



**UNIT 2: FOOD AND  
THE ENVIRONMENT**

L.15

# THE INDUSTRIALIZING FOOD SYSTEM

## Note to Teachers

The process of industrialization (which began in Britain in the late eighteenth century and in the United States in the nineteenth) completely altered agriculture and the way we eat. Industrialization of the food system included the mass production of farm implements and machinery, which in turn led to food production and preservation at a scale that was orders of magnitude greater than what had been possible before. These changes had wide-ranging consequences, one of the most important of which is specialization of production within each region. Instead of every region growing the diversity of crops it needed to feed its community, as had been the case previously, regions began to specialize in a particular crop that could be transported across the country. As a result, each region lost its agricultural self reliance as it grew crops primarily for commodity “export” and brought in the crops it was no longer cultivating locally. Lesson 15 tells that story, using wheat as our case study.

This curriculum includes two lessons on industrial agriculture. This first one focuses on the changes that characterize the early phases of industrialization, and the second examines our current industrial agricultural system. Students may want to jump ahead to share what they know of current industrial practices, but this historical context will help them to evaluate our current system more effectively.

### Goals *In this lesson, students will*

- understand many of the factors and decisions that drove the adoption of an industrial system and its impact on our food system’s complexity.
- perceive that useful benefits—like the advent of frozen food—are part of a larger process that has overall been detrimental to the environment, to our communities, and to individual health.

### Objectives

- Students will use a processed food item (here, a jar of mayonnaise) to brainstorm a definition of an industrially produced food.

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Please use this margin to notate how to best adapt this curriculum to your students.

## Objectives CONT.

- Students will study a history of wheat, as it was laid out in Dan Barber's *The Third Plate*, to explore the multiple changes that took place in the growing and processing of wheat.
- Students will use a notetaking rubric and subsequent discussion to process the changes and consequences of those changes that took place over roughly a century.
- The rubric will enable students to compare the movement of these two crops and their consequences.
- Students will articulate a broader claim about the dissemination of crops and their consequences.

## Materials

- Computer and projector
- Handout

## Instructions

### I. Introduction

Display for students an industrially produced product (a jar of mayonnaise, tomato sauce, etc.)

Remind students that industrially produced food is so common that we take it for granted and rarely think about the many developments with roots in the Industrial Revolution that are necessary to produce it.

Ask students to do some brainstorming. Can they begin to identify the technology or processes that made the displayed product possible?

With a little consideration, students are likely to offer these sorts of responses:

- Mass production of the containers (glass, cans and plastics)
- Mass production of the ingredients that make up the food product
- Transportation technology that can move raw materials and finishing food products and the infrastructure (such as road, railroad tracks, bridges, etc.) that make transportation possible.
- Preservation techniques like canning and freezing to create longer lasting foods
  - The first processed foods were products like crackers, canned milk and meat, margarine
  - Processing not only lengthens the shelf life, but also cooks the food, creating “heat and eat” foods like canned vegetables
- Machinery to prepare and process the raw materials

Emphasize that the prevalence of all of these practices are indicative of an industrialized food system. At the same time, remind them that there are other characteristics of an industrialized food system:



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Bringing machinery like the tractor onto the farm

Developing chemical fertilizers and pesticides

Hybridizing new plants that could grow more easily in populated areas

A great example of these broader changes: Wheat.

## II. Wheat as a Case Study

1. Distribute the handout. Let students know that the presentation will begin with a description of wheat production prior to 1845 and then recount of series of changes.
2. Ask students to make notes about what they hear on the handout, in order to help them process and remember that history.  
  
In order to understand the changes, ask them to listen first to pre-1845 practice, then to listen for changes, noting those that are changes in technology and other elements of the food production chain.
3. Use the script and slides to tell that history.
4. Then, give students a few minutes to allow them to look over their notes. Recognize that they have taken in a good deal of information in a short presentation.
  - What conditions and practices best characterize the era before 1845?
  - What technological changes did students hear?
  - What other types of changes did they note?
  - If technological change is one type of change, can students classify the other changes into categories? If so, what categories do they detect?
5. Open the floor for questions about what students have heard.
6. Turning back to their notes or turning to a neighbor, ask students to consider relationships of cause and effect.

Where, in the history of wheat, does one type of change unleash others?

Encourage students to explore those relationships by drawing arrows from one part of their notes to the other.

