added to detergent; it is sold separately. All bleaches can damage fabric. To minimize damage, carefully follow the manufacturer's directions printed on the product label. Specialty solvents for stubborn stains such as mustard and rust are also available.
Experiment 5B
Gelling Discovery

Things to Think About during the Experiment

Work together
Guide the children through the experiment by demonstrating procedures and encouraging conversation about what they are doing and observing. Use the questions as a guide, not a script to be followed.

I wonder...
Encourage children to wonder about what happened or didn’t happen while doing this experiment. For example, you might wonder

- what would happen if you heated kiwi.
- what other fruits cause gelatin not to gel.
- why fruits have enzymes.

Make a list of all the "I wonder..." statements that you and the children can think of together. Save the list to talk about again after completing the experiment(s).

Talk about
This experiment introduces the terms “gelatin,” “gel,” and “enzyme.” Gelatin is a protein product. After the granules swell and dissolve in water, the gelatin forms a semi-rigid gel. Fruits contain many enzymes. One type of enzyme breaks down protein, thus preventing gelatin from setting (gelling).
Focus
Show a box of powdered gelatin. Say,

"Tell me something about this. Have you ever prepared gelatin? How does it change after setting in the refrigerator? What can you add to it? (fruits, vegetables) Let's do an experiment to find out what happens when you mix different fresh fruits with gelatin."

Getting Ready to Experiment

• Use newspapers or a plastic tablecloth to protect the work area.
• Know how to handle sharp knives safely.

Experiment
1. Pour 2 tablespoons of cold water into a 9-ounce plastic cup.
2. Sprinkle a small spoonful (about 1 teaspoonful or half a packet) of unflavored gelatin over the cold water. Let stand about a minute, observing what happens.
3. Add ¼ cup hot water (two medicine measuring cupfuls) to the gelatin. Stir until completely dissolved.
4. Divide the gelatin solution evenly among the four 3-ounce cups. Set the 9-ounce cup aside to use again in step 7.
5. Cut a small chunk of fresh pineapple, kiwi, and banana.
6. Add the fresh pineapple to the first cup, kiwi to the second cup, banana to the third cup, and a piece of canned pineapple to the fourth cup.
7. Make ice baths from four 9-ounce cups. Fill each about half full with cold water and add two ice cubes.
8. Place each 3-ounce cup of gelatin into one of the ice baths. Let stand at least 10 minutes.
9. Remove the small cups from the ice baths. Jiggle each cup to compare the firmness of gelatin mixtures.
10. Pour the contents of each cup onto a paper towel, using a knife as needed to loosen the mixture. Examine the mixtures.

Conversation

Questions You Might Ask
What happens when you add gelatin to cold water?
What happens when you add hot water?
What would happen if you didn’t stir the mixture?
Tell me something about the fruits.
What do you think will happen after 10 minutes?
What happened with each sample?
Why do you think this happened?
How are fresh and canned pineapple different?
What would happen if you heated kiwi?
What other fruits could you test?

Closure: Connecting Food and Fabric
If you are doing only experiment 5B, remember to review the "I wonder..." statements. If you do both experiments in one session, talk with the children about how the experiments helped them to think about enzymes and the physical and chemical reactions that occur with food and fabrics. Ask, "What did you enjoy about these experiments? What did you learn about fabrics and foods?"

Show the list of "I wonder..." statements for both experiments. Say, "Often when scientists do experiments, they come up with lots of new ideas or questions. Which one is the most interesting to you? How could you find out more about it?"
Experiment 5B
Gelling Discovery

Supplies and Preparation
Individual items are listed. Multiply as needed for total supplies.

Focus
- box of gelatin

Experiment
- fruit
- unflavored gelatin
- pitcher of cold water
- pitcher of hot water
- ice cubes
- plastic spoon
- knife, plastic serrated or paring
- 3-ounce plastic cups (4 per person)
- 9-ounce plastic cups (4 per person)
- can opener
- paper towels
- newspapers or plastic tablecloth

- Purchase one of each: fresh pineapple, canned pineapple, kiwi, and banana.
- We recommend using the above foods for the first experience, but the following substitutions are possible: fresh and cooked kiwi instead of fresh and canned pineapple; cooked fresh pineapple for canned pineapple. Cut 10 small pieces of kiwi or fresh pineapple and microwave about 1 minute. These substitutions are not recommended for the first experience because freshness of the fruit and cooking time or temperature influence results. You may have to “mess around a bit” to observe differences.
- Unflavored gelatin will set faster than flavored gelatin products. One package contains about two teaspoons, which is enough for two participants. Because children may be less familiar with unflavored gelatin, you may want to use flavored gelatin for the focus activity.
- It is not important to measure exactly 1 teaspoon of gelatin. A small plastic spoon works well as a measuring tool.
- Gelling time is minimized by using an ice bath and making small batches of gelatin. The proportions of water and gelatin and the water temperature were altered from package directions to make it easy for each child to prepare samples.
- An adult could pour the hot water.
- Store the ice cubes in a small cooler or ice bucket if a freezer is not convenient.
- Half-gallon milk or juice containers work well for pouring both hot and cold water.
Behind the Scenes Science

After exploring the role of enzymes in laundry detergent, this experiment shows children that enzymes are also in foods. This experiment examines one type of enzyme in fruits that prevents gelatin from setting.

