Yeast

Images and Lesson Plan

Keystage 2

A bit about SAW....

The Science, Art and Writing (SAW) Trust is an international science education charity that breaks down the traditional barriers between science and the arts. SAW lesson plans use themes and images from science as a starting point for scientific experimentation, art and creative writing.
Using the cross-disciplinary SAW approach, our lesson plans are accessible to individuals of varied interests and learning styles.

The following lesson plan is designed to be delivered across an entire school day but can be adapted into separate sessions.

This lesson plan was developed to be part of the Lunchbox Science series and was developed with support from scientist Dr Jo Dicks (Quadram Institute), writer Mike O'Driscoll and Alex Lingford, artist.

Dr Jo Dicks
National Collection of Yeast Cultures (NCYC)

After studying maths at university, Jo became interested in how statistics can be used to look for patterns in large sets of data. This is a powerful tool in biology that enables scientists to explore data from whole genome sequences to individual genes across kingdoms of species. Jo is a computational biologist at the National Collection of Yeast Cultures which hosts one of the world's largest yeast collections, comprising over 4000 strains. Currently she leads a project sequencing the genomes of yeast strains to uncover genetic variation.
There is extraordinary biodiversity present within the NCYC collection and it is being used to identify yeast strains capable of converting agri-food waste into valuable chemicals as well as by many industry partners for a wide range of applications.

For more information, visit the National Collection of Yeast Cultures website;

http://www.ncyc.co.uk

Learning Objectives

This lesson is intended to introduce the single-celled organism, yeast.

Core curriculum areas; Science, Maths, English, Art & Design
Other areas that could be linked to; History, Geography

In this lesson students learn about using yeast to make bread and understand the process of fermentation. Activities include elements of scientific method, measuring volumes, temperature and design.

Included in this lesson pack:

- **Lunchbox Science Yeast Lesson Plan**
- **Lunchbox Science Yeast accompanying PowerPoint**

Yeast

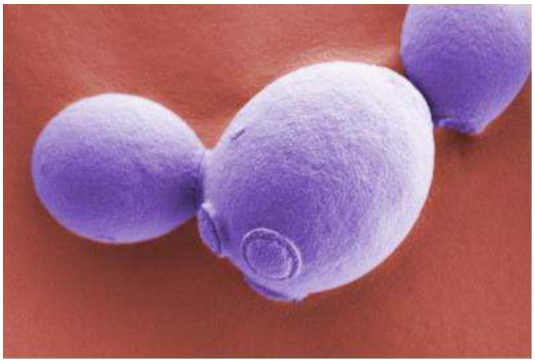
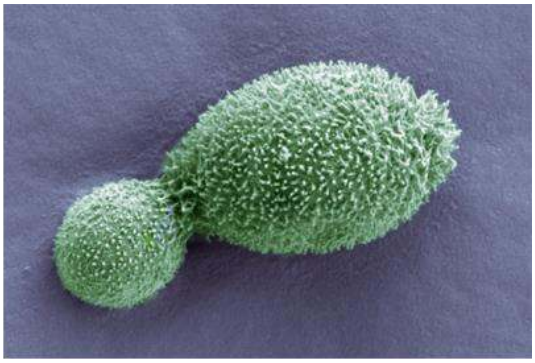
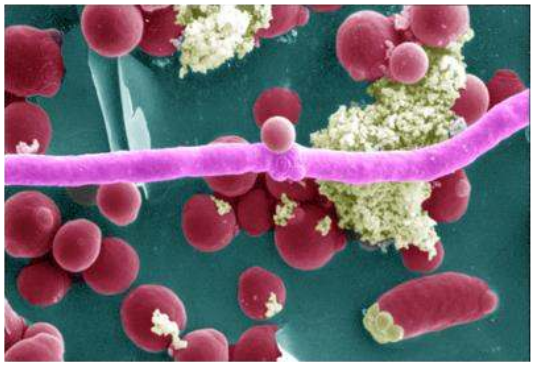
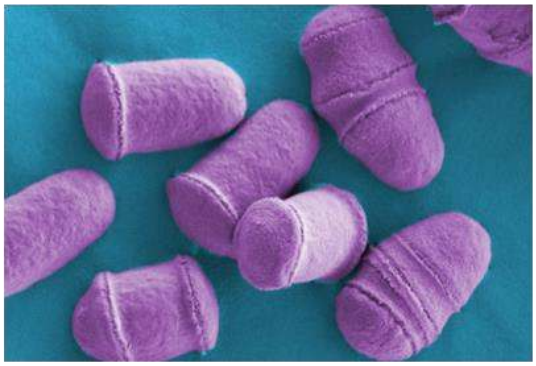
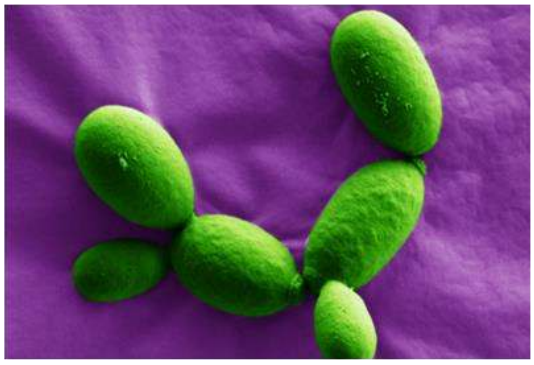
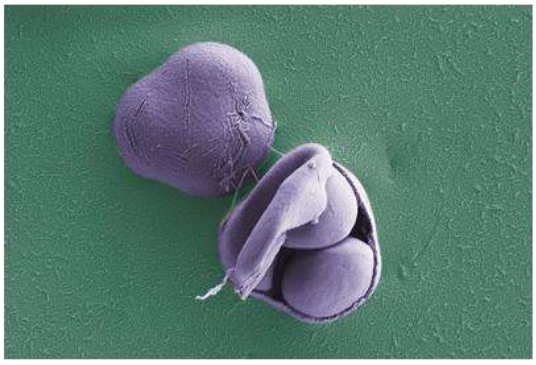
Key vocabulary for the day:

