

Corn Investigations

AIM

To explore corn and speculate on how corn is changed into oil, syrup, and flour.

SCIENTIFIC PROCESSES

- observe, investigate, speculate

OBJECTIVES

Students will be able to:

- describe how corn gets turned into corn oil, corn syrup, and corn flour;
- recognize science as a process of inquiry;
- communicate what they think it will be like to study science through learning about food;
- use their LiFE Logs to record questions, observations, data, and conclusions.

OVERVIEW

In this lesson, students are first introduced to the Module and Unit 1 questions to help them begin to understand how questions and questioning frame inquiry-based science. Second, students are introduced to the investigative aspect of science through thinking about corn, and how it can get turned into three very different products: corn oil, corn syrup, and corn flour. Students do not need to understand the exact details of what happens but rather realize that questioning, observing, speculating, and creating new ideas can help them learn about how the world works. This lesson's sample conversation and teacher note offer suggestions to guide students through this process. Finally, students are introduced to the communicative aspect of science through being introduced to LiFE Logs, a notebook in which students will record questions, observations, data, and conclusions. Through periodically reviewing what they have written in their logs, students can track their own learning.

MATERIALS

For the teacher:

- *Thinking about Corn Oil* sample conversation
- *Corn-Based Food Products* teacher note

For the class:

- 1 ear of corn, fresh, frozen, or dried (Indian corn)
- 1 bottle corn oil
- 1 bottle corn syrup
- 1 bag corn flour
- *Corn Investigations* experiment sheet
- (Optional) Several kernels of popcorn

- (Optional) 1 sharp paring knife
- (Optional) Hand lens
- (Optional) Overhead transparency film
- (Optional) Chart paper
- Module and Unit questions

For each group of 4–6 students:

- 1 paper cup
- *Corn Kernel* lesson resource

For each student:

- LiFE Log (composition notebook)

PROCEDURE

Before You Begin:

- Follow the setup instructions on the *Corn Investigations* experiment sheet.
- Review the *Thinking about Corn Oil* sample conversation and the *Corn-Based Food Products* teacher note.
- Make copies of the *Corn Kernel* lesson resource to distribute to each group of students.
- Post the Module Question and the Unit 1 Question at the front of the classroom.

MODULE QUESTION

What is the system that gets food from farm to table, and how does this system affect the environment?

UNIT QUESTION

What is a food scientist?



QUESTIONING

1. Introduce LiFE

Explain to students that they are about to begin a science program that focuses on the study of food. In LiFE, your students are scientists — a special kind of scientist called a food scientist. *What do you think food scientists might do? What kind of knowledge do they need?* Accept all answers. Record students' ideas on chart paper or on the board.

Food scientists investigate food in lots of different ways. Some study how food is produced. Others might look at how a food, like corn, is changed and combined with other foods to make another kind of food, like cereal, or cake, or pizza. There are food scientists who try to understand how what we eat influences our personal health. And

there are food scientists who investigate how the waste and pollution created through growing, processing, and packaging our food affects our natural environment.

2. Discuss Module and Unit Questions

Post the Module Question and the Unit 1 Question on the board. Invite volunteers to read the questions out loud. Tell students that as LiFE food scientists, they will be investigating answers to questions like these.

Understanding what food scientists do will help students be better prepared for their work as LiFE food scientists. Make sure you give your students time to discuss their ideas about a food scientist's work. As students work through this lesson, check to see how their understanding has changed.

3. Explain and Conduct Corn Investigation

Show students the ear of corn and the ingredients made from corn: corn oil, corn syrup, and corn flour. *How do corn kernels get changed into corn oil, corn syrup, and corn flour?*

Follow the procedure outlined on the *Corn Investigations* experiment sheet. Challenge students to think about different ways that corn gets changed into other products. Create a sense of mystery and intrigue. Make it clear that all ideas and thoughts are welcome. Remind students that they are asking questions and wondering about the products. They are not trying to come up with a correct answer. The sample conversation and teacher note can help you guide your students through this inquiry. Be sure to review the questions on the experiment sheet.

4. Have Groups Share Findings

Encourage a whole-class conversation led by students. You may wish to have each group

select a reporter to share the group's thoughts with the class. Remind students that this activity is about thinking, exploring, and learning. It is not about finding the correct answer. As the discussion comes to a close, remind students that as food scientists they are going to be investigating, experimenting, and developing new ideas about lots of topics related to food.

