



Wheat

Images and Lesson Plan

Key Stage 2

Wheat

A bit about SAW....

The Science, Art and Writing (SAW) Trust is an international science education charity that breaks down 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 in 2015 as part of the Lunchbox Science series and was designed in collaboration with scientist Simon Orford (John Innes Centre), writer Mike O'Driscoll and artist Molly Barret.

Simon Orford

John Innes Centre



After completing a BSc in Agriculture and Environmental Biology, Simon Orford joined the John Innes Centre in 1991 to work on the genetic improvement of wheat. Simon works in a research group led by Dr Simon Griffiths looking into global landraces of wheat collected in the 1930s to uncover genes not present in the modern commercial breeding pool. This could prove crucial to the long-term sustainability of wheat

production. Most of Simon's research at the JIC over the last 24 years has involved collaborations with the wider UK wheat industry working on a variety of goals. Past research projects have included introducing salt tolerance to wheat with the Overseas Development Agency to making improvements to the feed value of wheat with the Agriculture and Horticulture Development Board. He is currently part of the Wheat Improvement Strategic Programme (<http://www.wheatisp.org>).

Wheat

Learning Objectives

This lesson is intended to introduce key concepts of wheat production.

In this lesson students learn a brief history of wheat, wheat production and breeding and about gluten, a major component of wheat grains.

Included in this lesson plan pack:

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

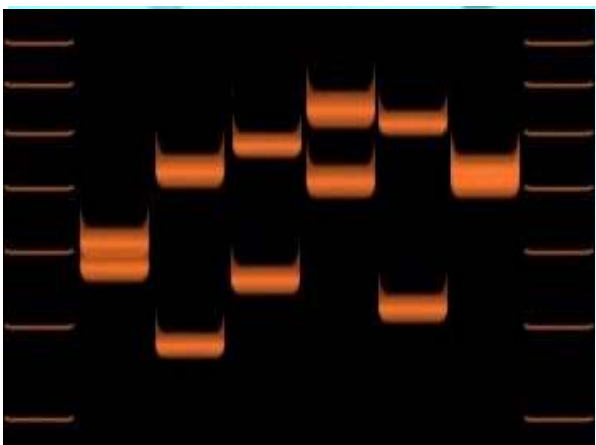
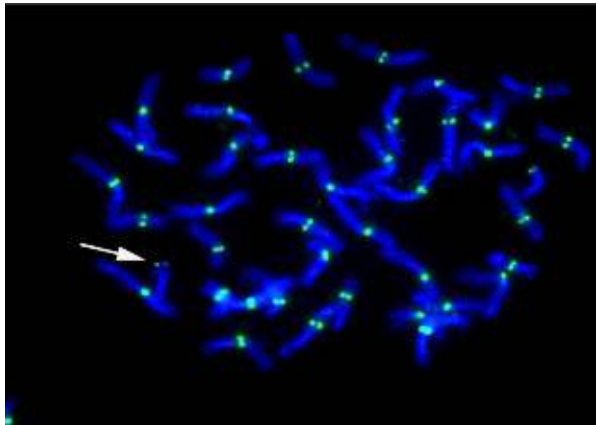
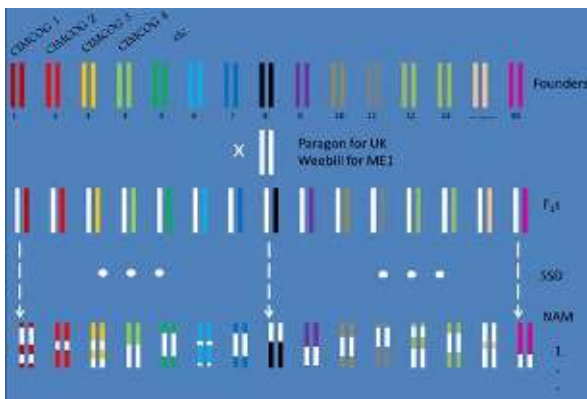
Key vocabulary for the day:

| | | | |
|-------------|--|------------|--|
| Agriculture | The practise of growing crops or raising animals for food. | Starch | A carbohydrate made by plants to store energy gained from sunlight. |
| Crops | Plant or animal product that can be grown and harvested extensively for profit or subsistence. | Yield | The amount of produce generated from a crop. |
| Cultivate | Nurture and help something grow. | Chromosome | An organised package of DNA found in cells, containing an organisms genetic information. |
| Cultivated | Purposely growing a plant for its produce | | |
| Gluten | A protein found naturally occurring in wheat and other grains, such as oat and rye. | Floret | One of the small flowers forming the head of a composite plant, like grasses. |

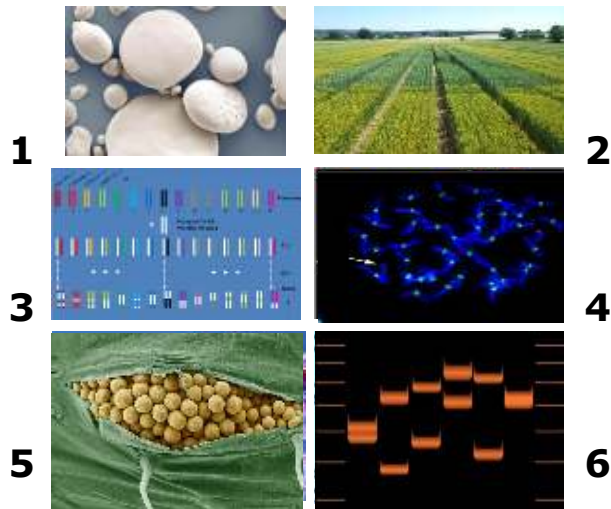
Wheat

Images

- Simon chose the following images to introduce the topic of wheat. These are used throughout all the activities to maintain the wheat theme. We recommend having these on display at the start of the day for students to view and discuss.



Wheat



1 Starch granules isolated from mature grain of durum wheat (*Triticum durum*) cultivar Kronos. Semolina flour from Kronos is used widely for making pasta. Imaged by scanning electron microscopy and false-coloured.

Brendan Fahy, NRP Image Library. CC BY1.0

2 These rectangular patches with different shades of green are part of a typical field trial. The wheat plants are grown on plots of 6 x 1.5 metres.

By Simon Orford, John Innes Centre CC BY 1.0

3 Simplified scheme of crossing different plant varieties to combine their characteristics (traits). The image shows when the chromosomes of a certain wheat variety (white) are paired with other varieties. The offspring generation will have individually mixed characteristics.

By Simon Griffiths, John Innes Centre. CC BY 1.0

4 Microscopic images of chromosomes (blue) with fluorescent markers (green) at the centromere region. These kinds of markers are used to identify the locations of plant genes responsible for characteristics of interest.

Guo X, Su H, Shi Q, Fu S, Wang J, Zhang X, et al. (2016) *De Novo* Centromere Formation and Centromeric Sequence Expansion in Wheat and its Wide Hybrids. *PLoS Genet* 12(4): e1005997. doi:10.1371/journal.pgen.1005997 CC BY 3.0

5 Microscopic image of a wheat leaf infected with yellow rust fungus. The image shows a leaf being ruptured by emerging spores post-infection that will spread by the wind to infect more wheat plants.

By Kim Findlay, John Innes Centre. CC BY 1.0

6 Image of a gel with different band patterns of DNA that act like a fingerprint to compare and identify the characteristics from different individuals.

By Palewhalegail. CC BY 3.0

Wheat

Science Activity (~1 hour and 30 minutes)

Lower Key Stage 2

- identify that animals, including humans, need the right types and amount of nutrition, and that they cannot make their own food; they get nutrition from what they eat
- setting up simple practical enquiries, comparative and fair tests

Upper Key Stage 2

- identify how animals and plants are adapted to suit their environment in different ways and that adaptation may lead to evolution
- 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
- planning different types of scientific enquiries to answer questions, including recognising and controlling variables where necessary

Use the accompanying Lunchbox Science Wheat lesson plan PowerPoint to introduce the topic of wheat and conduct the following activities.

