

Animal Enzymes & Cold – Teacher Notes

Catalysts called enzymes speed up most metabolic processes in living things. Catalysts affect the rate of chemical activity but do not themselves take part in the reaction. Enzyme activity is most efficient within a narrow range of:

1. Temperature
2. pH (acidity or alkalinity)
3. Concentration

Temperature

Enzyme activity in any species of plant or animal, works most efficiently within a narrow range of temperatures. The Arctic fox has enzymes that are most efficient at lower temperatures than a sidewinder snake that lives in canyons where temperatures often rise above 40°C. Animals can partially control their temperatures by behaviours such as lying in the shade, wearing clothes, moving at night or hibernating in winter. Plants are usually restricted to a specific geographic area by the requirements of their enzymes.

Core temperature in humans usually is about 37°C. Variation from this will cause enzyme dysfunction resulting in illness or death. Core temperature is usually a little higher than oral temperature. Human core temperature rises during the day and varies with women's menstrual cycle.

°C	Core Temperature	Result
50	43°C	Death
	42°C	Vomiting delirium
40	41°C	Fainting, vomiting, headache, confusion, panting, delirium
	40°C	Fainting, vomiting, headache, life threatening
30	39°C	Severe sweating, fast heart rate
	38°C	Hot sweating thirsty, onset of hyperthermia
20	37°C	Normal
	36°C	Moderate shivering
10	35°C	Blue skin, intense shivering, onset of hypothermia
	34°C	Severe shivering, loss of movement of fingers
0	33°C	Confusion, sleepiness, shivering stops
	32°C	Extreme sleepiness, delirium, medical emergency
-1	31°C	Comatose, shallow breathing
	30°C & less	Some people survived below 30°C for hours. Most do not.

Aim To demonstrate the effect of cold on the enzymes the activity of a human hand

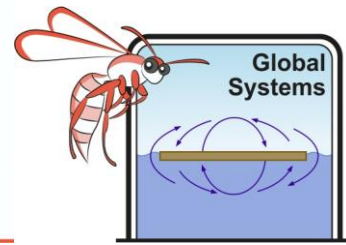
Plunging a hand into chilled water slows enzyme activity and results in slowed nerve muscle interaction and a marked loss of writing ability. The signature has to be written almost immediately after removal from iced water.

Materials per group or class

- Large buckets of cold water
- Ice cubes
- Scrap paper
- Ballpoint pens
- Towels or paper towels
- A laboratory thermometer
- Scissors and sticky tape or paste



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Method

1. Measure air temperature and add your observation to the table provided. (NOTE: remember to add units to the number!)
2. Add ice to the cold water and measure the temperature of the icy water. Add this observation to the table.
3. Each student quickly writes their signature on the scrap paper using their pen
4. Students immerse their writing hand in icy water for two minutes
5. After 2 minutes rapidly remove hand from water, dry it and write your signature directly underneath the first example.

Results/Observations

Air Temperature _____

Water temperature _____

Stick your two signatures onto the space below

Was there an observable change in your signature? **Cold resulted in poor signature**

What could have caused that change? **Change in temperature decreases efficiency in enzymes controlling nerves & muscles in hand**

Conclusion

Temperature affects enzyme efficiency.

How could this experiment be improved?

- Repeat
- Control for same sex, age, health etc.
- Select a result that is quantitative (measurable) not qualitative. Throw a dart at a spot and measure deviation?

EXTENSION

Why do most people in Australia suffer indigestion trying to eat a traditional English Christmas dinner in the middle of the day?

Traditional English Xmas dinner was full of fats and eaten during cold weather in the middle of winter. Fat digestion produces energy and necessary heat so the diet was relatively high in animal fat. Fat digesting enzyme production levels were high and digestion was efficient. People would not move around much in the cold weather so blood supply to the stomach was good.

Australians do not eat a lot of fat so their fat digestion enzyme levels are low. Australian Xmas is in summer and high temperatures decreases enzyme efficiency. Blood supply is diverted from the stomach to the skin surface to cool the body by radiation and sweating. Indigestion results!