Yeast	A beneficial single-celled micro-organism that is used to make bread.	*Species*	A group of similar organisms that can breed with one another to produce fertile offspring.
Fermentation	A chemical breakdown of a substance by a microorganism such as yeast.	*Strain*	A variety of something, for example a strain of yeast.
Carbon dioxide	A gas commonly produced as a bi-product of fermentation.	*Biofuel*	Fuel derived from living matter.
Colonies	A group of one specific species all living in one area.		
Spore	A tiny single-celled reproduction unit capable of growing into another individual.		

Yeast

Images

- The following images should be used throughout the day to provide a link for the yeast topic.

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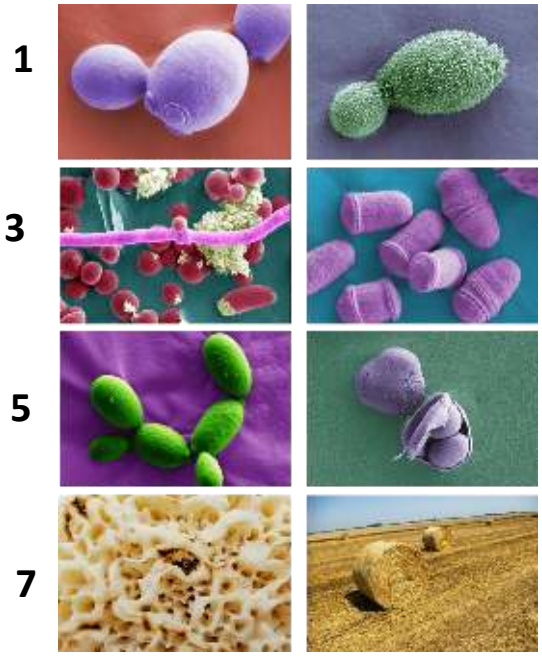
Yeast



1 Scanning Electron Microscope (SEM) image of dividing yeast cells. Kathryn Cross and Carmen Nueno-Palop, Institute of Food Research https://quadram.ac.uk/hail-to-the-ale-yeast/

2 Yeast strain *Cryptococcus shivajii*, a novel 'hairy' Cryptococcus species found growing in a UK industrial biogas reactor. Kathryn Cross, false-coloured by Carmen Nueno-Palop .CC0 NRP Image Library http://images.norwichresearchpark.ac.uk/imagedetails.aspx?imgid=151