Enzymes are biological substances (usually proteins) found in plants and animals that initiate a wide variety of reactions. The actions of some enzymes influence how we handle, store, and prepare foods. Enzyme reactions include browning of cut fruits, flavor changes in fruits and vegetables, and the breakdown of protein that prevents gelling of a gelatin mixture.

Fresh pineapple is the fruit most commonly known for having an enzyme (bromelin) that prevents gelatin from setting. Other fresh fruits and the enzymes that prevent gelling are kiwi (actinidin), papaya (papain), and figs (ficin). Only the papain in unripe papaya prevents gelatin from setting. Because heat inactivates the enzyme, cooked or canned fruit can be successfully mixed in gelatin.

The "Gelling Discovery" experiment provides opportunities for many observations in addition to enzyme activity. The process of making gelatin involves interaction of a powdered substance with water. Dried gelatin is allowed time to swell in cold water. This swelling increases the ease with which gelatin can be dispersed when hot water is added. Hot water and stirring help to dissolve the dry gelatin particles thoroughly by creating the framework for a semirigid gel to form when the mixture cools.
The supplies listed at right are needed to assemble one 10-person supply kit. Supplies are grouped as tools, fabric, food, and other supplies. The “quantity” column indicates amounts needed for 10 participants. The “experiment” column indicates when the items are used.

Because the tools are washed and reused, quantities are not separated by experiment number. For example, ten 10-ounce plastic cups are needed in experiment 1A, but 40 are needed in experiment 5B. Thus the greatest number of cups needed in any one experiment is the quantity needed for a 10-person kit.

The amounts needed for each experiment are listed for supplies that must be restocked. To make shopping easier, perishable foods are grouped by experiment number. If you complete the 10 experiments within two to three weeks, you could purchase most of the food supplies in one shopping trip.

To keep small items organized, place them in resealable bags or envelopes labeled with item name, quantity, and experiment number in the case of fabric samples. For safety, store paring knives and apples corers in a box or other container.

---

### Checklist for Assembling Supply Kits

**Item** | **Quantity** | **Experiment(s)**
--- | --- | ---
**Tools**
- apple corers | 10 | 1B
- cups, plastic, 9-oz. | 40 | 1A, 4B, 5B
- cups, plastic, 3-oz. | 40 | 5B
- cups, medicine measuring | 30 | 1B, 4B, 5B
- eyedroppers | 10 | 1B, 3A, 4B
- knives, paring | 5 | 1B, 3B, 5B
- knives, serrated plastic | 10 | 1A, 1B, 3B, 4A, 5B
- magnifying lenses | 10 | 1A, 2A
- spoons, plastic | 10 | 5A, 5B

**Fabric (yardage based on 45-inch width)**
- yarn, single (cut into 10 pieces) | 1 yard | 1A
- yarn, mixed (cut into 10 pieces) | 1 yard of each | 1A
- cotton, plain weave (10 2-x-6-inch strips) | 1/4 yard | 2A
- cotton, twill weave (10 2-x-6-inch strips) | 1/4 yard | 2A
- cotton, with finish (10 2-inch squares) | 1/16 yard | 3A
- cotton, without finish (10 2-inch squares) | 1/16 yard | 3A
- cotton, knit (20 2-inch squares) | 1/16 yard | 4A
- nylon (20 2-inch squares) | 1/16 yard | 4A
- cotton, plain weave (20 4-inch squares) | 1/4 yard | 5A

**Food (nonperishable)**
- baking soda | 2 tablespoons | 4B
- cornstarch | 1 tablespoon | 1B
- gelatin, unflavored | 5 packets | 5B
- ketchup | 2 packets* | 5A
- mustard | 2 packets* | 5A
- soy sauce | 2 packets* | 5A
- vinegar | 1 1/4 cups | 4A

