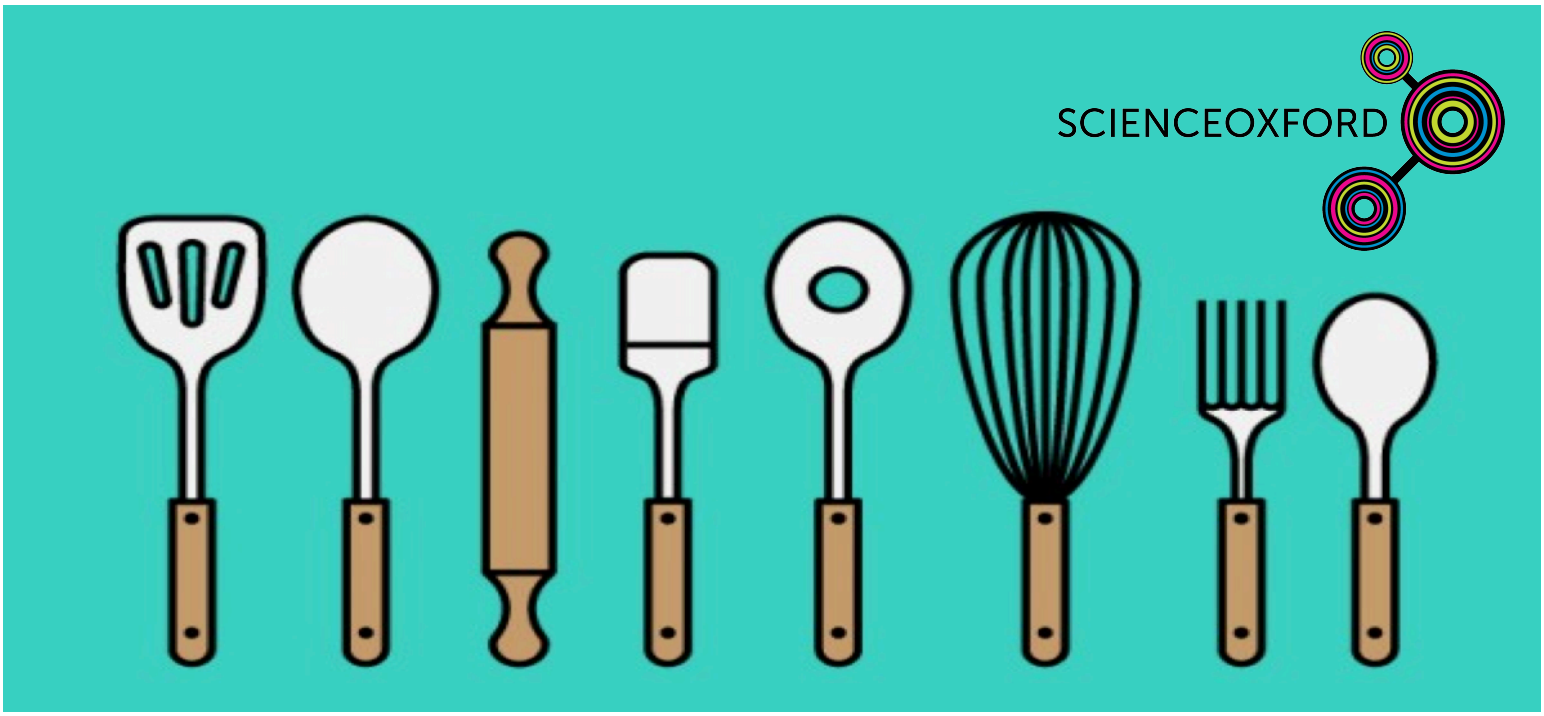


SCIENCEOXFORD

With support from Oxfordshire County Council,
Science Oxford is pleased to present

Kitchen Chemistry

The Science of Popcorn and Jelly

STEM Club Resource Pack

OXFORDSHIRE COUNTY COUNCIL

SCIENCEOXFORD

Introduction:

Have you ever wondered why corn pops in such a dramatic fashion and why jelly instructions say not to add pineapple to the mix?

Through kitchen chemistry and the appliance of science your mission is to answer these questions plus any others you come up with along the way

In this investigation you will be studying the properties of popping corn and jelly and discovering the science behind their behaviour.

- What are the specific properties of corn that make it ideal for popping?
- Can you make other grains pop?
- How much profit are the cinema chains making on their popcorn sales?
- Why does pineapple prevent jelly from setting?
- Are there any other fruits that act in the same way?
- Do all forms of pineapple prevent jelly from setting?
- Can we overcome the problem?

Completion of the project and presenting your findings will entitle you to receive a British Science association **CREST Bronze Award.**

CREST Awards

A British Science Association programme

Suggested Timetable:

Week 1 - Club launch event

Introduction to STEM Club and fun demo or activity

Week 2 - Let's make some popcorn

Prepare popcorn and discuss the science behind it

Week 3 - The essential properties of popping corn

Compare different types of corn

Week 4 - Puffed rice

Does popping rice work too?

