Barking & Dagenham BIG IDEAS

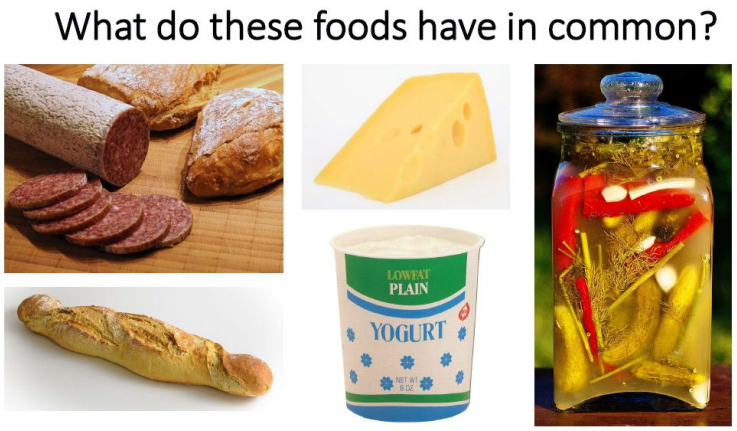
COOKING UP
The Curriculum

Post-Event Information and Activities

Good Microbes: Fermentation

Use guided questions to encourage students to begin thinking about how food is processed:

- Are these foods in the same form as they were when they left the farm? (No, they have been processed)
- How are each of these foods made? (Microorganisms play a role in making all these foods; cheese, yoghurt, sausage, and pickles are fermented by lactic acid producing bacteria; bread dough rises thanks to yeast, which are single-celled, microscopic fungi)



Once students are thinking about bacteria and microbes you can ask,

- “Is it safe to have bacteria in our food? Are bacteria always bad?”

You may want to show your class this video on the role of microbes in fermented food to refresh their memory:

http://ed.ted.com/lessons/why-is-bread-fluffy-vinegar-sour-and-swiss-cheese-holey-erez-gar

Foods We Ferment — And Why

Long before refrigeration prolonged the shelf life of perishable foods, people preserved seasonally available foods so they could have nutritious meals during times of scarcity. Fermentation is one of many methods of food preservation. The term fermentation describes a way to transform foods using the metabolic activity of microbes.

Miraculous little microbes are everywhere — in the air, on surfaces, in the soil, on our skin, and even inside us in our digestive tracts! For millennia, humans have harnessed the power of microbes, using them to make foods more nutritious, tastier, and longer lasting — think sourdough bread, cheese, pickles, beer. Let's take a closer look at these microscopic wonders.

Microbes: Tiny and Mighty

The word microbe was coined as a collective term for various microscopic organisms (this term itself is often shortened to microorganisms). A vast group, it includes thousands upon thousands of species of bacteria, fungi, protozoa, and algae. (What about viruses? Some say they're microbes; others exclude them from the group because viruses are considered non-living until they enter a host cell.)

Are microbes "germs?" Out of the countless species that exist on this planet, by far most microbes are either benign or beneficial to humans. Only a tiny fraction is considered harmful (also known as pathogenic or disease-causing), such as the Streptococcus bacterium that causes strep throat. Other bacterial diseases include cholera, tuberculosis, Lyme disease, and plague — the latter infamous for killing millions of Europeans during the Middle Ages. Although a few microbes like these can cause immense suffering, most play far more positive roles in our lives. Consuming fermented foods, for example, can benefit our digestive tract and contribute to our general well-being.

How Does Fermentation Work?

Let's start with two very different examples of familiar fermented foods. You'll soon see that the foods being fermented, the types of microbes, the techniques, and time all factor into the final products.