3 SEM of "stringy" yeast that grows as filaments. Kathryn Cross and Carmen Nueno-Palop, Institute of Food Research.

4 Yeast strain *Schizosaccharomyces pombe*, also known as 'fission yeast', used in traditional brewing and as a model eukaryotic organism in molecular and cell biology. Kathryn Cross, false-coloured by Carmen Nueno-Palop. CC0 NRP Image Library http://images.norwichresearchpark.ac.uk/imagedetails.aspx?imgid=149

5 SEM image of dividing yeast cells from Galapagos Islands, Ecuador. Kathryn Cross and Carmen Nueno-Palop, Institute of Food Research https://phys.org/news/2015-02-yeast-species-milestone.html

6 Two spore-forming bodies (asci) produced by *Saccharomyces paradoxus*. This species is a close relative of brewer's/baker's yeast (*Saccharomyces cerevisiae*) and is often associated with oak trees. Kathryn Cross, false-coloured by Carmen Nueno-Palop, NRP Image Library http://images.norwichresearchpark.ac.uk/imagedetails.aspx?imgid=150

7 A crumpet. Yeast used in the cooking process releases carbon dioxide gas which is responsible for the holes throughout. S.Stebbings Public Domain

8 Wheat straw. Yeast is used to ferment (break down) sugars found in waste products like wheat straw and turn it into ethanol that can be used in car biofuel. CC0 http://www.freeimages.com/photo/bale-of-hay-1344477

Yeast

Science Session (~1 hour and 30 minutes)

Objectives

Lower KS2:

- Setting up simple practical enquiries, comparative and fair tests
- Using results to draw simple conclusions, make predictions for new values, suggest improvements and raise further questions
- Identifying differences, similarities or changes related to simple scientific ideas and processes

Upper KS2:

- Planning different types of scientific enquiries to answer questions, including recognising and controlling variables where necessary
- Describe how living things are classified into broad groups according to common observable characteristics and based on similarities and differences, including micro-organisms, plants and animals

Use the yeast images and accompanying PowerPoint to introduce the children to these microorganisms. There are approximately 37.2 trillion cells that make up a human body but yeast is just one cell, a single-celled organism. However, there are thousands of different types of yeast living across the world in all kinds of environments, even inside us!

? Yeast is very useful. Does anyone know what yeast is used for?

Many children, with a bit of encouragement are familiar with the fact that yeast is important for making bread. Humans have been using yeast for 10,000 years! These activities explore the science and are best done in the summer term as the yeast works best in warmer temperatures.

Yeast

Activity 1: Making crumpets

Materials per group	Ingredients per group (5/6 children)
Large bowl	87.5g strong white bread flour
Weighing scales	87.5g plain flour
Measuring jug	1 x 7g sachets instant yeast
Wooden spoon	½ teaspoon caster sugar
Teaspoon	175ml warm milk
Cling film	¼ teaspoon bicarbonate of soda
For cooking	½ teaspoon salt
Frying Pan	75ml warm water
Crumpet rings	
Sunflower oil	**This makes 5 - 6 crumpets**

Activity 2: Yeast balloons

Materials per person or pair	
1 empty plastic bottle (500ml)	water (some cold some warm)
2 teaspoons sugar	1 x 7g sachet instant yeast
	1 balloon

Activity 3: Yeast alive!

Materials per person

1 dish, 1 block fresh yeast, 1 teaspoon sugar

- **Use the PowerPoint to help present the following activities –**

Activity 1: Crumpets

Part 1

The recipe was taken from the BBC food website, it makes 10-12 crumpets but we have halved the quantities of ingredients here and suggest children work in groups of 5 or 6. You could pre-weigh the ingredients for each group, although it's a good opportunity for the children to practice measuring out different volumes of liquids and solids.

Preparation time takes 1-2 hours but there are times when they will be waiting for the yeast to rise and so activities 2 and 3 can be slotted into these gaps. Cooking time takes 10-30 minutes – an adult could demonstrate cooking one batch but then cook the rest and bring all the batches back to class later for the children to sample.