Week 5 - Price analysis of popcorn

How much profit do cinemas make on popcorn?

Week 6 - Let's make some jelly

Prepare Jelly and discuss the science behind it

Week 7 - All sorts of pineapple

Does making jelly with pineapple work?

Week 8 - Do any other fruits behave the same?

Compare making jellies with different types of fruit

Week 9 - Can we reverse the effect?

Experiment to make Jelly with pineapple by adding another ingredient

Weeks 10 and 11 - Communicating your work

Create a poster and prepare for Bronze CREST Awards

Week 12 - Let's celebrate!

Showcase your work

Equipment List:

Week 2 - Food Technology Room:

- Cooking oil, popping corn
- Bowls, jugs for collecting popcorn
- Sugar and salt for tasting

Week 3

- Popcorn machines
- Samples of corn (popping corn and animal feed)
- Plastic bags
- Rolling pin

Week 4

- Heavy based saucepans with lids
- Samples of rice

Week 5

- "Popcorn price list"
- Cinema popcorn tubs
- Measuring cylinders
- Calculators

Week 6

- Liquidiser
- Commercial jelly cubes
- Pureed pineapple fruit and juice
- Measuring Jugs
- Petri dishes for preparing jelly
- "The science of gelatine" PowerPoint presentation

Week 7

- Jelly cubes
- Liquidised samples of fresh, frozen and tinned pineapple

Week 8

- Jelly cubes
- A variety of different liquidised fresh fruits and juices

Week 9

- Jelly cubes
- Fresh pineapple puree and chillies

Week 2: Let's make some popcorn

Equipment List:

Popcorn machines	Popping corn
Heavy based saucepans with lids	Bowls/jugs for collecting popcorn
Cooking Oil	Sugar and Salt for tasting
"The Science of Popcorn" PowerPoint presentation	"The Science of Popcorn" Demonstration kit

- Prepare popcorn using the popcorn machine and traditionally in a saucepan
- Discuss the process and what the requirements were to make the corn pop
- The science of popping corn (PowerPoint presentation)
- Visual demonstration
- Design experiment to test the required properties for popping corn

Week 3: The essential properties of popping corn

Equipment List:

Popcorn machines	Samples of corn (popping corn and animal feed)
Plastic Bags	Rolling Pin

- Prepare 4 samples of corn for inclusion in the experiment
  - Normal popping corn
  - Popping corn which has been soaked in water for several hours
  - Maize animal feed
  - Popping corn with damaged pericarp
- Test the different samples under controlled conditions
- Discuss results

Week 4: Puffed rice

The Science of Breakfast Cereals

Many breakfast cereals are made from "puffed" grains, such as corn, rice and wheat. We have shown how to puff or "pop" our popcorn kernels using a popcorn popper that works by circulating hot air through the kernels. Nearly this same principle is applied when puffing rice; however, one element is missing from rice that is part of popcorn and that is a hard outer shell to encase the moisture that allows the kernel to be popped without exploding into pieces. You cannot, then, just toss some rice into your air popper and expect it to puff. Most commercial puffed rice is made using very high pressure that would be difficult to do at home and not recommended; however, there are a few other techniques that you can employ using just a few kitchen items that are simpler.

To set the scene, watch the BBC clip from Jimmy's Food Factory which can be accessed here: http://www.bbc.co.uk/education/clips/zpwvr82

Making Puffed Rice

Equipment List:

Heavy based saucepans with lids	Samples of rice (wild, long grain, pudding)
Wok/large saucepan and oil	Metal sieve

Method:

1. Wash 1 cup of any type of rice until water is clear.
2. Drain the rice
3. Place rice into a saucepan and cover with 500ml of water
4. Bring the water to a boil.
5. Cover and cook on low for 25 minutes or until all the water has been absorbed
6. Drain the rice and spread it onto a baking sheet that is lightly greased.
7. Make an even layer approximately 0.5cm thick.
8. Set your oven to 275 degrees Fahrenheit (135 degrees Celsius).
9. Bake your rice for approximately 2 hours.
10. Remove from oven and cool.
11. Break the outer shell of the rice by rolling it with a rolling pin
12. Spread the rice on a baking sheet and bake again in the oven at 275 degrees for about half an hour
13. Allow to cool
14. Your rice is ready for puffing.
15. Spread it on a baking sheet and place in a hot oven and watch it bounce around as it pops

Alternative method 1

Follow instructions to stage 11

1. Pour 2cm of cooking oil into the bottom of a large heavy base saucepan.
2. Heat your cooking oil to 375 degrees Fahrenheit (191 degrees Celsius).
3. Place your broken rice pieces carefully into the oil.
4. Fry your rice pieces until they are puffy, approximately 1 minute.
5. Remove your rice pieces from the oil.
6. Place your rice on paper towels to drain.