(Optional) Distribute the cut-up popcorn kernels to each group of students. Have students look at the inside of the kernel. The small core part near the bottom is called the germ. There is oil in the germ. The germ is the part that is squeezed to get out the oil. Invite students to try to rub the germ on paper. *Do you see a stain? What does that tell you?*

5. Discuss Science Inquiry

Explain that the corn investigation is an example of a science inquiry. *What do you think "science inquiry" means?*

After several students have shared their ideas, review this definition of **science inquiry**: using your own curiosity about a topic to help you put together what you already know with what you are learning to construct new knowledge that you can use in your daily life.

6. Introduce the LiFE Logs

Throughout *Farm to Table & Beyond*, students will keep a log to record thoughts, observations, data, and conclusions about what they are learning. This allows students to reflect on what they learn and to understand how their thinking grows and changes.

7. LiFE Logs

Have students write a paragraph that responds to the following statement: "What I think it will be like to be a food scientist."

If your students are not accustomed to this type of reflective writing, they may find it challenging. Help students understand that it is fine to sit in front of a blank page for a few moments as they think about what they want to write.

You may wish to brainstorm a list of ideas (as a whole class or individually) to serve as prompts. Students can use this list as they write their paragraphs.

8. Assign Homework

Have students write two questions in their LiFE Logs that reflect what they would like to learn about food.

Have students look at home and select five different kinds of food. Have them look at

the ingredients lists to see if they can identify any ingredients made from corn. They can make a simple table, like the one shown below, in their LiFE Logs. Make sure students know how to read an ingredients list. You may wish to demonstrate in class.

Name of the Food	Ingredients from Corn in this Food

Thinking about Corn Oil

This sample conversation in the **Questioning** phase of the QuESTA cycle will help you guide your students through a discussion that will allow them to think deeply and thoughtfully about the corn investigation they are about to conduct. During the conversation, students may ask questions, think about what they already know, speculate on answers to questions, and wonder about what they are going to learn. This is a guide. Feel free to adjust your questioning to the needs of your class.

MS. D: Look closely at the kernels of corn. Now compare that to the oil. *Any ideas about how the corn kernel is changed into corn oil?*

JESSIE: One time I noticed that we had sunflower seed oil at my home. I asked my dad how the sunflower oil gets made from the seeds because I didn't see any oil in the seeds. He said the sunflower seeds are squeezed very hard and the oil comes out. Maybe if we squeeze the corn kernels very hard oil will come out.

MS. D: That's an interesting comparison to sunflower seeds. We can try squeezing one of our corn kernels. *What do you think would happen?*

ALEX: The corn kernel seems watery to me. I don't think water and oil are the same. I think if we squeeze a corn kernel, we will get wet, juicy stuff out, not oil. *How can we get oil from corn?*

MS. D: Good thinking. Let's start by figuring out how we can tell if we get water or oil from the corn. *Does anyone know how we can tell if what we get from squeezing a corn kernel is wet, juicy stuff or oil?*

ROSANNA: When I get pizza my mom always says that the stuff that gets on the paper plate and stains it is oil. If we squeeze the stuff that comes out of a corn kernel onto a paper plate and it's oil, it will stain the paper plate.

MS. D: Good idea. Let's try it. We don't have a paper plate here, but we can squeeze the kernel's juice onto a piece of paper. Let's see if what comes out stains the paper. (Do this simple experiment.) We'll have to let it sit for several minutes to dry.

This is a good start to what we often will do in the LiFE Curriculum Series. We'll start with a question and do some investigations that will help us develop theories about what the answer to the question might be. Our class discussions will help us come up with ideas. Talking through our ideas, even if your idea seems silly at first, is much more important than knowing the right answer. Scientists do this type of thinking and discussing all the time. Don't worry if you don't completely understand how corn flour, corn oil, and corn syrup are made from corn. You all did some excellent thinking about how corn gets changed. I think doing science this way is fun. I hope you do, too.

Continue the conversation to include a discussion of how corn kernels are made into corn syrup and corn flour.

