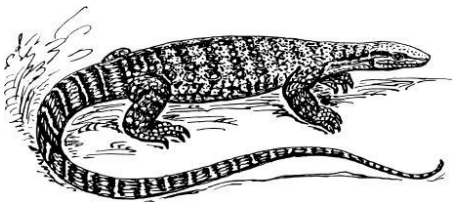
Heat and Yeast - Teacher's Notes

Life Depends on Enzyme Activity to Survive

Most living things depend on chemical reactions within their bodies to release energy for growth, movement, repairing damage and reproduction. Enzymes are biological catalysts. They accelerate the speed of necessary reactions without being used up. Because enzymes are proteins they only work effectively between narrow ranges of temperature. Most human enzymes work best at about 37°C and our bodies work hard to maintain that as a core temperature. If we become too hot or too cold our efficiency is affected. Without enzymes we die. This is the same for most "warm bloodied animals".



"Cold bloodied" animals such as reptiles and amphibians however cannot control their body temperature. If it is a cold morning they will slowly crawl out of their nests in the cold ground to sunbathe, raise their core temperature and get their bodies working better. If it is too hot they will crawl into the shade. Many find dark hot road surfaces perfect for this purpose and end up as road-kill.

Yeasts are simple fungi. They are single cells about 3/1000ths of a metre long that divide to create new cells and for that and any other process, they need energy. Their energy comes from breaking down food such as sugars and complex carbohydrates just like us. During the process of respiration (creating energy) carbon dioxide gas is released. Different varieties of yeast are used for brewing beer, making wine and baking bread.

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To make bread, flour is mixed with sugar, water and yeast to form resilient dough, which is then kneaded. Kneading mixes water with protein in the flour to form long elastic strands. The dough is left in a warm place so that escaping carbon dioxide from the yeast and sugar reaction is trapped within this elastic dough. When it has risen, the dough is placed into a hot oven. The yeast and its enzymes are killed by heat but the bubbles of gas remain trapped by cooked bread. In hot countries, bread dough is usually made to rise early in the morning whereas in cold countries it has to be placed in a warm area to help the enzymes warm enough to make it rise. The optimal water temperature for adding flour and sugar to yeast is just below 40°C.

Dried yeast can be bought from the bakery section of the supermarket. These packets contain little balls of many thousand individual cells. By stirring the yeast in tepid water first, the balls dissolve and the reaction proceeds much faster.

We cannot produce food in Science rooms, so we will only observe part of the reaction.

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The rate of reaction depends on temperature. The experiment pictured above was carried out when the temperature inside was 26°C and outside 37°C. The glass was left outside for 3 minutes.

Activity: To observe the effect of heat from the Sun on yeast enzyme efficiency

Materials (Alternative procedure given also)

- Two glasses or beakers of the same size. (The bottoms of two used cool drink bottles can be cut off for each student group).
- One warm sunny location and one cool location (or alternative such as inside a fridge).
- 2 half tablespoons of sugar.
- 2 teaspoons of dried yeast. If you are using live yeast double the quantity
- Tepid water. Tepid water is about the temperature of your elbow.
- Water
- Teaspoon, tablespoon, pop stick to stir the mix.

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Method

1. Measure the temperature inside and outside in the heat of the Sun.
2. Half fill both containers with tepid water (Same amount of water)
3. Dissolve 1 teaspoon of sugar in each container. (Same amount of sugar).
4. Sprinkle 1 tablespoonful of dried yeast on top of the water then stir in. (Same amount of yeast)
5. Place one container in a sun warmed area and the other in a shaded cool part of the classroom.
6. Observe changes in the two mixtures.
7. Draw your observations in the table provided.
8. While you are waiting and watching answer the last question on how human's use the Sun's heat.

Alternative: Using a water bath instead of heat from the Sun

If the weather is not hot or it is unwise to move in and out of the classroom:

Fill one basin or sink or bucket with hot water (40°C is ideal) and another with cold water. The experimental containers should be able to fit into these water baths.

The warm bath will simulate the heat of the Sun and the cold bath the ambient temperature.

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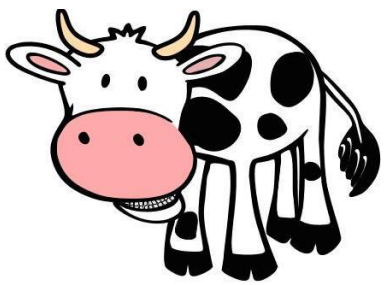
Location	Inside	Outside
Start		
After 3mins		
After 6 minutes		

Conclusion

Does energy from the Sun affect enzyme efficiency? Yes

Explain your answer. The reaction in the glass in the Sun's heat was very much faster and more vigorous than in the glass which stayed cool inside.

Was this a good scientific experiment? Did the cow moo softly? No.



What one thing did we change? Sun energy

What one thing did we measure? We didn't measure anything.

Did we keep everything the same? Yes.

If we did the experiment again, what would we

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have to do to make it a good one? Measure the yeast's production of carbon dioxide gas/height of froth.
What materials would we need to do this? A ruler

Use of Heat from the Sun

Hint: Heat from the Sun also causes winds to blow.

In your group, list and describe five ways ordinary Western Australians benefit from the Sun's heat.
Drying washed clothes outside, sun-drying tomatoes and figs, heating household water (Solar passive and photoelectric),
Tourism both on the coast and in the desert inland.
Wind powers water pumping windmills for farmers and other windmills produce electricity.
Sailing boats use wind energy for recreation.
Heat is necessary for plants and animals to survive. Our native plants and animals, and introduced food plants and animals need heat from the Sun.
Many of our native plants are adapted to our hot climate.
Growing crops in the correct climate zones where the temperature suits their enzymes.

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Extra for Experts – Sunny Showers

As an exploration geologist in the early 1970s, I worked from my tent camp out in the desert. Days were hot and dusty, and the nights weren't much better either. I had to find sneaky science ways to make my life more comfortable. Setting up the equipment below allowed me to have a very quick and quite hot shower in the evening. All I needed was a length of garden hose, the shower rose from a watering can, a large cork, water and an S shaped hook. What did I have to do to get my evening wash?

1. Fit the shower rose to one end of the hose. Hook this end of the hose onto a spade or branch so that it is higher than the rest.
2. Fill the hose with water and seal off with the cork.
3. Leave sealed hose lying in an open sunny area
4. At the end of the working day park the truck near the hose, take your clothes off; sling the hose onto the roof of the truck and shower under sunshine heated, gravity fed, water.

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