Yeast

Ingredients

87.5 g strong white bread flour
87.5 g plain flour
1 x 7 g sachet instant yeast
½ teaspoon caster sugar
175 mL warm milk
¼ teaspoon bicarbonate of soda
½ teaspoon of salt
75 mL warm water

Method

1. Add the two types of flour and yeast into a bowl and stir.
2. Dissolve the sugar in the warm milk (in a measuring jug).
3. Add the sugar and milk mixture into the flour mix and stir until smooth. This usually takes around 3-4 minutes.
4. Cover the bowl with cling-film and place somewhere warm (maybe a sunny windowsill) for 20 minutes (or up to 60 minutes if it is not warm enough).

Move onto Activity 2 while you wait

Activity 2: Yeast Balloons

If the experiment is set up using the following instructions then the balloon should inflate. However, there is an opportunity to use the scientific method!

If there are 6 children working on a table in pairs, encourage them to set up one bottle as described below but then set up one bottle with cold water and one bottle with no sugar. Get them to label which bottle is which and then record the results. There are many more variables that could be introduced such as various temperatures of water, different amounts/types of sugar (i.e, syrup or honey) etc to enable the children to use the scientific method.

Yeast

You will need (per child or in pairs):
1 empty plastic bottle
1 x 7g sachet instant yeast
2 teaspoons sugar
Warm water
1 balloon

What to do:

1. Pour warm (but not hot!) water into the plastic bottle, so that it measures 4-5cm up the side.
2. Add the yeast to the water.
3. Add the sugar to the water and yeast mixture. Put the bottle top on and give the bottle a gentle shake.
4. Remove the bottle top and attach the balloon to the top of the bottle.
5. **Place the bottle in a warm spot and watch**

? What is happening to the balloon? Why is it happening?

Return to Activity 1 for the next step

Part 2

? What does the mixture look like?

5. Mix the bicarbonate of soda and salt with the warm water and stir into the batter in your large bowl.
6. Cover the bowl again and leave it alone for 20 minutes.
7. The crumpets are now ready to cook!

? Does the mixture look different to when you started?
What has happened?

Yeast

Activity 1: Cooking the Crumpets

1. Grease a frying pan and four crumpet rings with sunflower oil and put the frying pan over a medium heat.
2. Drop 2-3 tablespoons of the mixture into each ring. After 4-5 minutes bubbles should appear and the top of each crumpet should no longer be runny.
3. Turn the crumpets over and cook for another 3 minutes.
4. The crumpets are now ready to eat. You can also let them cool and warm them up later in a toaster.

After completing activity 1 and 2

Yeast

Activity 3: Yeast alive!

You will need:
1 dish or saucer
1 block fresh yeast
1 teaspoon sugar

What to do:

1. Open the block of fresh yeast. If you want to, squidge it between your fingers. Smell it.

? What does it feel and smell like?

2. Put the yeast in the dish.

3. Add the sugar to the dish. Stir the mixture until it changes.

? HOW DOES THE MIXTURE CHANGE?

Yeast

Science notes for teachers

Introducing yeast

You might like to start the day having some dried yeast (unlabelled) in a bowl for children to see and touch and ask them if they think it's alive. This challenges them to think about how we determine if something is living. Collect their ideas and note them down to revisit later. You could then do the science activities to reveal that the yeast is a living thing and then show them the amazing microscope images at the end of the science and discuss the long history humans have had using yeast

Activity 1

The chemistry:
When a dough or batter is mixed, the starch in the flour mixes with the water to form a matrix, which is why flour and water can be combined to use as glue for Papier Mache. Other proteins like gluten or polysaccharides add further stability to the matrix. The added yeast feeds on the sugar (fermentation) and releases ethanol and carbon dioxide as a consequence, which creates bubbles of gas in the crumpet batter.
The second addition to the mix of bicarbonate of soda boosts the production of bubbles when the soda warms up, creating further carbon dioxide. The starch in the flour is then "gelatinised", meaning the intermolecular bonds of the starch molecules are broken down in the presence of water and heat, allowing the hydrogen bonding sites to engage more water. This irreversibly dissolves the starch granules in water and "sets" the batter with the holes left by the gas bubbles intact.

The cooking:
Depending on the facilities, it may be best to demonstrate cooking one lot of crumpets in front of the children and then cook the rest later. If it isn't possible for the children to watch them being cooked you could get a colleague to video the first lot being cooked and then show it on the white board. The crumpets that were made in the school Jo visited were cooked in the school kitchen during break time by members of staff and so the children didn't get to see that bit. However, they did get to enjoy eating the crumpets at the end of the day and were given recipes to take away.