*single-serving packets
### Other supplies to purchase and prepare

<table>
<thead>
<tr>
<th>Item</th>
<th>Quantity</th>
<th>Experiment(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>aluminum foil (to make 10 strips)</td>
<td>5 square feet</td>
<td>3A</td>
</tr>
<tr>
<td>coffee filter paper</td>
<td>30 papers</td>
<td>4B</td>
</tr>
<tr>
<td>detergent, with enzyme</td>
<td>2 tablespoons</td>
<td>5A</td>
</tr>
<tr>
<td>detergent, without enzyme</td>
<td>2 tablespoons</td>
<td>5A</td>
</tr>
<tr>
<td>food coloring</td>
<td>1/4 fluid ounce</td>
<td>3A</td>
</tr>
<tr>
<td>iodine</td>
<td>1/4 fluid ounce</td>
<td>1B</td>
</tr>
<tr>
<td>paper towels (to make 20 strips)</td>
<td>2 sheets</td>
<td>3A</td>
</tr>
<tr>
<td>paper towels</td>
<td>10-30 sheets</td>
<td>4B</td>
</tr>
<tr>
<td>plastic bags, resealable</td>
<td>40 bags</td>
<td>4A, 5A</td>
</tr>
<tr>
<td>sandpaper (to make 20 strips)</td>
<td>2 sheets</td>
<td>2A</td>
</tr>
<tr>
<td>swabs, cotton-tipped</td>
<td>20 swabs</td>
<td>5A</td>
</tr>
<tr>
<td>tape, masking</td>
<td>20 pieces</td>
<td>2A</td>
</tr>
<tr>
<td><strong>Other supplies to gather</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>can opener</td>
<td>1</td>
<td>1B, 5B</td>
</tr>
<tr>
<td>dishpans</td>
<td>2 and as needed for cleanup</td>
<td>1A, 4A, 5A</td>
</tr>
<tr>
<td>ice cubes</td>
<td>40</td>
<td>5B</td>
</tr>
<tr>
<td>water, hot</td>
<td></td>
<td>4A, 5A, 5B</td>
</tr>
<tr>
<td>water, cold</td>
<td></td>
<td>4A, 4B, 5A, 5B</td>
</tr>
<tr>
<td>newspapers</td>
<td>as needed to protect work surface</td>
<td></td>
</tr>
<tr>
<td>paper towels</td>
<td>as needed for cleanup</td>
<td></td>
</tr>
<tr>
<td>plastic tablecloth</td>
<td>as needed to protect work surface</td>
<td></td>
</tr>
<tr>
<td>plastic milk jugs</td>
<td>as needed to hold water</td>
<td></td>
</tr>
<tr>
<td>sponge or rag</td>
<td>as needed for cleanup</td>
<td></td>
</tr>
<tr>
<td>coffee can or other container</td>
<td>1 or 2 as needed to discard waste</td>
<td></td>
</tr>
</tbody>
</table>

### Food (fruits and vegetables)

<table>
<thead>
<tr>
<th>Item</th>
<th>Quantity</th>
<th>Experiment(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>pineapple, fresh</td>
<td>1</td>
<td>1A</td>
</tr>
<tr>
<td>apple</td>
<td>1</td>
<td>1B</td>
</tr>
<tr>
<td>banana</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>carrot</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>cucumber</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>parsnip</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>potato</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>vegetables, mixed</td>
<td>1 can</td>
<td></td>
</tr>
<tr>
<td>apple</td>
<td>10</td>
<td>2B</td>
</tr>
<tr>
<td>banana</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>kiwi</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>mango (or other)</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>apple</td>
<td>1</td>
<td>3B</td>
</tr>
<tr>
<td>banana</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>carrot</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>cucumber</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>potato</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>turnip (or other)</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>blueberries</td>
<td>1 frozen bag</td>
<td>4A</td>
</tr>
<tr>
<td>red cabbage</td>
<td>1 head</td>
<td></td>
</tr>
<tr>
<td>purple grape juice</td>
<td>2 cups</td>
<td>4B</td>
</tr>
<tr>
<td>purple grape juice</td>
<td>1/4 cup</td>
<td>5A</td>
</tr>
<tr>
<td>banana</td>
<td>1</td>
<td>5B</td>
</tr>
<tr>
<td>kiwi</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>pineapple, canned</td>
<td>10 small pieces</td>
<td></td>
</tr>
<tr>
<td>pineapple, fresh</td>
<td>10 small pieces</td>
<td></td>
</tr>
</tbody>
</table>
In-Touch Science: Foods & Fabrics

Checklist for Assembling Supply Kits to Loan

Wash and Repack
Indicate if any are missing

<table>
<thead>
<tr>
<th>Item labeled in bags or boxes</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>apple corers</td>
<td>10</td>
</tr>
<tr>
<td>cups, plastic, 9-ounce</td>
<td>40</td>
</tr>
<tr>
<td>cups, plastic, 3-ounce</td>
<td>40</td>
</tr>
<tr>
<td>cups, medicine measuring cups</td>
<td>30</td>
</tr>
<tr>
<td>eyedroppers</td>
<td>10</td>
</tr>
<tr>
<td>knives, paring</td>
<td>5</td>
</tr>
<tr>
<td>knives, serrated plastic</td>
<td>10</td>
</tr>
<tr>
<td>magnifying lenses</td>
<td>10</td>
</tr>
<tr>
<td>plastic spoons</td>
<td>10</td>
</tr>
</tbody>
</table>

Fabric (labeled by experiment number)
Repack bags and envelopes with any unused supplies.

<table>
<thead>
<tr>
<th>Item</th>
<th>Quantity</th>
<th>Experiment(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>yarn, single</td>
<td>1 yard</td>
<td>1A</td>
</tr>
<tr>
<td>yarn, mixed</td>
<td>1 yard of each</td>
<td></td>
</tr>
<tr>
<td>cotton, plain weave</td>
<td>1/6 yard</td>
<td>2A</td>
</tr>
<tr>
<td>cotton, twill weave</td>
<td>1/8 yard</td>
<td></td>
</tr>
<tr>
<td>cotton, with finish</td>
<td>1/8 yard</td>
<td>3A</td>
</tr>
<tr>
<td>cotton, without finish</td>
<td>1/8 yard</td>
<td></td>
</tr>
<tr>
<td>cotton, knit</td>
<td>1/8 yard</td>
<td>4A</td>
</tr>
<tr>
<td>nylon</td>
<td>1/8 yard</td>
<td></td>
</tr>
<tr>
<td>cotton, plain weave</td>
<td>1/4 yard</td>
<td>5A</td>
</tr>
</tbody>
</table>
Other Supplies

Repack original containers with any unused supplies.