Introduce the science topic by exploring the images and by reading Little Red Hen for lower Key Stage 2, then begin science activity 1.

Science activity 1: The Wheat Guessing Game

1. Place paper with one of the following letters (A, B, C, D) in each corner of the class.
2. Ask the children one of the questions below and tell them to go to the letter they think is the correct answer.
3. When you reveal the answer, only the children who were correct continue. The children who have the most answers correct win the game (last people playing).

Wheat

Question 1



If we planted one wheat seed in a pot – How many roughly could we expect to get back when the wheat plant is harvested?

- A) 5
- B) 10
- C) 100
- D) 500

Question 2



What does a wheat seed need to germinate?

- A) A nice bedtime story
- B) Sunshine
- C) Warmth and water
- D) Coca Cola

Question 3



Which of these plants is most related to wheat?

- A) Carrots in a farmer's field
- B) Grass on a playing field
- C) Cabbages in a garden
- D) Peas on a plate

Question 4



What is the smallest part of a wheat plant?

- A) Leaf
- B) Seed
- C) Cell
- D) Root

Question 5



Who grows the biggest yields* of wheat in the world?

- A) UK
- B) New Zealand
- C) Russia
- D) USA

*Yield meaning tonnes of grain per hectare

Using the PowerPoint, continue to **Activity Two: Discovering Wheat Plants**. During this activity, children will dissect wheat plants to discover the different parts of the plant. You could ask a local farm to supply plants or grow some yourself (many wild bird food mixes contain wheat seed).

Wheat

Science activity 2: Discovering wheat plants

Materials for groups of 2-3 children

- 2-3 wheat plants (save some plant parts for the art)
- magnifying glasses
- microscopes if available
- pencil and plant labelling sheet
- paper and glue

Check for seed allergies in the class

1. Have a look at the wheat plants on your table.



How many different plant parts can you identify?



2. Measure your plant.



How tall is your plant?
How many stems and leaves can you count?
How many seeds are in a single wheat ear?

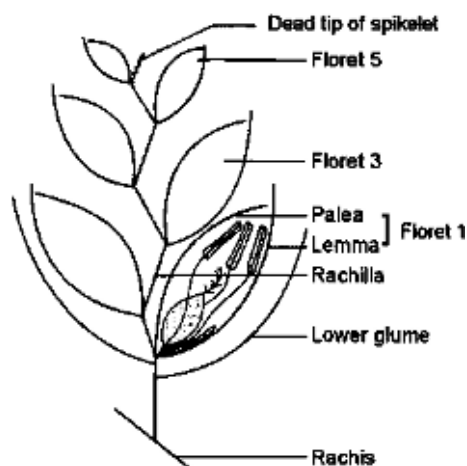
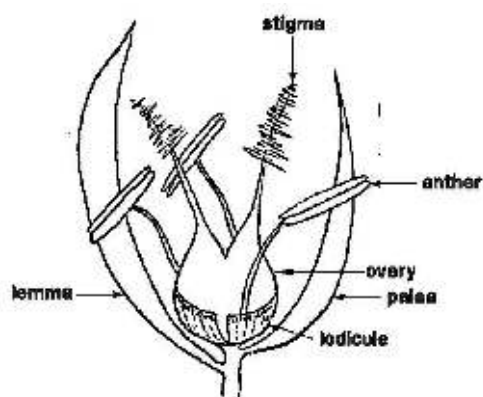