Corn-Based Food Products

What's the first thing that comes to mind when you think of corn? Probably it's corn on the cob, fresh from the field. Yet most of the corn in the American diet is not fresh, whole corn. It's corn that has been refined and processed into its component parts and used in the highly processed food products we buy at the supermarket. Although corn has been refined for more than 150 years, the number of corn products used as ingredients in our food has increased tremendously in the last 50 years. If you look at the ingredient list on the most highly processed foods, you'll find that one or more ingredients are corn-based. In this lesson we're focusing on three corn products: corn flour, corn oil, and corn syrup.

Corn flour is made either from the entire corn kernel or from a kernel that has been degermed. Flour made from the whole kernel has a richer, more robust flavor, but it is more likely to turn rancid because of the oil found in the germ. Commercially, corn flour, also called cornmeal, is made from the mechanical grinding of dried kernels of white or yellow corn and is available in fine, coarse, and stone-ground varieties. You can make your own corn flour by grinding dried corn in a coffee grinder or a hand grinder.

Corn oil is made from the germ of the corn kernel. Before corn can be degermed it is steeped in 50°F water for about 35 hours. This adds moisture to the corn and releases the starch. Large corn refiners have bins that can hold up to 3,000 bushels of corn! After it's steeped, the corn is coarsely ground so that the germ breaks free from the rest of the kernel. A centrifuge spins out the low-density germs. These germs are pumped onto screens and thoroughly washed to remove any remaining starch. Next, they are pressed to release the oil. Chemical solvents are applied to extract any remaining oil. Filtering and further refining removes free fatty acids and phospholipids. The final product is high in polyunsaturated fat — healthy fat — and low in saturated and trans fats — less healthy fats.

Over the past few decades, the corn product that has experienced the greatest increase in use is corn syrup. In 1966 the average American consumed about 14 pounds of corn sweeteners a year. By 2004 this amount had increased more than five-fold. High fructose corn syrup (HFCS) accounted for much of the increase. Introduced into the food supply in 1968, HFCS consumed by Americans has steadily increased to the current level of 80 pounds per person per year. If you take a look at food labels, you'll find HFCS in products ranging from salad dressing to chewing gum. Corn syrup or corn sweeteners are made from cornstarch. After corn is degermed, what remains is the gluten, fiber, and starch. A series of steps removes the starch, yielding cornstarch that is more than 99% pure. Some cornstarch is sold directly as starch, but the vast majority is further processed to make corn syrup. To make syrup, the cornstarch is treated with enzymes to break the starch down into sugar. HFCS is the most refined of the corn sweeteners and has been processed until there is virtually no starch — it's all sugar.

To help students begin to develop an awareness of how many different kinds of food contain corn products, they will have a homework assignment to look for processed foods on their kitchen shelves. When you give the homework assignment, reinforce the fact that students are applying what they have learned in the classroom to their daily lives.

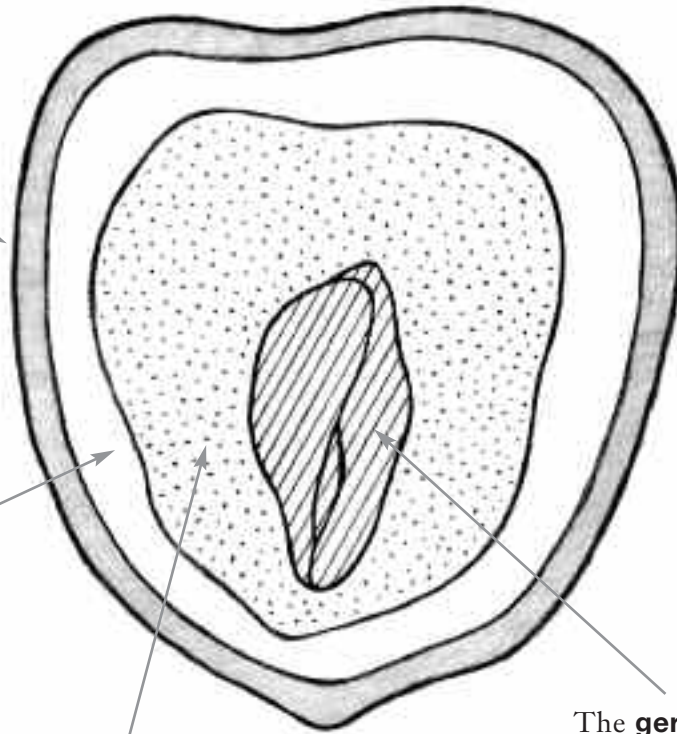
Corn Kernel

The **seed coat** is mostly fiber and protects the kernel.