Yeast

Activity 2 and 3

The yeast alive and balloon activity proves to the children that yeast is a living thing. It uses the sugar as a food source and creates carbon dioxide gas as a by-product (Respiration). This shows that yeast can be a useful organism, for example when it is used to ferment waste products like wheat straw, where the ethanol and carbon dioxide produced are used as biofuels for cars.
The balloon expands as it fills with gas and yet remains compressed by the balloon, building up energy that would be released if the balloon popped. The children loved watching their bottles and by lining them up on a sunny windowsill, a balloon race ensued!

Building vocabulary

During the science session it is good to create a 'word wall' of new terms that the children are introduced to and are using in context, such as 'fermenting', carbon dioxide, single-celled etc. Any good words that come up can be jotted down on the wall so the children can see how they are spelt and can refer back to them during the day.

The Writing Session (~1 hour and 30 minutes)

Objectives

Lower KS2:

- Gain, maintain and monitor the interest of the listener(s)
- Composing and rehearsing sentences orally (including dialogue), progressively building a varied and rich vocabulary and an increasing range of sentence structures
- Read their own writing aloud, to a group or the whole class, using appropriate intonation and controlling the tone and volume so that the meaning is clear.

Upper KS2:

- Identifying the audience for and purpose of the writing, selecting the appropriate form and using other similar writing as models for their own
- Selecting appropriate grammar and vocabulary, understanding how such choices can change and enhance meaning
- Using expanded noun phrases to convey complicated information concisely

The aim of the session is to use the concepts, experiences, images and new vocabulary from the science as a starting point for writing poetry. This gives children a chance to make a personal response using their best, descriptive language to create a first draft. Spelling, grammar and further editing of work can be done later.

The following session was designed by writer Mike O'Driscoll and was delivered at Catton Grove Primary School with year 6.

Spread a set of the science images out on each table and do a short recap on things that the children remember from the science session. Write any interesting words or facts on the word wall. Pick up one yeast image at a time and ask the children what it looks like. Suggestions can vary and include things such as spongy bullets, purple peas in a pod, a balloon model dog, a fuzzy green fish etc.

Write down the suggestions to help create excitement about the possibilities for imaginative use of the images.

Most children will know that a poem is often written like a song in short verses, that different types of poems exist such as haiku's, acrostics,

kennings and free verse, but it's important to point out that a poem doesn't have to rhyme!

Read a couple of age-appropriate poems of different styles to the students and ask the class after each one, if they liked it, what their favourite line was and demonstrate how the authors were choosing every single word very carefully.

Now encourage the children to use the yeast images for inspiration to write their own poem, drawing on the suggestions they had previously given. This will take around 40 minutes. Walk around the class and support promising lines by reading them aloud to the class.

Quick workers can write short haiku's and acrostics to enable the majority of the class to finish their poems.

For the final 15 minutes the children can take it in turns standing up to perform their poem to the class. Make sure each poem is met with applause.

Example poems

I am Yeast *by Cerise age 10*

I'm a yeast,
I'm a yeast cell,
Purple peas splitting from a pod.
I'm a yeast,
I'm a yeast cell,
Thousands, multiply, strange forms.
I'm a yeast,
I'm a yeast cell,
Bubbling higher, higher and higher.
I'm a yeast,
I'm a yeast cell,
We are yeast and we are everywhere.

Yeast

I'm a yeast *by Zak age 11*

I'm a yeast, yeast,
One cell only,
I come from another yeast,
Multiplying, splitting, separating.
I like sugar, I make gas,
I may look harmless,
But I could be a killer.

I'm a yeast star *by Harvey age 10*

I'm a yeast star,
I'm a purple round sugar-eating beast,
I'm a balloon blowing, multiplying yeast,
I'm a marmite munching king of guy,
I'm a single cell that creates you.

The Art Session (~1 hour and 45 minutes)

Objectives

- produce creative work, exploring their ideas and recording their experiences

Key Stage 1

- to use a range of materials creatively to design and make products
- become proficient in drawing, painting, sculpture and other art, craft and design techniques

Key Stage 2

- to improve their mastery of art and design techniques, including drawing, painting and sculpture with a range of materials

During the following art session designed by Alex Lingford, the structures of yeast seen in the science images (1-6) were explored and created.