- Sauerkraut: During the making of sauerkraut, cabbage is submerged in brine (salty water). Lactobacillus bacteria (found naturally on the cabbage or added separately) transform some of the sugars in the cabbage into lactic acid, a natural preservative that inhibits the growth of harmful microbes and acts as a health-promoting bioactive compound. The fermentation process also radically changes the flavour and texture of the cabbage.
- Sourdough Bread: Crafting sourdough bread involves two types of microbes. The bread gets its flavour from lactic-acid producing bacteria. And it gets its rise from yeast, a type of single-cell fungus that metabolises sugars in the grain and gives off carbon dioxide gas, creating the bubbles that lighten the loaf.
- Injera - an East African flatbread
- Fufu - a doughlike West African dish of boiled and ground plantain, yam, or cassava, made into balls to go with soups or stews

Our modern food system offers most people access to foods year-round, negating the need for time-consuming preservation methods such as fermentation. Yet there's been a resurgence of interest in the diverse family of fermented foods. Why? Possible explanations are that fermented foods:

- Introduce unique flavours into our diet
- Offer insights into cultures very different from our own
- Contain health-promoting bioactive compounds

This last attribute may be the driving force behind the remarkable growth production of fermented foods. Research has shown that a healthy "gut biome" — the spectrum of microbes found throughout the digestive system — is a vital factor in overall health.

The live microbes in some fermented foods introduce beneficial organisms (called "probiotics") into the gut. These "good" gut microbes can balance out harmful organisms. In addition, gut bacteria help us digest and extract nutrients from foods, such as some starches, that would otherwise pass through undigested.

It appears we humans have come full circle regarding fermented foods. Once a necessity, home fermentation fell out of favour, replaced by processed foods and faster preservation methods. In recent years, fermentation has made a comeback, evidenced in the popularity of these fermented treats. Now, research is showing that the probiotics in fermented foods are a vital component of a healthy gut biome — and a healthy human. Distinctive flavours and improved health are a compelling combination.

A World of Goodness

Over centuries — even millennia — cultures across the globe have created signature foods that have not only become staple foods in everyday life, but have also come to represent shared cultural pride. The living microbes responsible for the distinct qualities of some fermented foods, such as kefir grains and sourdough starter, are family treasures literally passed (as in a crock of sourdough starter) from generation to generation. Here's a small selection of the many fermented foods consumed daily worldwide:

- **Kombucha**. Made with black tea, sugar, and a bacteria-and-yeast culture called a SCOBY ("symbiotic culture of bacteria and yeast"), kombucha is a tangy drink easily made at home. You can reuse the gelatinous SCOBY to make continuous batches. (Probable origin: Russia and Ukraine)
- **Kefir**. During fermentation, "kefir grains" (clumps of yeast and bacteria) are added to milk. As it ferments, the bacteria transform the lactose sugar into lactic acid, rendering the milk easier to digest. (Probable origin: Eastern Europe).
- **Miso**. Soybeans, brown rice and/or barley and salt are mixed with a fungus called koji and allowed to ferment anywhere from a few weeks to a few years. The result is a paste that ranges widely in flavour, colour, and taste, depending on the process and time. (Origins: Japan, Korea)
- **Kimchi**. Prepared by Korean families for over 1500 years, kimchi consists of cabbage and other vegetables that are fermented in their own juices, as well as brine and spices. Historically used as a way to preserve vegetables for out-of-season consumption, kimchi is a staple in Korean culture. (Origins: Korea)
- **Poi**. This staple is made from starchy vegetables, usually taro stems, breadfruit, or plantain, that have been cooked and mashed into a paste or dough. Although it can be

eaten fresh, fermenting poi makes it easier to digest and increases the available nutrients. (Origins: Hawaii, Polynesia)

- **Injera**. This spongy, fermented flatbread starts off with teff, an ancient, gluten-free grain. The teff is mixed with water, and then ersho is added to trigger fermentation. Ersho is a liquid containing certain bacteria and yeasts, that is saved from batch to batch of injera. (Origins: Ethiopia, Eritrea)
- **Chocolate**. Once the cacao beans are freed from their pods using machetes — a laborious and dangerous job — the beans and surrounding white pulp are covered and left to ferment. During the fermentation process, chemical changes occur that develop the chocolate flavour. (Origins: ancient Mesoamerica, present-day Mexico)

Other popular fermented foods include beer, yoghurt, wine, fish sauce, soy sauce, cheeses, pickles, and cured sausages.

Practical: Milk Fermentation

The purpose of this experiment is to find out how easy or difficult it is to make cheese in your own kitchen using milk, lemon juice, and cheesecloth.

Research Questions:

- What are some of the benefits to eating cheese?
- Are the benefits the same for eating cheese with live cultures the same as those for eating cheese without live cultures?
- What are curds and whey?
- How did the invention of cheese help different cultures?