3. Take off different parts of the plant. Use a magnifying glass to see more details.



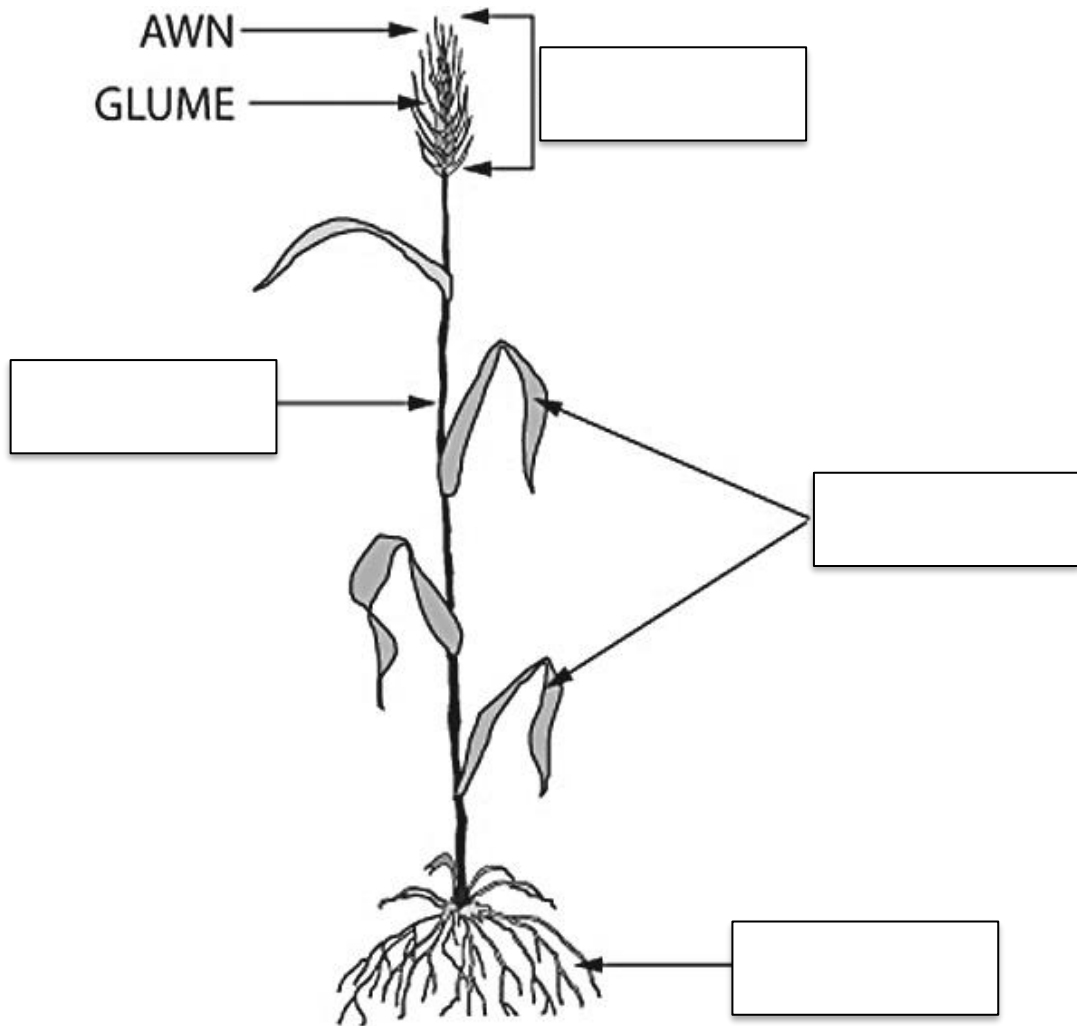
Can you see any flowers?
Do they look like flowers?
Are there any other interesting patterns?

Wheat Florets



Wheat

Parts of a wheat plant



Ear

Stem

Roots

Leaves

The _____ soak up water and minerals from the ground. They also store food for the plant.

The _____ supports the plant. It contains thin tubes for carrying food, minerals and water.

The _____ contains the grains of wheat that are milled to make flour.

The _____ make food for the plant by absorbing energy from sunlight. They take in carbon dioxide and release oxygen.

Wheat

Science activity 3: Gluten Balloons

Materials per group of 2/3 children

- Bread flour
- Mug
- Sieve/colander
- Bowl
- Spoon

And a bicycle pump (more than one would be preferable)

During this activity the class will make their own gluten balloon by washing the starch out of wheat dough balls.