<table>
<thead>
<tr>
<th>Item labeled in bags or boxes</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>aluminum foil</td>
<td>1 box</td>
</tr>
<tr>
<td>baking soda</td>
<td>1 box</td>
</tr>
<tr>
<td>coffee filter paper</td>
<td>1 box</td>
</tr>
<tr>
<td>condiments: ketchup, mustard, soy sauce</td>
<td>2 single-serving packets each</td>
</tr>
<tr>
<td>cornstarch</td>
<td>1 box</td>
</tr>
<tr>
<td>detergent, with enzyme and bleach</td>
<td>1 bag or small box</td>
</tr>
<tr>
<td>detergent, without enzyme and bleach</td>
<td>1 bag or small box</td>
</tr>
<tr>
<td>food coloring</td>
<td>1 bottle</td>
</tr>
<tr>
<td>iodine</td>
<td>1 bottle</td>
</tr>
<tr>
<td>sandpaper</td>
<td>2 sheets</td>
</tr>
<tr>
<td>swabs, cotton-tipped</td>
<td>1 box</td>
</tr>
<tr>
<td>vinegar</td>
<td>1 bottle</td>
</tr>
</tbody>
</table>

Supplies Not Provided

- can opener
- coffee can or other container
- dishpans
- food items
- ice cubes
- newspapers
- paper towels
- plastic bags, resealable
- plastic milk jugs
- plastic tablecloth
- sponge or rag
- tape, masking
- water
Most of the supplies used in *In-Touch Science: Foods & Fabrics* can be purchased at local food stores, drugstores, discount stores, and fabric stores. These or similar mail order sources may be useful if you are assembling several supply kits or have difficulty finding supplies.

**Aldrich Chemical Co.**  
1001 W. St. Paul Ave.  
Milwaukee, WI 53233  
800-558-9160  
Dropper bottles (noted as an alternative to eyedroppers and cups in experiments 1B and 3A)

**Central Restaurant Supply**  
Syracuse, NY 13208  
800-244-6848  
Knives, cylindrical corers, and other kitchen supplies

**Delta Education**  
Hands-On Science K–8 catalog  
800-442-5444  
Magnifying lenses, eyedroppers, medicine measuring cups, and other basic science equipment

**Nasco**  
901 Janesville Ave.  
P.O. Box 901  
Fort Atkinson, WI 53538-0901  
800-558-9595  
Cylindrical corers

**Test Fabrics**  
200 Blackford Avenue  
P.O. Box 420  
Middlesex, NJ 08846-0420  
Phone: 908-469-4446  
Fax: 908-469-1147  
Many types of fabrics. Because these fabrics are "test" quality (designed to yield reproducible experimental results), they are more expensive than those purchased from fabric stores.
Copy as needed, using separate forms for each session.

**Sessions and Experiments**

- 30-minute session with one experiment
- 60-minute session with two experiments
- Other
  - Session 1  1A Discovering Fibers • 1B Starchy Discoveries
  - Session 2  2A Wear and Tear • 2B Core Comparisons
  - Session 3  3A Drop by Drop • 3B Water Attraction
  - Session 4  4A Color or Not • 4B Color Changers
  - Session 5  5A Stain Away • 5B Gelling Discovery

**Participation**

Number of participants:
- Adults _____
- Children _____

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
- Community youth program
- Camp
- Museum
- Other ______________
Children’s Interest and Conversation

<table>
<thead>
<tr>
<th></th>
<th>Low</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5 (high)</th>
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</thead>
<tbody>
<tr>
<td>Level of interest</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Amount of conversation among children</td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>Amount of conversation with you</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Children’s Ideas and Comments

List sample “I wonder...” statements:

Other comments:

Adult’s Ideas and Comments

<table>
<thead>
<tr>
<th></th>
<th>Low</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5 (high)</th>
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</thead>
<tbody>
<tr>
<td>Prior knowledge of this session’s topic</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Comfort level using this teaching approach</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age appropriateness of materials/procedures</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Difficulty managing noise and disruptions</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level of support (site, parents, volunteers)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Amount of time for preparation/cleanup</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Would you use this experiment again?  
☐ Yes  ☐ No

Other comments:
**Abrasion Resistance**
The ability of a fabric to resist wear caused by rubbing against other surfaces.

**Absorbency**
The ability of fibers to soak up water or moisture.

**Acidity**
The capacity of a substance to release acid or hydrogen ions. The naturally occurring acids in fruits and vegetables give them a high level of acid. A high level of acid can give a sour taste such as in lemons.

**Bleach**
A chemical that removes color. Two types of bleaches are chlorine and oxygen. Chlorine bleach, which is typically liquid, has a powerful effect and should not be used on silk, wool, or spandex fibers or on fabrics treated with certain resin finishes. Oxygen bleaches (sodium perborate and sodium persulfate) are usually in dry form. They may be used on all fibers and finishes and are relatively safe for colors.

