Yeast is a type of fungi, which is a type of microorganism. Yeasts can respire in two different ways, aerobically and anaerobically. Aerobic respiration in yeasts means they use oxygen to respire. The equation for this process is glucose + oxygen → carbon dioxide + water + lots of ATP. Anaerobic respiration in yeasts means they can respire without the need of oxygen. The equation for this process is glucose → ethanol + carbon dioxide + little ATP.
Respiration plays in important part in making sourdough bread, this is to make the bread rise and produce its unique taste.

Temperature of Water Bath (°C)	Height dough has risen after 1 hour (mm)
15	**0mm**
35	**23mm**
80	**2mm**

Changing the temperature affects the rate of respiration because in our practical we found that putting our starter culture in 15°c, the yeast respired the slowest because the starter culture rose 0mm. We also found this in another practical we did, where we tested for the relationship between temperature and fungal respiration: where we found that a yeast and sugar solution in cold water didn't respire as fast as it did in warmer water. We found this out from the amount of froth that occurred in the tubes as there wasn't as much froth in the test tube in the cold water, and there was more froth in the warm water, meaning that the yeast respired the fastest in the warmer water. We also found that the yeast respired slow in 80°c as our starter culture only rose 2mm. We did something similar when we made yoghurt because we firstly heated the milk up to 85°c to kill the bacteria so they couldn't respire. However, when we put our starter culture in 35°c, we found that it rose 23mm, which means that the yeast respired the fastest. We did a similar thing when we made yoghurt because after we heated up the milk then added the lactobacillus, we put the yoghurt in a water bath at around 40°c, this meant the bacteria in the yoghurt respire faster and fermentation could happen.

The yeast respired the slowest at 15°c because the enzymes were not in their optimum temperature meaning the enzymatic reactions in the yeast were slow. This means the enzymes move at a slower rate and they don't collide very often, all resulting in a slow respiration rate. The yeast respired the fastest at 35°c because at this warmer temperature, which is also the enzymes optimum temperature, glucose and enzymes have more energy and the enzymes reactions in the yeast move at a faster rate and they collide more frequently. Which results in an increased rate of respiration. The yeast also respired slow at 80°c, this occurred because at this high temperature the yeast denature the enzymes that are needed for respiration. When enzymes denature, the bonds holding the enzyme together are ruined, resulting in a loss of structure and they cannot function again. This is why the yeast did not respire much at 80°c. We also found something similar when we researched about making beer. One of the last steps to making beer is heating the liquid to a high

temperature of around 80°c for a period of time, and this is to kill/denature microorganisms that could cause spoilage in the beer. This is a good explanation to why the rate of respiration was slow when we made sour dough bread starter.

Oxygen levels in the starter culture change over time, we can see this in resource one as it shows us over 12 days the oxygen levels in the starter culture decrease. On day 0 the oxygen levels were high at around 220ppm.
Then on day 2 it starts to decrease as the oxygen levels were around 130ppm. Then jumping to day 6 the oxygen levels were measured at approximately 48ppm. From day 9 – 12 the oxygen levels were about 0-1ppm. This is showing us how only 2 microorganisms tend to take over in the 12 days; yeast and lactobacillus because they can survive the environment.

Type of Bread	General Observations e.g. texture	Taste
Sourdough	**Denser texture** **seedy**	**Sour after taste** **Tangy**
Common Bakery Bread	**Fluffy** **Air bubbles** **Light**	**Mild** **Slightly sweet and salty**

Respiration in yeast causes oxygen levels in the starter culture to decrease over time as we saw in the graph. The reason for this is that aerobic respiration in yeast means that the yeast needs oxygen to respire. This respiration will decrease the oxygen levels because the oxygen is used to help turn glucose into carbon dioxide, water and energy, to make bread. While this is happening, yeast and lactobacillus come from the surroundings like the flour or the oxygen/air and settle in the sourdough starter because they are the only microorganisms that can take on the environment in the sourdough. Once all of the oxygen available is used up by aerobic respiration, the yeast and lactobacillus bacteria in the starter culture respire using anaerobic respiration which is also known as fermentation. This is why we see the graph decreasing. During anaerobic respiration (fermentation) in the lactobacillus bacteria, it uses glucose in the starter and produces lactic acid along with a little bit of energy. Anaerobic respiration in yeast is a process where glucose is turned into ethanol, carbon dioxide and a little bit of energy. When we tasted the sourdough bread, we could taste that it was very sour and had a bit of a tang to it while also being a little bit dense. The reason for the unique sourness and density we observed is because the lactic acid that was produced in the fermentation process lowers the pH of the starter. The yeast in the starter culture also plays a big part in the making of the sourdough bread because when the carbon dioxide is produced during respiration in yeast, it means that the sourdough bread can rise and give it an airier texture. When we tasted bakery bread, we noticed that the texture was a bit lighter and fluffier than the sourdough bread, the reason for this is because there is more oxygen in bakers bread as there is no starter culture meaning no fermentation time and the bread is baked almost straight away leaving not much time for respiration. We found something similar in another practical when we made yoghurt. The lactobacillus bacteria that we add, respires anaerobically. Which means it breaks down the lactose (which is a form of sugar present almost exclusively in milk) and turns it into lactic acid and a little bit of ATP (energy). The lactic acid produced is what gives yoghurt a sour taste. So, yoghurt and sourdough bread are similar because they both taste sour, and the sourness from both, is due to the lactic acid being produced when lactobacillus bacteria is respiring anaerobically.