Ask them to weigh those changes. How significant were the effects in each case?

Finally, ask them to assess the scope of the transformation these changes produce overall.

- What did the U.S. look like before 1845?
  - How different was the country by 1975?
  - How profound was the transformation?
7. Encourage students to share their findings and talk about their responses. Use the remainder of this class session to highlight important themes and let the enormity of these changes (technological, economic, geographic, dietary, and social) settle in.

Remind students that similar changes occurred across the food system, helping to motivate the very recent responses described at the end of the presentation.



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The history of wheat was framed by Chef Dan Barber in his book, *The Third Plate*. As he put it, “I’m going to tell you about the perfect murder.”

“The nice thing about wheat is how it’s tied to Western civilization. The history of wheat is the history of a sociable crop.” -Klaas Martens, an Organic grain farmer in upstate New York

## Presentation Slide 1: Wheat fields

For centuries, wheat was a community builder, a grain whose benefits were reaped only through cooperation and effective social organization – farmers grew it, millers ground it, and bakers turned it into sustenance and pleasure.

Emmer wheat was one of the first domesticated crops.

## Slide 2: Emmer wheat

The Spanish first brought wheat to the continents now known as the Americas. It failed at first but eventually took hold as a crop.

Now, nearly 60 percent of American cropland is in grain production – primarily corn, wheat and rice. Vegetables and fruits occupy just 5 percent of our cropland.

Of the grain we eat, the white flour is dead. It is literally a dead part of a plant.

## Slide 3: Bread

For most of the history of the United States, the east coast was America’s breadbasket. There was one gristmill for every seven hundred Americans in 1840. Once ground, flour had a shelf life of about 1 week. You brought your wheat to the mill or you milled it yourself.

What is the last piece of bread that you had – did you bake it? Did you buy the flour or grind the wheat yourself? Did you grow the wheat?

In 1845, wheat was grown in every country of New York. There were even four acres of wheat grown in Manhattan.

Many wheat varieties were under cultivation, and they were grown in different conditions. As a result, they had distinctive characteristics, flavors and baking qualities.

## Slide 4: Erie Canal

The first major change took place when the Erie Canal opened in 1825, creating a transportation link between the Eastern seaboard and the Midwest.

Rochester, New York became a milling hub and was known as Flour City. Railroads filled out the new transportation link, and wheat went with it. For the first time, wheat was able to travel long distances and be sold far from where it was grown.



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## Slide 5: Stone mill and roller mill

The roller mill appeared in the late 1800s. It revolutionized the wheat industry. Before this invention, people used stone mills, which crush the wheat between two stones – much like the mortar and pestle.

Roller mills have the capacity to separate the components of the wheat seed

## Slide 6: The wheat seed

The wheat seed has three main parts – germ, bran and endosperm.

The endosperm is the starchy part that becomes white flour. It stores food for the germ.

The seed coat, or bran, surrounds the endosperm and protects the germ until its ready to germinate.

The germ is a seed embryo.

## Slide 7: Stone mill and roller mill

In crushing the seed, the stone mill crushed the germ—releasing the oils. If flour was not used very quickly, the oils would become rancid—deteriorate—and give the flour an off-taste.

By contrast, roller mills could separate the germ and bran from the endosperm. This process created a shelf-stable endosperm, or white flour.

White flour becomes a commodity crop with the introduction of the roller mill. That is, it becomes a stable product, grown for the market, and transported long distances.

White flour drops in price.

## Slide 8: A Wheat Berry

The germ and the bran, while comprising only 20% of the wheat seed's weight, provide 80% of its fiber and nutrients. These components are extracted to produce white flour – and with the loss of the germ and bran, most of the flour's flavor disappears too.

White flour became a tremendous commercial success but a nutritional failure.

Yet, the demand for white flour grew.

What did this do to farming?

## Slide 9: Map of the Great Plains

Railroads helped European-Americans settle the Great Plains, and small wheat farms in New York were no longer able to compete with new larger-scale wheat farms in that region.

At this point industrialization completely changed the way we use crops, and changed the face of farming.



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## Slide 10: Map of the United States

Nearly half of our country (40%) is prairie: the terrain is grassland from basically Missouri to Montana and straight down to Texas. Wheat, being a grass, grows well in this ecosystem.