Step 1: Create a dough ball

Pour two mugs of bread flour into a bowl. Slowly add 1- 1½ mugs of water. Using a spoon mix the flour and water, once you have added enough water, create a dough ball with your hands. Aim for the ball to be non-sticky to the touch.

Step 2: Wash out the starch

Place the doughball in a sieve and run water over it, squeezing the dough ball. The water will be milky in appearance. Once all the starch is washed out the water should run clear and the remaining ball of gluten should be similar in texture to chewing gum.

Step 3: Create your gluten balloon!

Once the surface water of the gluten ball has dried off, use your hands to slightly flatten out the gluten ball (be careful not to rip it) and wrap it round the end of the bicycle pump tube. Be careful to seal all gaps so that it is air tight. The children can then pump up their balloons!



Left to right: mixing flour and water to create dough ball. Washing out the starch. Wrapping gluten ball around pump. Gluten balloon.

Wheat

Activity guidance for teachers

Activity 1

Correct answers: 1 – D, 2 – C, 3 – B, 4 – C, 5 – A

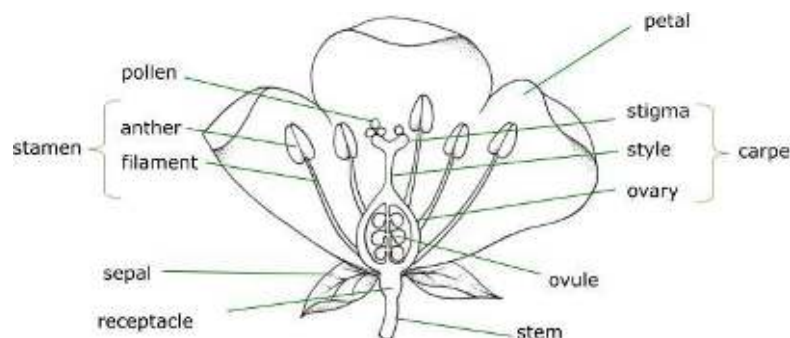
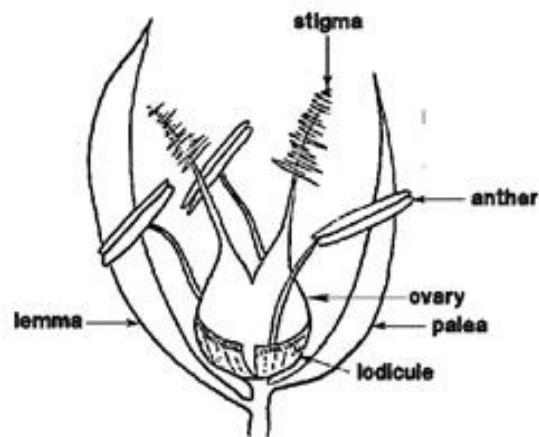
Activity 2

Plant samples

Fresh plants can be sourced by asking local farms or by growing your own. Bunches of dried wheat plants can be bought through florists and some craft bakers. Other wild grasses can be used as an alternative if they are of a similar structure.

The almost hidden flowers (florets) of wheat and grass plants may look completely different to the colourful flowering plants in our gardens but they share a common structure. The female reproductive part (stigma or carpel) in the centre of the flower receives pollen from the male reproductive part (anther or stamen) arranged around the centre. Instead of having colourful petals, the reproductive parts in wheat are surrounded by green sheets (palea and lemma). They serve as a protective barrier for the florets and the seeds later on.

Wheat floret diagram:



Wheat

Activity 3

Earlier in the science session the children would have been introduced to starch and gluten, the dough ball they create contains both. By washing the flour dough ball, they wash away the starch and are left with the stretchy gluten ball.

The dough ball may fall apart as you rinse out the starch – don't worry – it should bind back together again and form a firmer, stretchy substance. Its important to dry and knead the gluten ball to make sure it can bind properly and not to pull it apart or rip it.

The stretchy and binding properties of gluten means that it will stretch when filled with air. In this activity the children will use bread flour to create their gluten balloons as it has the highest gluten content. Other flours can be used but the quantity needed and strength of their balloon will vary.