The **air cavity** is the space between the seed coat and the endosperm.

The **endosperm** is mostly starch. It provides food for the young corn plant.

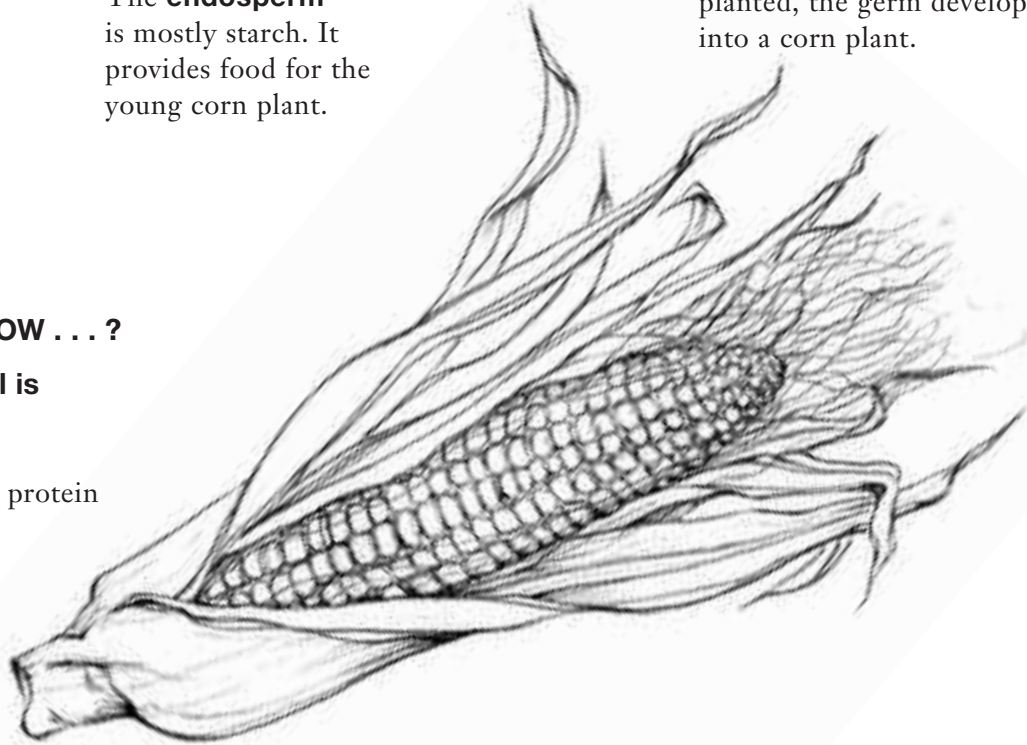
The **germ** contains most of the oil found in a corn kernel. When the kernel is planted, the germ develops into a corn plant.



DID YOU KNOW . . . ?

A corn kernel is

- 16% water
- 4% oil
- 20% fiber and protein
- 60% starch



Corn Investigations

Students observe three different corn products and try to determine how corn is changed into these products.

Setup

1. Prepare enough paper cups of corn oil, corn flour, and corn syrup so that each group of 4–6 students gets one paper cup of corn oil, corn flour, or corn syrup.
2. Make an overhead transparency of the *Corn Kernel* lesson resource or make one photocopy for each student group.
3. (Optional) If you choose to examine the popcorn endosperm and germ, use the sharp paring knife and cut several popcorn kernels in half.

Procedure

1. Have students work in groups of 4–6. Assign each group one product (corn oil, corn syrup, or corn flour) to investigate.
2. Give each student group several kernels from the ear of corn to help them with their investigation.
3. Encourage students to be creative in their thoughts and discussion. This experiment is not about figuring out exactly how these products are made, but rather to have an enjoyable experience as a food scientist.
4. Have groups share their findings. Remind students that all thoughts and ideas are welcome.
5. Encourage questions, discussion, and debates during these presentations.

Questions

1. *How does your product look similar to a kernel of corn? How is it different?*
2. *What could you do to the corn kernels that might make them become more like your product? List all the steps you can that might happen in this process.*
3. *Do you think the whole corn kernel is used to make your product or only part of the kernel? What part?*
4. *Does the picture of the corn kernel with the parts labeled help you at all?*
5. *Is your product similar to any other food product? If it is, does this help you think about how your product was made?*