Alternative method 2

Using the sample of wild rice with the husks still intact;

1. Heat some oil in a wok to about 375 degrees Fahrenheit (191 degrees Celsius).
2. Drop kernels of rice, a few at a time, into the hot wok (very carefully); they will begin to puff and pop.
3. Drain your puffed rice and allow to cool.
4. Separate the husk from your puffed rice using a sieve.

Week 5: Price analysis of popcorn

Equipment List:

"Popcorn price list"	Measuring Cylinders
Cinema popcorn tubs	Calculators

The Profit in Popcorn

1. Research the prices of popping corn and commercially available popped corn
2. Note the volume of popped corn available to buy
3. Repeat popping experiment from week 1 to determine the change in volume between un-popped and popped corn
4. Calculate how much popping corn would be required to produce the measured volume of commercial popcorn
5. Calculate how much profit we are giving to the cinema chains each time we buy a carton of popcorn

Product	Source	Price
Popping corn 	Supermarket	£1.90
Popped corn 	Supermarket	£1.00
Small Popcorn 	Cinema	£3.95
Medium Popcorn 	Cinema	£4.95
Large Popcorn 	Cinema	£5.95

Calculate the volume increase between un-popped and popped corn

1. Using a small measuring cylinder measure 50ml of popping corn
2. Add the corn to the popcorn machine and collect the popped corn in a large measuring jug
3. Measure the volume of popped corn produced
4. Calculate the increase in volume;
   volume of popped corn
   Volume of un- popped corn

Calculate the weight/volume of the commercial popcorn

1. Ask the students to suggest ways to do this
2. Discuss the pros and cons of measuring weight or volume (weight will be the same for popped and un-popped)
3. E.g. fill with water and measure volume of the water in measuring jugs

Calculate the volume of un-popped corn required to produce these volumes and compare costs

1. Using the change in volume value calculated in step 1. Calculate how much un-popped corn would be needed to produce these volumes
2. Calculate what the price would be of the un-popped corn and compare to the price charged by the cinemas
3. Discuss what additional costs the cinemas would have to add to this amount

Present your findings

1. Remember to write down all the results and calculations
2. Record any comments and discussions
3. Present figures

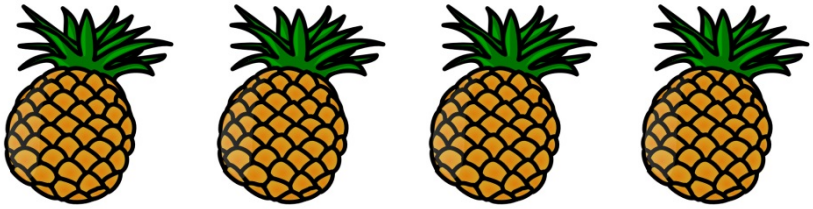
Week 6: Let's make some jelly

Equipment List:

Liquidiser	Pureed pineapple fruit and juice
Commercial jelly cubes	Measuring Jugs
Petri dishes for preparing jelly	"The science of gelatine" PowerPoint presentation

1. Prepare jelly with and without added pineapple juice and fruit
2. Note which jellies set quickest and best
3. The science of gelatine (PowerPoint presentation)
4. Design experiment to test the theory

Week 7: All sorts of pineapple



Enzymes and jellies

Jellies are made from gelatine. When it is dissolved in hot water and allowed to cool, gelatine forms a three dimensional network of molecules that holds water rather like a sponge. Party jellies are just gelatine with added sugar, fruit flavouring and colouring.
Many people like to add fruit to jellies but you will not be able to make jellies with certain fresh fruit such as **pineapple, kiwi fruit or papaya** – the jelly will not set. Jelly packets usually have a warning about this in the instructions. However, tinned versions of the same fruit can be added and the jelly will set without difficulty.

Your task over weeks 7 and 8 is to find out as much as possible about this apparent mystery.

Equipment List:

Jelly Cubes	Liquidised samples of fresh, frozen and tinned pineapple

1. Prepare jellies using fresh, frozen and tinned pineapple juice and fruit. Remember to include a sample made with water for comparison
2. Discuss the results
3. Explain why some set and some didn't

Week 8: Do any other fruits behave the same?

Equipment List:

Jelly Cubes	A variety of different liquidised fresh fruits and juices

1. Prepare jelly using a variety of different fruits (try to include kiwi and papaya if possible)
2. Compare which jellies set and which do not
3. Record your results

Week 9: Can we reverse the effect?

Equipment List:

Jelly Cubes	Fresh pineapple puree and chillies

1. Talk about Heston Blumenthal and his chilli and pineapple jelly
2. Try making pineapple jelly with and without varying amounts of chilli
3. Note that this technique is not 100% effective, so multiple samples are recommended
4. Discuss your results

Weeks 10 and 11: Communicating your work

1. Produce an A2 sized poster describing the aims of your investigation, how you planned your experiments, your results and your conclusions
2. Make your posters as colourful and interesting as possible
3. Complete your CREST Bronze workbooks

Week 12: Let's celebrate!

1. Invite your friends and family to the STEM Fair
2. Showcase your work and your posters to invited guests
3. Receive your CREST Bronze awards