EASY | 8 - 12 | 30 MINS *plus 3 days for observations*

1. Learn about the work of Hans Krebs
2. Investigate what yeast needs for respiration
3. Find out why yeast is used in baking

STORIES IN CHEMISTRY

USEFUL YEAST

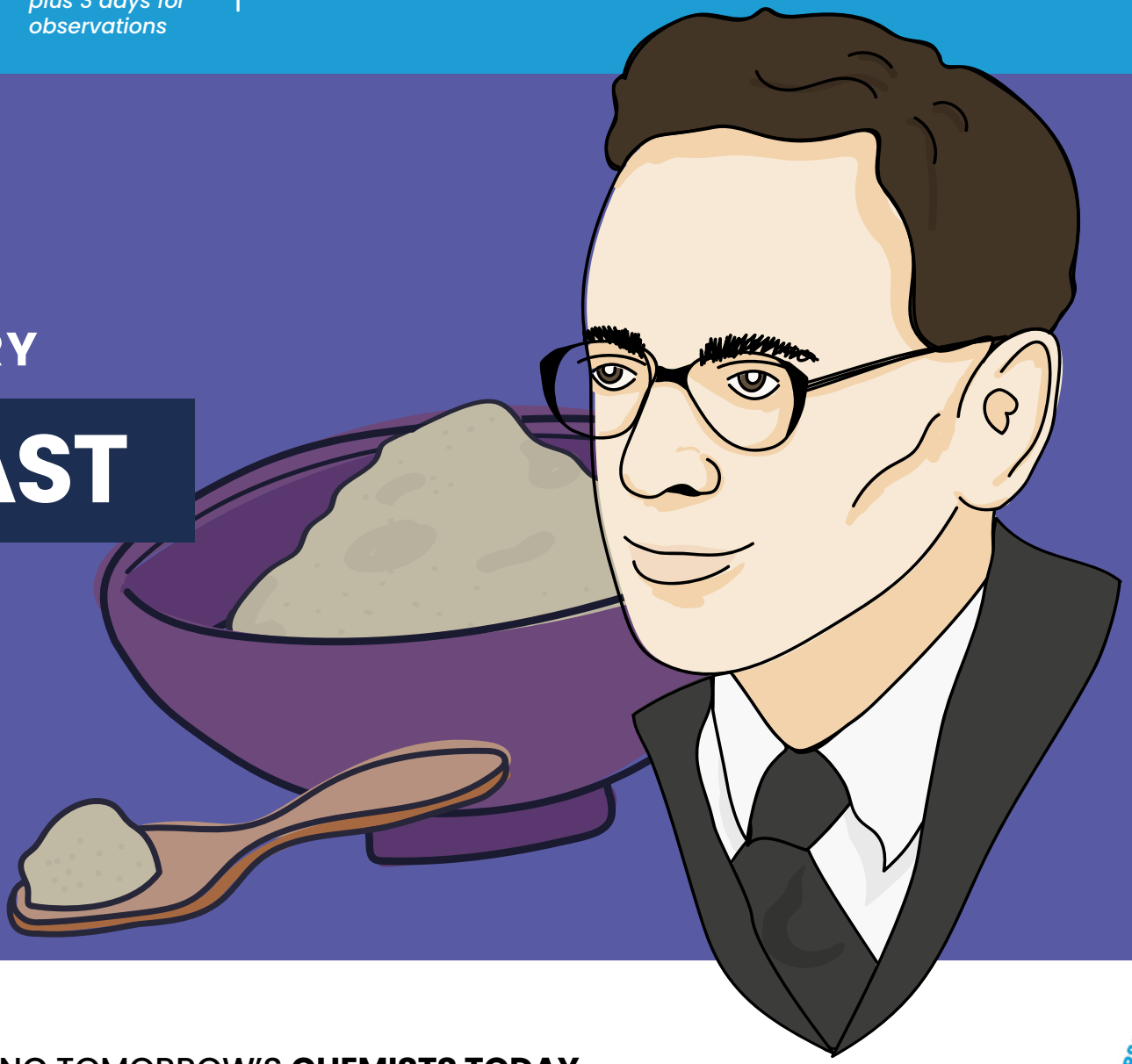

Illustration: Hans Adolf Krebs

Salters' Institute

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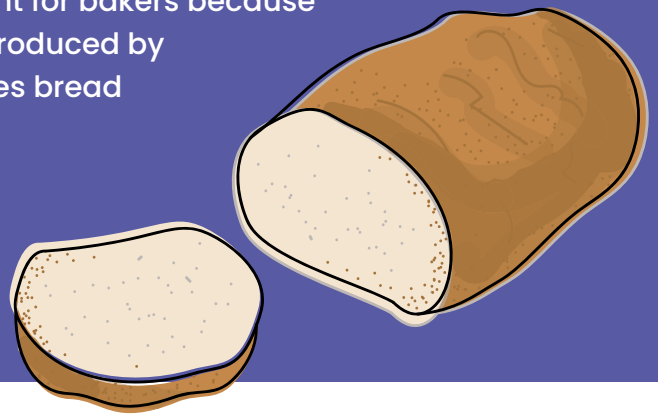
INTRODUCTION

Hans Adolf Krebs was a doctor and biochemist.

