

**Achieved**

Intended for teacher use only

**For Achievement the student response includes:**

Fungi is a common microorganism found in a compost. In a compost, fungi break down organic waste into nutrient rich soil called humus. Fungi in a compost gain nutrients by feeding on organic waste such as fruit and vegetable scraps, eggshells, coffee grounds, grass clippings, garden clippings, newspapers, or manure. Fungi feed by extracellular digestion which involves the hyphae of the fungi secreting enzymes through its cell membrane onto the food source. The enzymes breakdown the food into small enough particles to be absorbed by diffusion, back across the cell membrane. Once inside the fungi's cell the nutrients are used for growth or reproduction.

Fungi live in the interconnected environment of a compost. Other organisms such as bacteria, protozoa, nematodes, insects, spiders, and plants also live in a compost. Abiotic factors inside of a compost include, temperature, moisture levels, pH, and oxygen availability.

An abiotic factor that affects extracellular digestion and therefore nutrients available for growth or reproduction of the fungi is temperature.

Our group used fungi growth on bread as a model to determine the effect of temperature on fungi extracellular digestion. We used 4 pieces of bread from the same packaging. We put 1 piece of bread inside a plastic bag. We added the same amount of water to the surface of each bread slice. Each piece of bread was put in different places with specific temperatures:

- fridge at 4°C
- freezer at -18°C
- bench in school lab 18°C
- incubator at 25°C

We observed and measured the amount of fungi growth on the bread using percentage cover. We also recorded moulding, colour, and appearance of the bread on the 12<sup>th</sup> day. Below is the table of our results and observations:

## Expected Student Response for Chemistry and Biology Achievement Standard 1.1

Table 1: Fungi growth and reproduction on bread stored at locations of different temperatures

Location	Temperature (°C)	Amount of Bread Covered by Fungi (%)					Observations of appearance at Day 12
		Day					
		0	3	6	9	12	
Fridge	4	0	0	1	3.5	5	Very small patches of fungi growth, grey colour.
Freezer	-18	0	0	0	0	0	No fungi grow
Bench in school lab	18	0	2	15	40	70	Grey-green colour, fuzzy and powdery, covered most of the bread
Incubator	25	0	4	20	80	100	Grey-green, fuzzy and powdery, covered all of the bread

Out of the four temperatures observed, three developed fungi, while one did not. Both the breads kept in the incubator (25°C) and on the bench (18°C) showed fungi growth by day 3. The bread stored in the fridge started showing fungi growth on day 6. By day 12, the bread in the incubator was fully covered by grey-green, fuzzy, and powdery fungi. The bread on the bench had 70% fungi coverage, whereas the one in the fridge had only 5% coverage.

The data shows as temperature increased from cold (4°C) to warm (25°C), the fungi growth also increased on the bread which means more extracellular digestion was taking place as the temperature increased.

### 92020 Achieved Exemplar Notes

The student has demonstrated understanding of the relationship between a microorganism and the environment by:

- describing the life process of extracellular digestion in fungi.  
The student has provided details of the way fungi gain nutrients using enzymes, a cell membrane and diffusion.
- describing that temperature (abiotic factor) within the interconnected environment of a compost pile affects extracellular digestion of fungi.  
The student has used fungi growth across bread as a model to observe and measure that temperature affects the enzymes involved in extracellular digestion.