Teacher notes

Background Info

Wheat developed from wild grass plants in the middle east (Syria, Lebanon, Iran, Iraq) about 10,000 years ago. It was one of the earliest crops to be cultivated and is now the third most widely grown crop in the world - after maize (sweet corn) and rice.

Wheat has a relatively short growing season and thrives in temperate climates.

The wheat seed is the part that we use, mostly ground into flour for baking into bread, biscuits etc (milling wheat). The stems (straw) and roots are usually recycled by the farmer: ploughed back into the soil or the straw used for animal bedding. A lot of the wheat grown in this country is fed to farm livestock (feed wheat).

One wheat seed grows several shoots and so at harvest farmers expect to gather about 180 wheat seeds for every one seed that has been planted. If grown in a pot (with no competing plants), one plant can generate as many as 500 seeds!

On average a square metre plot of wheat will produce a kilo of wheat seed that will grind into 800 grams of flour – enough to bake a large loaf.

There are generally two types of wheat, which are called hard wheat, and soft wheat. The hard wheat produces flour with highest levels of gluten – essential for bread making. Hard wheat grows best in the USA and Canada so much of the bread that we eat is made from wheat grown abroad. However plant breeding has produced some harder wheat varieties that will grow in this country so it is possible to buy 'locally grown bread' mostly from small scale 'artisan bakers' who use wheat from local farms. Most of the milling wheat produced in the UK is used for biscuits etc.

Wheat

An alternative introduction to wheat that's particularly suited to younger children is to begin by asking the class who ate grass or plants for breakfast! They will not think they have but when they begin to tell you about the cereal or toast they had it's the perfect starting point for learning more about wheat. Follow this by telling them the folk story, Little Red Hen which will explain the whole process from planting a seed of wheat right through to making bread, with a message about the benefits of team work underlying the story.

Vimeo Little Red Hen story: <https://vimeo.com/170164673>

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 developed by Mike O’Driscoll in the Mile Cross Primary School project on the theme of wheat.

Spread the science images out on all tables and begin with a short recap on things the children remember from the science session. Write any interesting words or facts on the board.

Next ask the children to name as many foods as they can think of that are made using wheat. Suggestions can include things such as bread, cakes, pasta, biscuits, pies etc. The children may well be surprised by the number of things that they eat every day that contain wheat.

Show them the image of the yellow rust spores bursting out of a diseased wheat leaf and ask them what it looks like. Explain that sometimes plants get sick and in ancient Greece, classical poets would write a special kind of poem called an “ode to the gods” asking that they protect the wheat crops so that they have a plentiful harvest.

Then ask the children if they know what a poem is and discuss any poems that they may have come across as a class before, for example Haiku’s and acrostic poems. Also discuss with the class whether a poem needs to rhyme (it doesn’t!).

Wheat

Read a selection of poems written in different styles about wheat to the class. One is available in the PowerPoint provided. Discuss the poem(s) with the children, what was their favourite line or word? Did they see any similes etc?

Then encourage the children to write a poem inspired by the science session and the poetry introduction. Provide plain paper to jot ideas, word-pairings and to draft lines on. When they feel ready, give them lined paper to write their poem.

Walk around the room to support the writers and spot any promising lines that you can read out to the class.

We suggest allowing the children at least 40 minutes for quiet writing.

For the final 15 minutes have the children take it turns to stand at the front of the room to perform their poem, make sure all of which are met with applause.

Example Poems

Wonderful Wheat by Jessica, age 8

In wheat a flower hides.
In wheat seeds wait to grow.
The wheat itself is an ingredient to us.
The soil we rely on to grow the wheat.
We lay the wheat in rows.
When the wheat starts to grow it is always a shade of green.
When it is ready to pick it is usually a golden shade.
If you ate some wheat a long time ago and it had a disease you might go crazy.
Let the sun shine and the clouds make it rain.
Wheat gives us delicious food.
Farmers please look after our wheat and harvest it.