**Carbohydrate**
A nutrient the body needs to function properly. Glucose and sucrose are examples of simple sugars found in foods and used by the body. Starch is a complex carbohydrate that is used by the body.

**Cellulose**
A complex carbohydrate that contains long chains of glucose molecules that the human body cannot break down. Although it is not digested, cellulose provides bulk (fiber), which is important to good health.

**Chemical Reaction**
The interaction of two chemicals that form a new substance. Indicators of a chemical reaction are color change, release of gas, release of heat, precipitate, and formation of a new substance.

**Detergent**
A cleansing substance capable of emulsifying dirt and oil.

**Digestion**
The process used by the body to break down foods into small particles and substances that can be used for growth and health.

**Durability**
The ability of a textile to remain intact under conditions of mechanical stress for a reasonable length of time.

**Dye**
A substance that absorbs and reflects light. Dyes react chemically with fibers to provide color.

**Enzyme**
A biological substance (usually a protein) found in plants and animals that facilitates a wide variety of reactions important to life. Enzymes can be isolated and added to products such as laundry detergent.

**Fabric**
A structure consisting of yarns or fibers. The yarns and fibers may be intertwined in many ways.

**Fiber (in fabric)**
A natural or manufactured material that has an extremely small diameter and a length at least 100 times this diameter.

**Fiber (in food)**
Complex carbohydrates in plant food (cellulose, lignin, pectin, and hemicellulose) that are important for good health. Although most fiber is not digested in the body, bacteria in the digestive tract can break down some types of fiber into digestible components.

**Finish**
A chemical, mechanical, or thermal treatment of yarn or fabric to change its properties.

**Laundry soil**
Particles of matter that adhere or lodge between the yarns and fibers of fabrics. They may be soluble (sugar, salt, and some proteins) or insoluble (oils, grease, proteins, dyes, and clay). Soils do not react chemically with the fibers.
Nutrient
A chemical the body needs to function properly. The six types are proteins, carbohydrates, fats, vitamins, minerals, and water.

Osmosis
Movement of water in and out of cells through a semipermeable membrane. The water moves in response to different concentrations of sugars and salts within the cell and in the environment outside the cell.

Pigment
Naturally occurring chemicals in plant foods that impart color to the plant. Examples are chlorophylls (green), anthocyanin flavonoids (red, blue, purple), and carotenoids (yellow, orange).

Stain
An undesirable color change by a fabric when it comes in contact with coloring substances that react chemically with the fibers.

Starch
A complex carbohydrate that contains long chains of glucose molecules that the body breaks down to use for energy.

Sugar
A simple carbohydrate. The six common sugars found in food are glucose, fructose, galactose, sucrose, lactose, and maltose.

Textile
A material made of fibers, yarns, or fabrics.

Waterproof fabric
A fabric coated with plastic or rubber to prevent moisture or air from passing through.

Water-repellent fabric
A fabric characterized by reduced spreading, wetting, and penetration of water because of the presence of chemical repellents. The fabric allows passage of air, water vapor, and perspiration.

Yarn
A continuous strand(s) of textile fiber, filament, or other material that can be made into a fabric. Yarns may be mono- or multifilament. (The term “thread” is reserved for strands of textile fiber, filament, or other material that are used to join materials.)
More Activities for Children

For ordering information, contact your local Cornell Cooperative Extension office (see page 77) or Resource Center-GP, 7 Cornell Business & Technology Park, Ithaca, NY 14850 (phone: 607-255-2080, fax: 607-255-9946, e-mail: dist_center@cce.cornell.edu.)

Nutrition


Textiles


Information for Educators

Nutrition


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Teaching Science


In-Touch Science: Foods & Fabrics
Cornell Cooperative Extension Offices

Albany
PO. Box 497
Voorheesville, NY 12186-0497
Phone: 518-765-3300

Allegany
Cooperative Extension Center
5453A County Road 48
Bolivar, NY 14473-2705
Phone: 716-268-7644

Broome
840 Upper Front Street
Binghamton, NY 13905-1542
Phone: 607-772-8953

Cattaraugus
28 Parkside Drive
Elliottville, NY 14731
Phone: 1-877-2377

Cayuga
246 Grant Avenue
Auburn, NY 13021-1495
Phone: 315-255-1183

Chautauqua
Frank W. Bell County
Agr. Center
942 Turner Road
Jamestown, NY 14701-9608
Phone: 716-664-9502

Chemung
175 Pennsylvania Avenue
Elmira, NY 14904-1793
Phone: 607-734-4543

Chenango
Education Center
99 North Road Street
Norwich, NY 13815-1386
Phone: 607-334-5091

Clinton
60-64 Route 22
Pattisburgh, NY 12901-9601
Phone: 518-561-7450

Columbia
Lewitten Center
479 Rt. 56
Hudson, NY 12534-9706
Phone: 518-828-3346

Cortland
PO. Box 5590
(6D Central Avenue)
Cortland, NY 13045-5590
Phone: 607-753-5077

Delaware
PO. Box 184 (N.Y. Route 10)
Hammondville, NY 13782-0184
Phone: 607-865-6531