He had to flee Nazi Germany during World War Two due to his Jewish ancestry, taking only his personal belongings and some basic equipment to England. After escaping, he was given refugee status in Britain where he worked in universities. His most famous discovery was **the Krebs Cycle**: a series of chemical reactions starting with parts of a sugary chemical called glucose and converting them into chemical energy, releasing carbon dioxide. The Krebs Cycle is an important part of the human respiration process. This is when food is converted into chemical energy using up oxygen breathed in from the air, producing carbon dioxide which we breathe out. In 1953, Krebs earned a Nobel Prize for his work.

Plants, animals and fungi (including yeast) use the Krebs Cycle to release chemical energy from their food, so they can grow. Yeast is an essential ingredient for bakers because the carbon dioxide bubbles produced by yeast during respiration makes bread and cakes rise.



DID YOU KNOW?

The earliest records of yeast being used to make bread come from Ancient Egypt. It is thought that uncooked bread dough left out on a warm day was accidentally contaminated with naturally occurring yeasts (from fruit skins and soil).

This made the bread rise, making it lighter and fluffier than the traditional flat breads. The yeast was cultivated by keeping a small piece aside from each dough batch to be used in making the next dough.

SAFETY

- **Do not ingest anything you use or make during a science experiment.**
- **Ask an adult to dispose of the experiment when completed.**
- **This activity should be supervised at all times.**

ACTIVITY

INVESTIGATING RESPIRATION IN YEAST

To commemorate the work of Adolf Krebs, the experiment below will demonstrate respiration in yeast.

INSTRUCTIONS

1. Make an open ended funnel by rolling the paper into a cone shape and holding it together by using the tape. Make sure the narrow end fits neatly inside the necks of the two litre bottles.
2. Label the four bottles with '0 teaspoons', '10 teaspoons', '20 teaspoons' and '30 teaspoons'.
3. Using the paper funnel, add 5 teaspoons of yeast to each of the 4 bottles.
4. Using the paper funnel, add 10 teaspoons of sugar to the bottle marked '10 teaspoons'. Now add 20 teaspoons of sugar to the bottle marked '20 teaspoons', and add 30 teaspoons of sugar to the bottle marked '30 teaspoons'.
5. Using the measuring jug, add 1.5 litres of warm tap water to each of the four bottles. Screw the caps on the bottles securely and gently shake each one to mix.
6. Remove the caps from the bottles, and stretch the neck of an uninflated balloon over the neck of each bottle so it seals the top of the bottle.
7. Place the bottles in a warm place such as an airing cupboard for 3 days. Observe what happens to the balloons. After a few hours you may start to see frothy bubbles appearing in the bottles. After 3 days, which of the balloons have inflated? Which balloon inflates the most? Why do you think this is happening?

CHALLENGE

Can you design an experiment to investigate whether it is possible to make the balloon pop? You could try using different amounts of water, yeast and sugar.

YOU WILL NEED

- 4 empty 2 litre bottles with lids (rinsed clean)
- 4 balloons (any colour)
- 250g sugar (caster or granulated)
- 50g dried yeast
- Teaspoon
- Measuring jug
- A piece of A4 paper
- Tape
- Pen, paper and tape to label the bottles
- Access to a warm place

WHAT'S HAPPENING?

Respiration occurs in yeast. Yeast break down sugar into glucose using a special chemical called invertase. Yeast uses oxygen from the air to convert the glucose into chemical energy which the yeast uses to grow. Carbon dioxide is released as a waste product.

Without sugar, the yeast cells cannot perform the respiration reactions, so no carbon dioxide will be produced and the balloon will not inflate. When only small amounts of sugar are added, the yeast will quickly use this up so only a small amount of carbon dioxide is produced. The bottles containing the most sugar will have the largest inflated balloons as there is a good supply of sugar for the yeast to respire.

This complicated chemical reaction can be carried out by a tiny organism – yeast! If you were to try the experiment without the yeast, adding only sugar to the warm water, the balloon would not inflate.

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