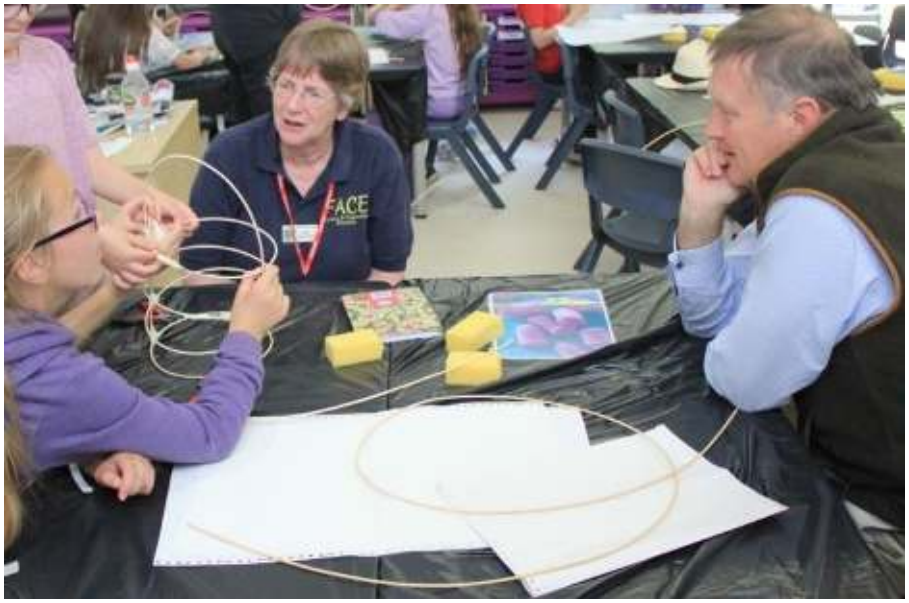
Art Activity – 3D Yeast Structures

Materials

Cane (See resources for sourcing)
Masking tape
Craft pliers
PVA glue
Sponge/paintbrush
Wet strength White tissue paper
Wet strength Coloured tissue paper

1. Soak the cane in water for at least 30 minutes before the start of the session to make it pliable.
2. Ask the children to decide in small groups what type of yeast structure they would like to build using the microscope images provided.

3. Show the children how to bend the cane into shapes and secure in place using masking tape. Make sure to mention they need to be careful not to poke themselves or others in the eyes with the ends of the cane! They can now begin to create their shapes.



4. We suggest starting with one hoop and attaching hoops of various sizes to it using the masking tape. The cane is easily cut with craft pliers.

5. Once the children are happy with the structure, create a mixture of PVA glue and water and brush/sponge the adhesive mixture onto wet strength white tissue paper, and carefully attach it to the cane structure.
6. Once the cane structure is completely covered by one layer of white tissue, let it dry.

7. Refer back to the images again, choose a final colour/colours for the structure and apply the chosen colour of tissue paper using the PVA glue and water mix.
8. A third layer of colour can be added to the structure to make it more robust. Finally covered the structure in a thin coating of the PVA mixture and let it dry overnight.

The final sculptures are light enough to be hung from a display board alongside some yeast-themed poems and some photos of the science experiments to showcase the day!

Thank you to scientist Dr Jo Dicks, writer Mike O'Driscoll and artist Alex Lingford for their support in creating this lesson plan. Thanks also to Moya Myerscough from Farming And Countryside Education (FACE), now merged with Linking Environment And Farming (LEAF).

Useful links

Organisations

www.sawtrust.org	The Science Art and Writing trust
https://leafuk.org/education/leaf-education	LEAF Education
www.ncyc.co.uk	National Collection of Yeast Cultures
https://quadram.ac.uk/	Quadram Institute, Norwich

Resources

Yeast

www.countrysideclassroom.org.uk	Countryside Classroom Resources
www.images.norwichresearchpark.ac.uk	NRP Image Library
http://www.bbc.co.uk/food/recipes/crumpets_61013	Crumpet recipe
https://www.musgrovewillows.co.uk/	Basketry willow for sculpture and wet strength tissue paper

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