The science of making cheese dates back thousands of years. Many different human cultures have made cheese throughout history. The invention of cheese was important to these societies because it allowed them to have a source of protein on hand that did not spoil as quickly as fresh milk or meat. Aged, hard cheeses, in particular, keep for long periods of time in cool places, such as in caves. With an available source of protein, cultures that learned to make cheese could devote their attention to other matters, such as inventing new technology or engaging in artistic endeavours.

Materials

- 8 pints of whole or buttermilk
- The juice of a lemon
- Cheese cloth
- A few heavy books
- A draining board
- A stove
- A strainer
- A slotted spoon

Experimental Procedure

1. Pour the milk in a large saucepan.
2. Bring the milk to a boil.
3. Turn the heat down to low.
4. While stirring the milk continuously, pour in the juice from one lemon (about 1/3 of a cup).
5. The milk will curdle, meaning that the milk fat (curds) separates from the liquid in the milk (whey).
6. Allow the milk to cool slightly.
7. Using a slotted spoon, remove as many of the curds from the milk as you can and place them in the cheesecloth.
8. Pour the rest of the milk through the strainer. You can keep the whey if you would like. It is drinkable.
9. Transfer the remaining curds that are in the strainer into the cheesecloth.
10. Gently roll the curds up in the cheesecloth.
11. Place the cheese cloth on a draining board and place a few heavy books on top.
12. Allow the cheese to drain for two hours.
13. Enjoy. Place any uneaten cheese in the refrigerator. It is best to use the cheese within three days.
14. Experiment with other types of cheeses as time allows. There are several soft cheeses that can be made quickly and easily at home. Many recipes are available through the internet or cookbooks.

Useful Terms/Concepts: Fermentation; Milk; Acid; Bacteria Culture; Harmful bacteria; Beneficial bacteria

Practical: Make your own fizzy drink

Commercial fizzy drinks are fizzy because carbon dioxide has been pumped through them. However, people have also been able to make fizzy drinks for hundreds of years by fermenting them. This is when yeast is used to make the carbon dioxide. In this project, students will make their own additive-free fizzy drink using yeast. They can compare your homemade fizzy drink to fizzy drinks you can buy in the shops.

Research Questions

Buy a fizzy drink (but not a fermented one) and compare:

- What different ingredients do the two drinks have?
- How will our drink differ in appearance from the shop-bought one? For example, is one cloudier than the other, or a different colour?
- How fizzy will our drink be in comparison with the shop-bought drink? Which will give off more CO_2 when we open each bottle?
- Which drink will have a longer shelf-life?
- What additives are there in the bought drink? Why do you think they have been put in?

- How does our drink compare to the bought drink?
- How could we improve our drink?

Ask students what they remember about fermentation. What's needed for it to happen and what's produced? You can encourage them to think of the story of Yeasterson. Find a recipe for a homemade fizzy drink. Popular ones are traditional lemonade and ginger beer. Search for a recipe or you can use this recipe for making ginger beer:

Materials

- 1 litre of boiling water
- 150 g of peeled root ginger cut into thin slices
- 1 lemon
- 140 g of sugar
- 4 g of cream of tartar
- ¼ tsp of dried yeast

Experimental Procedure

1. Put the sliced root ginger in a clean plastic bag and crush it with a rolling pin.
2. Peel the zest off the lemon and put it in a bowl.
3. Squeeze the juice from the lemon and add it to the bowl.
4. Put all the other ingredients, apart from the yeast, in the bowl.
5. Pour over the boiling water. Take care when you do this.
6. Cover the bowl with a clean tea towel. Leave the liquid to cool for 1 – 2 hours. It needs to be kept at a temperature of 25 – 30 oC.
7. Add the dried yeast to the liquid, stir well.
8. Cover the bowl again and leave it somewhere warm for one day.
9. Spoon the yeast off the top of the liquid. Strain the liquid.
10. Pour the liquid into clean plastic bottles. Make sure you leave an air gap.
11. Ferment the ginger beer for up to two days.
12. Place the bottles in a fridge. The ginger beer should not be kept for longer than 6 days.

Remember, you should never drink anything that has been prepared in a laboratory or with laboratory equipment or chemicals.

