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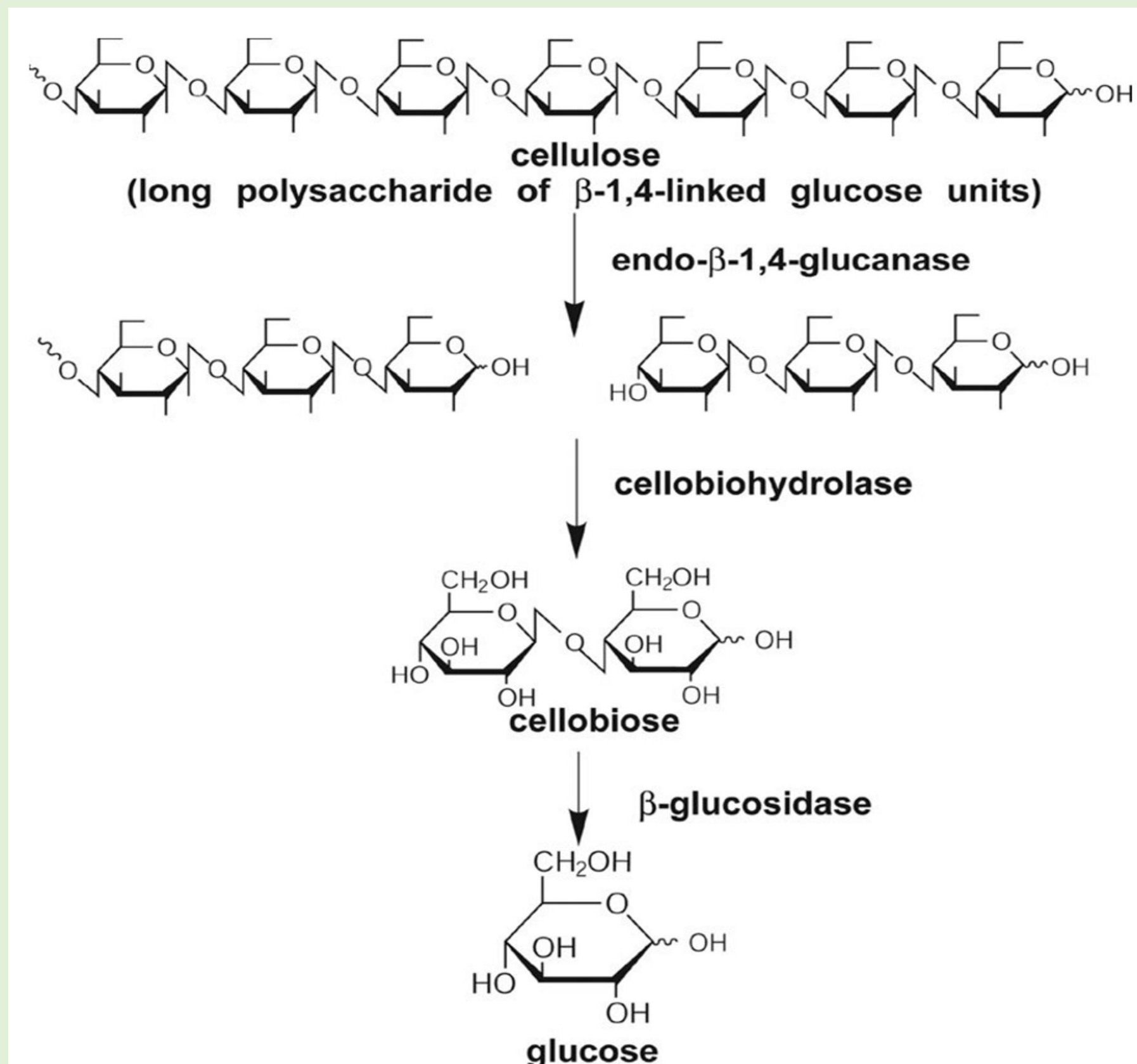
The Process of Decomposing Organic Textiles using Fungi

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Priority Topic Area: Responsible Production, Innovation and Industry

Aim:

Due to fast fashion, 92 million tonnes of textile waste is landfilled or incinerated and, our landfills are overflowing[1]. Recycling is not always a viable option for clothing disposal. Because of constraints to the recycling industry, 14% of clothing requires incineration, as of 2025 [2]. At point of manufacture, quality clothes consist of long staple fibres but, each time an item is recycled fibres are shortened. Short fibres produce low quality clothing with increased pilling and low durability, showing this is not a perfect solution. Our solution of using mushrooms to compost textile waste, tackling the problem of waste fabric.



Findings:

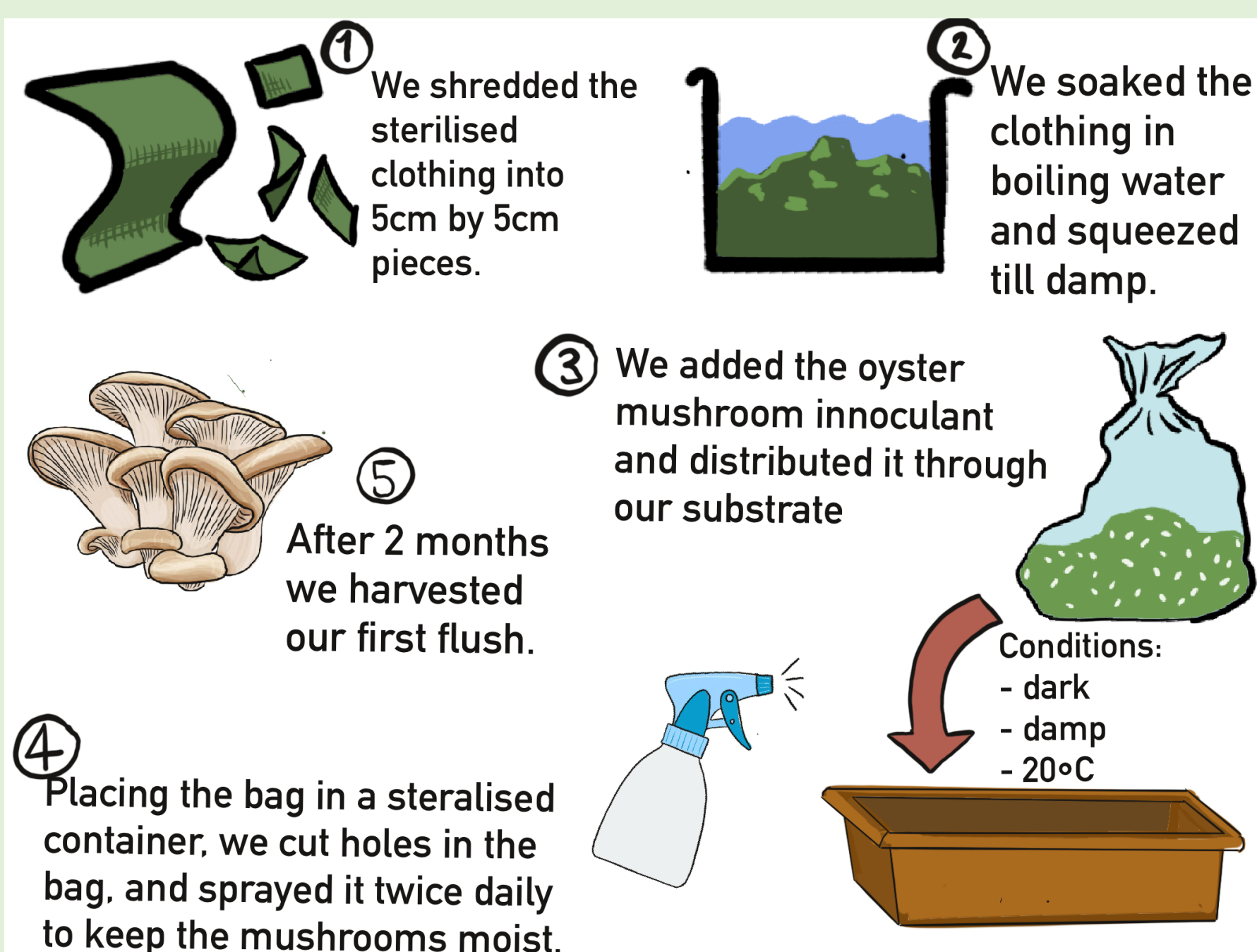
High-water compare the energy released from mushrooms and the energy released when textiles are incinerated, we performed a calorimetry experiment on the clothing. We burnt the clothing using a calorimeter, filled with 100 cm³ of water and measured the temperature rise.

The average joules of energy per gram of clothing was calculated to be 3880 J/g. Using commercial calorimetry data, we determined there are 151 joules per 100g in fresh mushrooms [3], calculating that 13.4 joules of energy is stored per gram of dry oyster mushrooms. Overall, we calculated for the same mass of substrate, that we would produce around 202.2- 270.0g of dried mushrooms per 520g of dry substrate.

This equates to an efficiency of "recapturing" 0.17 percent of the energy stored in the clothing. Because cotton is energy rich, whereas mushrooms are notoriously low in calories due to their high-water content. Although this percentage is small, the most valuable mechanism is the decomposition of the clothing into a compostable form (for organic based clothing).

Benefits to society:

Our project tackles sustainability within the fashion industry by reducing waste going into landfills while also supporting sustainability in food production by using oyster mushrooms to decompose cotton clothing. As landfill space is depleted, landfill taxes augmented, and pollution is increased. Using mushrooms offers a financially viable way of disposing of clothing that has reached the end of its life cycle or that cannot be recycled. This involves partially "recapturing" the energy stored in the clothing through mushroom growth, also breaking down garments into smaller particles.



Method:

90-95% of cotton is cellulose. Fungi secrete digestive exoenzymes (endoglucanases, cellobiohydrolases, and β -glucosidases) to break down cellulose into glucose by cleaving internal β -glycosidic bonds in the cellulose chain.

To test our hypothesis, we used 520g of dry substrate, using an old 100% cotton sheet to grow mushrooms. After shredding it by hand into 5-5cm pieces, we sterilizing them by putting them in an industrial oven for 2h 120 degree Celsius, killing competing microorganisms. We used oyster mushrooms as they traditionally grow well in wood-based substrates, which have high cellulose content, and best fit the environmental conditions of a kitchen cupboard. Procedure is described above.



Next steps:

We hope to collect fabric by partnering with clothing companies to collect offcuts before expanding to collecting clothing from the wider population. Expanding our range of other materials to break down eg: composite fabrics, (separating the polymer from the organic part to be disposed of separately) would enable us to tackle the wider range of textile waste.

References:

<https://www.businesswaste.co.uk/your-waste/textile-recycling/fashion-waste-facts-and-statistics/>
<https://doi.org/10.1016/j.jclepro.2024.140619>
<https://jbiochemtech.com/storage/models/article/NG23jvirki6MsPU83nHuA6CbEMW8XcyYx1abn0BuLtqBOKsnuWPknyki9rj5/pleurotus-ostreatus-an-oyster-mushroom-with-nutritional-and-medicinal-properties.pdf>