Dutchess
PO. Box 259 (U.S. Route 44)
Millbrook, NY 12546-0239
Phone: 914-677-8223

Erie
21 South Grove Street
East Aurora, NY 14052-2398
Phone: 716-652-3370

Essex
PO. Box 388 (67 Sirco St)
Plattsburgh, NY 12903-0388
Phone: 518-982-4810

Franklin
63 West Main Street
 Malone, NY 12953-1817
Phone: 518-463-7403

 Fulton
Agronomic Education Center
75 West Main Street
Gloversville, NY 12078
Phone: 518-725-5411

Genesee
Education Center
420 East Main Street
Batavia, NY 14020-2599
Phone: 716-343-3040

Greene
Education Center
North America
Cairo, NY 12413-9503
Phone: 518-622-9620

Hamilton
PO. Box 207
County White House
N.Y.S. Rte. 3
Lake Pleasant, NY 12108-0207
Phone: 518-518-6191

Herkimer
110 North Main Street
Herkimer, NY 13350-9721
Phone: 315-866-7920

Jefferson
225 J.B. Wise Place
Watterson, NY 13601-2597
Phone: 315-780-9450

Lewis
PO. Box 72
Quay Street
Lowville, NY 13367
Phone: 315-376-5270

Livingston
158 South Main Street
Mount Morris, NY 14510-1595
Phone: 716-858-3250

Madison
PO. Box 203
(5th Avenue Street)
Whitewater, NY 13065-0201
Phone: 315-684-3001

Monroe
210 High Avenue
Rochester, NY 14620
Phone: 716-461-1000

Montgomery
PO. Box 1500
Fonda, NY 12068

Nassau
14750 Country Road
Plainview, NY 11050-3015
Phone: 516-454-9100

Niagara
Education Center
4489 Lake Avenue
Lockport, NY 14094
Phone: 716-453-8539

Onondaga
1090 West Genesee Street
Syracuse, NY 13204-2243
Phone: 315-424-9480

Ontario
480 North Main Street
Canandaigua, NY 14424-1099
Phone: 716-791-3377

Orange
Community Campus detach
Littleton, NY 10940
Phone: 914-344-1234

Oswego
North Main Street
Oswego, NY 13126-9596
Phone: 315-963-7286

Otsego
123 Lake Avenue
Cooperstown, NY 13326-0121
Phone: 607-547-2356

Putnam
Tarrant Ave Cooperative
10 Center Road
Brewster, NY 10917-9041
Phone: 914-272-6738

Rensselaer
Agriculture and Life Sciences
881 State St.
Troy, NY 12180
Phone: 518-270-2781

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PO. Box 1000
(204 King Road)
Tarrytown, NY 10591
Phone: 914-429-7085

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University Shopping Center
125 Main Street East
Canton, NY 13617-1477
Phone: 315-737-9192

Saratoga
50 West High Street
Ballston Spa, NY 12020
Phone: 518-889-8995

Schenectady
1 Broadway Center
8th Floor
Schenectady, NY 12305-2583
Phone: 518-336-1528

Schuyler
Rural Urban Center
203 Broadway
Montauk Town, NY 11901
Phone: 607-555-7141

Seneca
Education Center
203 East Williams Street
Waterloo, NY 13165
Phone: 315-733-9251

Staten
3 East Pulverhouse
Bath, NY 14810
Phone: 607-776-9631

Suffolk
264 Clifton Avenue
Riverhead, NY 11901-3086
Phone: 516-727-7850

Sullivan
600 Pendleton Road
Liberty, NY 12754-2903
Phone: 914-292-6180

Tioga
56 Main Street
Oswego, NY 13827-1582
Phone: 607-687-4020

Wayne
Education Center
1581 NYS Rt. 85
Newark, NY 14513-9739
Phone: 315-331-8415

Westchester
26 Old Greenbush Road
Valhalla, NY 10595
Phone: 914-602-2070

Yates
County Office Building
110 Court Street
Penn Yan, NY 14527
Phone: 315-534-5113

New York City Offices
Administrative Office
16 East 60th Street
New York, NY 10021-4328

Rochester
PO. Box 223
650 East St.
Brooklyn, NY 11216-2606
Phone: 718-783-2727

Manhattan
2000 7th Avenue
Room 108
New York, NY 10023-4990
Phone: 212-352-4990

Queens
161-10 Jamaica Avenue
Room 215
Jamaica, NY 11432-6149
Phone: 718-525-3490
Experiment 3A
Drop by Drop

Things to Think About during the Experiment

Work together
Guide the children through the experiment by demonstrating procedures and encouraging conversation about what they are doing and observing. Use the questions as a guide, not a script to be followed.

I wonder...
Encourage children to wonder about what happened or didn't happen while doing this experiment. For example, you might wonder

- if a water-repellent finish washes away.
- if "water repellent" and "waterproof" are the same thing.
- what other finishes are used on fabrics.

Make a list of all the "I wonder..." statements that you and the children can think of together. Save the list to talk about again after completing the experiment(s).