Thank you by Isabelle, age 9

Wheat, wheat, wonderful wheat,
Chop it down when it's ready to eat!
Chocolate biscuits, pasta too,
I love them, how about you?

Seeds growing out of the ground,
Silently, without a sound.
Leaving not a trace,
But a smiley face.

Wheat

We pray to say,
Thank you, thank you, we say today.
Protect it from rust,
Or it will bust!

Harvest in summer,
Not in autumn or winter.
We pray to say,
Thank you, thank you, we exclaim today!

Wheat

The Art Activity (~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

The theme of crossing wheat varieties to optimise plant characteristics is further explored in the following art session developed by Molly Barrett.

Note: you will need to use leftover pieces of the wheat plants in both these activities so be sure to save some.

Art Activity One: Wheat Collage

Materials

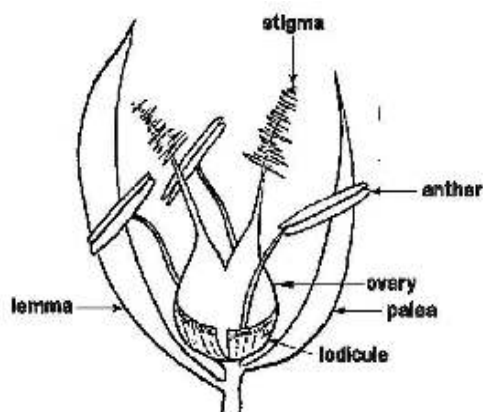
Paper and pencil

PVA glue (or glue stick)

Wheat seeds/ears (left over from science activity)

Long piece of paper (used as a stem)

Large A3 paper (Used to draw and cut out a wheat ear shape)



1. Working in pairs, have the children draw around their hands, this enables them to create a shape that loosely looks like that of the wheat flower (left).
2. Then have the children decorate their wheat flower with the seeds and wheat ears you used in the science activity
3. Then have the children place their dry wheat flower on the wheat ear. (we suggest that you have the wheat ear and stem already set up, possibly on a display wall).

The class will then have created a large collaborative piece of art.

Wheat

Art Activity Two: Wheat Varieties

Materials

Clay (preferably in a range of colours or paint can be used when the clay is dry)
Wheat plant parts
Rolling pin
Water

In the following activity the children will make patterns using parts of the plant on a square slice of air-drying clay. This clay tile represents a section of DNA on a chromosome that carries information about the section of plant pattern that is printed on it. This connects the art to the science session in which the children should have learnt about improving wheat to make plants more resistant against diseases and to optimise their yield.



1. Experiment with making patterns. In the first part of the activity, the children experiment with making patterns by pushing plant parts dissected from wheat in the science session into a rolled-out piece of clay. They can either use the plant parts to replicate the pattern of the plant or create entirely new patterns. This gives them an opportunity to practice working with clay and to explore what patterns they can produce. (If the clay becomes too dry, it can be moistened with a little bit of water).

2. Creating a chromosome tile. In the second part of the activity children are shown how to cut out a square tile from clay to create their final pattern on. Different colours of clay can be used to represent different wheat varieties. (Alternatively, white clay can be painted after drying).



Wheat

Leave the clay to dry and then arrange and glue the coloured tiles onto a large piece of card to represent the chromosomes of mixed wheat varieties, which inherited characteristics from their parent plants.



Useful Links

Organisations

| | |
|---|-----------------------------------|
| www.sawtrust.org | The Science Art and Writing trust |
| www.leaf.org | Linking Environment And Farming |
| www.jic.ac.uk | John Innes Centre, Norwich |
| http://www.wheatisp.org | Wheat Improvement Strategic Prog. |

Resources

| | |
|---|--------------------------------|
| https://en.wikipedia.org/wiki/The_Little_Red_Hen | Little Red Hen Story |
| http://daisyshop.co.uk/ | Dried Wheat bunch |
| www.images.norwichresearchpark.ac.uk | NRP Image Library |
| http://www.saps.org.uk | Science And Plants for Schools |
| www.countrysideclassroom.org.uk | Countryside Classroom |



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