Domesticated wheat – the wheat we eat – is an annual crop. Every year, new seed must be planted. If it were perennial, like grasses that grow in the wild, farmers could avoid plowing and chemical fertilizers.

## Slide 11: Wild vs. domesticated wheat.

All of the health of the prairie resides in the soil.

The root system of wild grasses keeps the soil structure in place and absorbs nutrients.

By contrast, because domesticated wheat is an annual and must be planted every year, every time farmers plow and re-seed the field they break up that root base and make the soil fragile and vulnerable to erosion.

Early farmers had a difficult time breaking up that wild root system because the roots could break plows and other equipment. So farmers invented more powerful machines to break up the ground, turn the soil, and plant.

## Slide 12: The cast-steel plow

In 1837, the cast-steel plow did the trick. Prairie grass was steadily replaced with annual wheat.

The early wheat often failed. By the 1870s, breeders developed hard winter wheat, which grew well in the fields and worked well with the steel roller mills.

Annual wheat has shallow roots, making it difficult for the plant to access the nutrients it needs and creating a reliance on external fertilizers. Fertilizers enabled farmers to plant and reap wheat, but these synthetic inputs badly damaged the soil, and therefore the prairie, in the process.

A series of Homestead Acts offered free land to settlers, and record amounts of wheat were harvested by the early twentieth century. American grasslands became annual wheat fields.

## Slide 13: The Dust Bowl

In the 1930s, a drought turned the soil to dust. This environmental disaster came to be called the Dust Bowl. Without deep root systems to keep it in place, the soil blew away. Families would set the table with the plates upside down.

With the conversion of the prairie, we replaced a diverse agricultural ecosystem with 56 million acres of monoculture.

## Slide 14: Wheat field

Today's wheat fields are uniform. Almost all of the wheat grown in the prairie comes from just two varieties.

In the past, wheat was a social crop—a community organized around its mill. That community ceased to exist when white flour could be processed and transported as a commodity.



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## Slide 15: Kansas town

The population of the wheat belt has fallen due to technological advances in equipment and economies of scale.

In Kansas alone, six thousand towns have vanished in the past eighty years.

## Slide 16: Combine

New tractors and other equipment require fewer people to produce the same amount or more of wheat.

Threshing (separating the edible part of the grain from the chaff) used to take many farmers and many hours before milling. Now this all happens in one fell swoop with a piece of equipment called a combine, which harvests the grain and removes the grain from the stalk.

Due to this and other innovations, between 1950 and 1975 the number of farms and the number of people who live on farms in the U.S. fell by half. The size of the farms doubled as farm owners could handle ever larger pieces of land with a small number of workers.

Because of the demand for cheap flour, as Chef Dan Barber puts it, we have blood on our hands—for the death of wheat.

## Slide 17: Stone Barns Center

In recent decades, some positive changes are taking place:

Communities outside of the prairies (particularly in the northwest and northeastern parts of our country) are beginning to grow wheat again.

New seed varieties are also being bred that grow well in non-grasslands ecosystems.

Mills and other infrastructure are also being built, and helping to shape new communities.

Whole grain foods have become easier to find.

Can we learn from the past to improve the future?



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## HOMEMADE WHEAT CRACKERS

4 students

TOTAL TIME: 25 minutes

(will take longer if you can only fit one tray of crackers in the oven at a time)

This would be cooked alongside caramel apple jam, pickled beets and pickled carrots, so the materials list only includes enough for 4 students to do the prep work. However, you can add more students to the mix, just add more knives, cutting boards and rolling pins.

### Equipment List

- Oven/toaster oven
- Medium mixing bowl
- 4 rolling pins
- 4 cutting boards
- 4 knives
- 4 forks
- 2 baking sheets (or however many fit the most crackers into your oven)
- Small bowls, one for each topping
- 1 cup dry measure
- Teaspoon measuring spoon
- Tablespoon measuring spoon
- Wet measure

### Food Items

- 3 cups flour
- 2 tsp sugar
- 2 Tbsp olive oil
- Pepper
- 1 cup water
- Toppings such as
  - Fennel seeds
  - Maldon finishing salt
  - Sesame seeds
  - Poppy seeds
  - Caraway seeds





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### PICKLED CARROTS

4 students

This recipe should be done along side wheat crackers, pickled beets and apple jam. This recipe has four students working on it, adjust the number of students working on this recipe, add or take away cutting boards, knives and peelers. Some of these materials and food items like the burner, saucepan, wooden spoon, sugar and vinegar, etc. can be shared between pickling recipes. You will see those materials listed in both but are only needed once.