Talk about
This experiment introduces the terms "absorbency" and "water-repellent finish." Absorbency is the ability of fibers to soak up water or moisture such as perspiration. A "finish" is a treatment that changes the properties of a fabric. A water-repellent finish changes the absorbency of a fabric by making it harder for water to go through the fabric. The clothes we choose to wear can help absorb or repel water.
Session 3

Drop by Drop
Water Attraction

These two experiments introduce some properties of water as they relate to foods and fabrics.

In experiment 3A, "Drop by Drop," children examine one effect of water on fabric. Fabrics pick up, hold, and release water. The way that fibers, fabrics, and fabric finishes interact with moisture leads to different fabric choices for umbrellas, towels, and sweatsuits.

In experiment 3B, "Water Attraction," children examine water as a major component of plant foods. It moves in and out of plant foods when they are stored, cut, soaked, or cooked. Water is also one of the nutrients the body needs for good health.

The two experiments encourage children to be more curious about how water interacts with foods and fabrics.
This experiment allows children to examine physical components of fruits and their resistance to being mashed. Cell walls (which are primarily cellulose) and water inside cells strengthen plant tissues and influence their resistance to chopping, grinding, and chewing. This resistance can be related to ease of chewing foods, the first step in digestion.

Peels, seeds, pits, cores, juice, fleshy tissue—fruits contain many parts that can be compared in various ways. A banana peel is much thicker than an apple peel. The peel of a Red Delicious apple may be firmer than that of another apple variety. The flesh of an unripe banana is firmer than that of a ripe banana. In general, these differences depend largely on cell structure, water content of the cells, and chemical composition.

Fruits often change in firmness (texture) during storage. Some continue to ripen as chemical changes cause cell walls to soften; they eventually become overripe and decay. Some fruits lose water.

Fruits are often eaten raw. Sometimes we eat the whole fruit; sometimes we discard parts of it. What we eat and don’t eat relates to what we can chew and digest. Kiwi seeds are small and soft enough to be eaten, but a peach pit is not. Some components of fruits we eat such as kiwi seeds are not actually digested.

The “Core Comparisons” experiment also allows children to observe the browning of some fruit, which is caused by an enzyme reaction. When cells are disrupted by cutting, certain enzymes initiate reactions between oxygen in the air and compounds in the fruit. The browning reaction occurs very quickly when the fruit is thoroughly mashed and not simply cut in half. Not all fruit turns brown. In fact, combining a fruit such as kiwi with a fruit that browns will slow down the reaction. That’s because ascorbic acid (vitamin C) in kiwi interferes with the browning reaction.
Supplies and Preparation

Individual items are listed. Multiply as needed for total supplies.

Focus

- sock with hole
- apple

Experiment

- fruits
- cylindrical corer
- plastic bags, resealable (3 per person)
- newspaper or plastic tablecloth

- Purchase one apple, banana, and kiwi for every participant. Try to include one less familiar fruit such as mango, papaya, or guava for the group to examine. This selection of fruits allows children to compare variations in seeds, peel, firmness, and juiciness and to observe how some fruits will brown.

- A cylindrical corer allows you to control the size and shape of samples. It does not work well with fruits that have a pit or a very juicy interior. Samples could be taken from those fruits using a knife.
Focus
Start by showing the sock with a hole again. Then take a bite out of an apple or other food. Say,

"An apple with a bite out of it is kind of like a sock with a hole. Something is missing. But while we usually don't want holes in our clothes, we are constantly cutting, mixing, mashing, and cooking foods to change them into something we want to eat. And our body breaks down the food even more to change it into a form that it can use. Do you think all fruits have the same parts and will be the same when they're mashed? Let's find out by doing an experiment."

Getting Ready to Experiment
• Use newspaper or a plastic tablecloth to protect the work area.
• Know how to handle the cylindrical corer safely.

Experiment
1. Choose a fruit to test.
2. Make some predictions about the physical components of the fruit.
3. Use a corer to take a sample of the fruit. Insert and push the corer crosswise through the fruit. Twist and pull to remove it from the fruit. Carefully remove the sample from the corer.
4. Place the sample in a resealable plastic bag. Push out the excess air while closing the bag. Ensure that the seal is secure.
5. Begin smashing the sample with your hand. Observe how the sample changes. Identify components of the smashed sample (e.g., skin, peel, flesh, seeds, juice).
6. Repeat steps 1–5 for each fruit. Compare results.

Conversation
Questions You Might Ask
Tell me something about this fruit.
What is inside?
Was it easy to take a sample?
Describe the sample.
How easily did the sample smash?
Are some parts harder to smash than others?
Describe the different components.
How are the samples alike? different?
What components would you eat? not eat?
How would cooking change those parts?

Closure: Connecting Food and Fabric
If you are doing only experiment 2B, review the "I wonder" statements. If you do both experiments in one session, talk with the children about how the experiments helped them to think about changes in fabrics and foods. Ask, "What did you enjoy about these experiments? What did you learn about fabrics and food?"

Show the list of "I wonder..." statements for both experiments. Say, "Often when scientists do experiments, they come up with lots of new ideas or questions. Which one is the most interesting to you? How could you find out more about it?"
Experiment 2B
Core Comparisons

Things to Think About during the Experiment

Work together
Guide the children through the experiment by demonstrating procedures and encouraging conversation about what they are doing and observing. Use the questions as a guide, not a script to be followed.