Useful Terms/Concepts: Fermentation; Yeast; Fungus; CO2; Additives; MIcrobes

Practical: Other things you can ferment

Fermentation experiments can be a fun and educational way to introduce primary school children to science and the fascinating world of microbes. Here are some easy fermentation experiments suitable for young children:

Sourdough Starter

Materials needed

- A glass jar
- Flour
- water
- spoon

Procedure:
Mix equal parts flour and water in the jar to create a thick paste. Cover the jar with a cloth or paper towel secured with a rubber band. Place it in a warm spot. Daily, add equal parts of flour and water, stirring well. In a few days, bubbles will form, and you'll have a sourdough starter. Discuss how wild yeast and lactic acid bacteria are responsible for fermentation in sourdough.

Fermenting Fruit Juice

Materials needed:

- Clear plastic cups
- Plastic wrap
- Rubber bands
- Juice (apple, grape, or any fruit juice)
- A small amount of yeast
- A spoon

Procedure:
Pour a small amount of juice into each cup, add a pinch of yeast, stir gently, cover the top of each cup with plastic wrap secured by a rubber band. Make sure the wrap is slightly stretched so it's not airtight. Place the cups in a warm, sunny spot and observe daily. Explain how yeast turns sugar into gas (carbon dioxide) and alcohol, causing the juice to bubble and ferment.

Fermenting Cucumbers

Materials needed:

- A glass jar
- Cucumbers
- Water
- Salt
- Pickling spices (optional)

Procedure: Fill the jar with cucumbers (you can also add pickling spices for flavour). Create a brine by dissolving salt in water (about 1-2 tablespoons per cup of water). Pour the brine over the cucumbers until they are submerged. Cover the jar with a lid or plastic wrap and let it sit at room temperature for a few days to a week. Discuss how the lactobacilli bacteria transform cucumbers into pickles through fermentation.

Making Yoghurt

Materials needed

- Milk (preferably whole milk)
- Store-bought plain yoghurt with active cultures
- A thermometer
- A pot
- A container

Procedure: Heat the milk in a pot until it reaches about 180°F (82°C), then let it cool to around 110°F (43°C). Add a small amount of yoghurt culture or store-bought yoghurt with active cultures and mix well. Pour the mixture into a container, cover it, and let it sit in a warm place for several hours or overnight. Discuss how bacteria (specifically, Lactobacillus) ferment the milk into yoghurt.