#### Equipment List

- Quart sized jar with lid
- 4 peelers
- 4 cutting boards
- 4 knives
- Small saucepan
- Burner
- Wooden spoon
- 1 cup wet measure
- ½ Tbsp
- 1 tsp
- Compost bowl

#### Food Items

- 4 large carrots
- 1 ½ cups white vinegar
- 1 ½ Tbsp sugar
- Salt
- 1 clove garlic
- 2 sprigs dill
- 1 tsp mustard seeds
- Bay leaf

### PICKLED BEETS

4 students

#### Equipment List

- Quart sized jar with lid
- 4 peelers
- 4 cutting boards
- 4 knives
- Small saucepan
- Burner
- Wooden spoon
- 1 cup wet measure
- ½ Tbsp
- 1 tsp
- Compost bowl

#### Food Items

- 1 pound beets
- 1 cup white vinegar
- ¼ cup sugar
- Salt
- Bay leaf
- Mustard seeds
- Coriander seeds



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## HOMEMADE WHEAT CRACKERS

YIELD: 40 crackers

### Ingredients

- 1 ½ cups freshly ground whole wheat flour
- 1 ½ cups all-purpose flour
- 2 tsp sugar
- 1 tsp salt
- 2 Tbsp olive oil
- 1 cup water
- Optional toppings: salt, pepper, fennel seeds, sesame seeds, poppy seeds, caraway

### Directions

1. Preheat oven to 450 F.
2. Combine flour, sugar, salt, olive oil and water into a bowl until it forms dough. **DO NOT OVERWORK THE DOUGH!** The more that you mix, the tougher the dough gets.
3. Use rolling pin to roll dough into a flat sheet. Again, keep in mind that you do not want to overwork the dough.
4. Dampen with water and sprinkle with salt and pepper or any other seasonings.
5. Cut into thin strips and then cut into squares or desired shape.
6. Prick crackers with a fork so they don't puff up while baking.
7. Place on baking sheet and cook for 10 minutes or until golden brown and crispy.



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### PICKLED CARROTS

YIELD: one quart-sized jar

#### Ingredients

- 4 large carrots
- 1 ½ cups white vinegar
- 1 ½ tablespoons sugar
- 1 teaspoon salt
- 1 clove garlic, thinly sliced
- 2 sprigs fresh dill
- 1 teaspoon mustard seeds
- 1 bay leaf

#### Directions

1. Peel carrots and discard the skin. Slice each carrot into thin rounds.
2. Add vinegar, sugar and salt to a pot and simmer over medium heat until the sugar has dissolved.
3. Fill the jar alternating between carrots, garlic and dill.
4. Add mustard seeds and bay leaf to that jar, and then pour the simmering vinegar mixture over the contents.
5. If the carrots are above the vinegar, add a bit of water to top it off.
6. Allow the mixture to cool to room temperature, then cover and chill.
7. Store in refrigerator for at least 2-3 days. Will last for several months in the refrigerator.

### PICKLED BEETS

YIELD: one quart-sized jar

#### Ingredients

- 4 large carrots
- 1 ½ cups white vinegar
- 1 ½ tablespoons sugar
- 1 teaspoon salt
- 1 clove garlic, thinly sliced
- 2 sprigs fresh dill
- 1 teaspoon mustard seeds
- 1 bay leaf

#### Directions

1. Peel beets and discard the skin. Cut beets into quarters, and then slice thinly. Place beets into jar, leaving ½ inch of space at the top.
2. Combine the vinegar, sugar and salt in a pot and bring to a simmer.
3. Add coriander seeds, mustard seeds and bay leaf to the jar. Pour the simmering vinegar mixture over the beets, leaving ½ inch of headspace at the top.
4. Let cool for about an hour before capping and placing in the refrigerator.
5. Store in the refrigerator for at least 2-3 days before eating. Will last for several months in the refrigerator.



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Rubric

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- Use detailed language here to note key differences that you observe.

<p><b>PRE-1845 CONDITIONS AND PRACTICES</b></p>	
<p><b>TECHNOLOGICAL CHANGES</b></p>	
<p><b>OTHER CHANGES</b></p>	