I wonder...
Encourage children to wonder about what happened or didn’t happen while doing this experiment. For example, you might wonder:

- why we eat kiwi seeds but not apple seeds.
- if seeds are bad for you.
- why some fruit turned brown.

Make a list of all the “I wonder...” statements that you and the children can think of together. Save the list to talk about again after completing the experiment(s).

Talk about
This experiment introduces the terms “texture” and “digest.” Foods or parts of foods that are the hardest to mash have a firm texture. The coarse texture of peels and seeds makes them difficult or impossible to chew. Your body cannot use or digest some parts of fruits.
**Behind the Scenes Science**

Durability is the ability of a textile to remain intact under conditions of mechanical stress. It can be evaluated by measuring a fabric’s strength, elongation, elasticity, flexibility, and abrasion resistance.

Abrasion resistance is the ability of a fabric to resist wear caused by rubbing against other surfaces. This experiment lets children compare the abrasion resistance of two cotton fabrics. The jeans fabric is more resistant to the friction of rubbing with sandpaper than the shirt fabric. Both fabrics are made of cotton yarns, but they differ in thickness, weight, and weave structure.

In plain weave fabrics, the yarns interlace in an over-one-under-one repeating pattern. In twill weave fabrics, some yarns are allowed to float over two or more yarns. Some sample twill patterns are over-two-under-two, over-three-under-three, and over-three-under-one. The progression of these interlacings produces a diagonal line. Because twill weaves have fewer interlacings, they pack in more yarns for a tighter structure. Thus they are more resistant to abrasion.
Experiment 2A
Wear and Tear

Supplies and Preparation
Individual items are listed. Multiply as needed for total supplies.

Focus
☐ sock with hole

Experiment
☐ fabric, cotton plain weave
☐ fabric, cotton twill weave
☐ magnifying lens (with at least 4x magnification)
☐ sandpaper strip (2 per person)
☐ masking tape

- Cotton plain weave and twill weave fabrics are uniform in fiber content and different in structure and weight. They are commonly used in shirts (plain weave) and jeans (twill weave). Cut fabrics into 2-x-6-inch strips (see fabric cards located in the back of this publication).

- Select medium-weight (#60-100) sandpaper for this experiment. A higher-number sandpaper will lengthen the rubbing procedure; a lower number will shorten it. Cut a 9-x-11-inch sheet into 12 pieces. Using a fresh piece of sandpaper for each fabric sample ensures comparable results.

- Demonstrate the rubbing technique or lead the group in doing the first few strokes. The rubbing technique should be approximately the same for each stroke.
Focus
Show a sock or other article of clothing with a hole. Say,
"Tell me something about this sock. Have you ever gotten a hole in a sock? How do you think it could have happened? Clothes are made using different fabrics. Do you think some fabrics get holes more easily than others? Let's find out by doing an experiment."

Getting Ready to Experiment
• Work on a flat, firm surface.

Experiment
1. Compare the two cotton fabrics (2-x-6-inch strips). Use a magnifying lens to take a closer look.

2. Tape an end of one fabric to your work area. Place one hand over the tape to steady the fabric further. Pick up the sandpaper with the other hand.

3. Press the sandpaper against the top of the fabric near the tape. Pull the sandpaper down the length of the fabric, lifting when you reach the end. Use as little or as much force as you like, but try to use the same amount for each stroke.

4. Repeat the rubbing pattern of press, pull, and lift. After every five strokes, use the magnifying lens to examine the fabric for damage. Continue until you wear a hole in the fabric.

5. Repeat steps 2-4 with the second fabric and a new piece of sandpaper.

Conversation
Questions You Might Ask
- How are the fabrics alike? different?
- Do you have clothes made of either fabric?
- Can you see individual yarns?
- What patterns do they make?
- What happened to the fabric after 5 strokes?
- What will happen if you keep doing this?
- How many strokes did it take to cause damage?
- Did you make a hole? How many strokes did it take?
- How big is the hole?
- How does the abrasion resistance of the fabrics differ?

Transition or Closure
If you are doing only experiment 2A, remember to review the "I wonder..." statements. If you are doing experiments 2A and 2B together, have the children help clean up their work areas. Then shift their attention to the food experiment.
In-Touch Science: Foods & Fabrics entices children aged 8 to 11 (grades 3 to 5) to focus on their everyday encounters with foods and fabrics and learn about the science of it all.

Through 10 experiments, children observe how similar science concepts relate to both foods and fabrics. Each child is offered the opportunity to manipulate materials and equipment, test ideas, and explore what interests him or her in a creative learning environment.

The teaching style emphasizes the fun of manipulating supplies and engaging in the scientific process of discovery. Together, adults and children will share “I wonder...” statements that could lead to more science exploration.

In-Touch Science: Foods & Fabrics is appropriate for 4-H clubs, school-age child care programs, summer camps, the Expanded Food and Nutrition Education Program (EFNEP), scout programs, science centers, and other community programs. It could be easily adapted for use in school science programs.

This 78-page manual contains samples of the fabrics used in the activities.