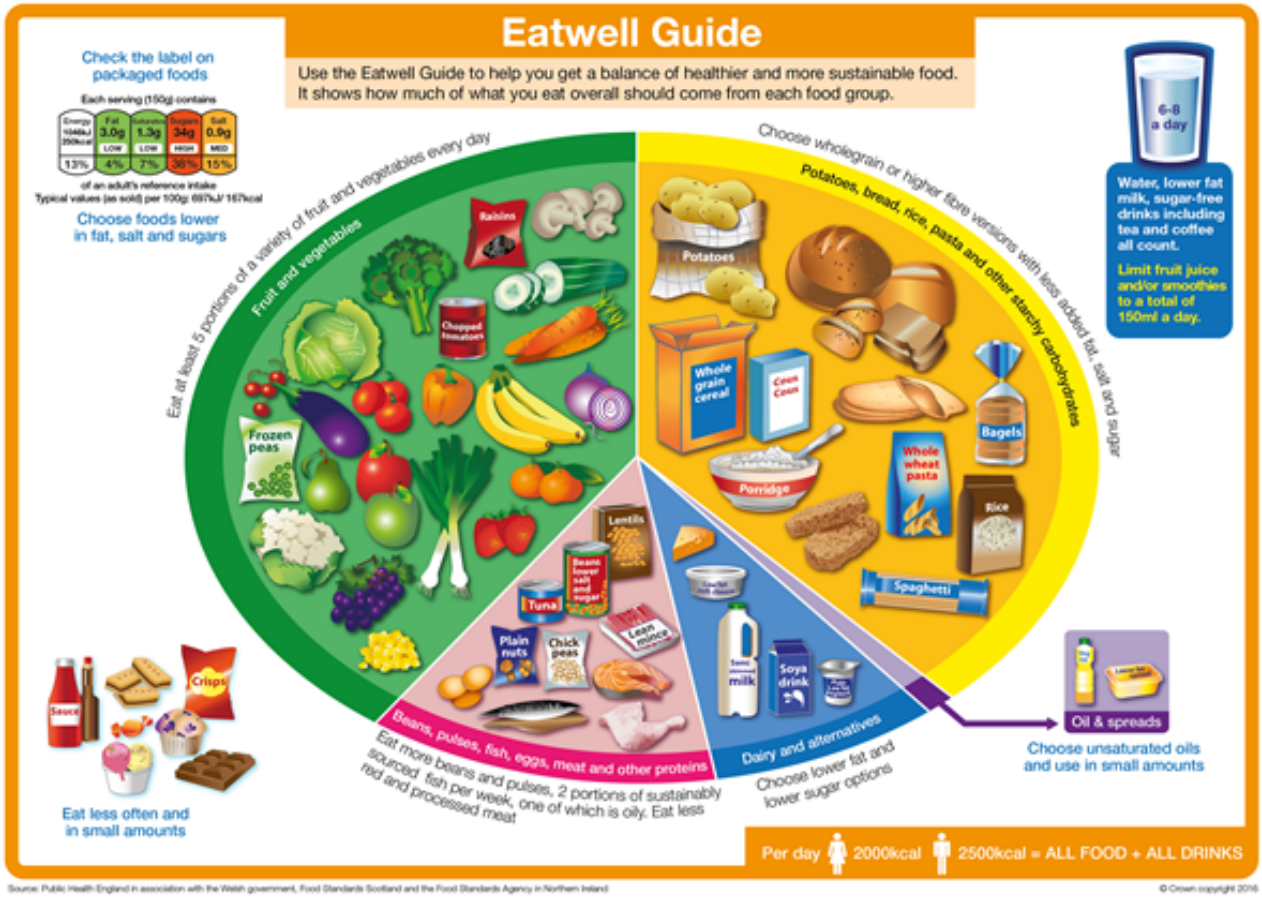
Remember to emphasise safety precautions and explain the science behind each experiment in simple terms suitable for primary school children. These experiments can be a great way to explore the concepts of fermentation, microorganisms, and the role of yeast and bacteria in food transformation

Cooking Up the Curriculum: Top Tips

Food is universal, and therefore a great way to engage students in the curriculum. Science is only one avenue through which we can explore food, and healthy eating habits should be taught as part of health and wellbeing education. The Eatwell Guide below is a helpful image about how much of each food group we need to maintain a healthy and well rounded diet.

Learning can be framed through a number of perspectives, including:

- dedicated food or personal health lessons
- science and physical education
- literacy and maths
- cross-curricular learning, such as STEM, geography, history, religious education and art
- assemblies and event days
- extra-curricular activities and off-site visits



Food is an excellent vehicle for all kinds of learning, and can be incorporated into the teaching of various subjects. Some examples include:

- History: Learning about the types of food people use to eat e.g. the Vikings, Tudors etc.
- Geography: Learning about the climates and conditions needed to grow food, learning about where food comes from and food miles.
- Art: Drawing and painting different types of healthy food, food portraits
- English: Writing instructions for recipes, creative writing about food, using descriptive words when tasting food
- Maths: Counting healthy food, adding and subtracting types of food, learning about portions.
- PE: Learning about energy balance and nutrition for athletes
- Drama: Creating plays and performances to help educate about food and healthy eating
- Languages: Leaning the names of foods in other languages or ordering healthy meals

Careers education is another avenue through which food can be explored, and there are many opportunities in the UK for careers in food all the way from the farm to the fork.

Tasty Careers has amazing resources for students, teachers and parents about the variety of careers available in food, and the different routes young people can take to get into them. Their resources are applicable to all age groups.

Links and further reading about food and the curriculum

The Eatwell Guide: https://www.nhs.uk/live-well/eat-well/the-eatwell-guide/

Change4life School Zone:
https://campaignresources.phe.gov.uk/resources/campaigns/40-school-zone/Change4Life

Food a fact of life: https://www.foodafactoflife.org.uk/

Health Education:
https://www.gov.uk/government/publications/relationships-education-relationships-and-sex-education-rse-and-health-education

Personal, Social, Health and Economic education:
https://www.schoolwellbeing.co.uk/pages/pshe