SESSION TITLE

Food waste and biomaterials

ACTIVITY IN A SENTENCE:

Give a second life to food waste and fabricate biomaterials that can be used to produce small objects and accessories.

DISCIPLINES INVOLVED IN ACTIVITIES:

Chemistry

RECOMMENDED AGES:

12+

LEARNING ENVIRONMENT (CONTEXT SETTING):

Makerspace, class, restaurants and bars

LEARNING OUTCOMES:

Learners will:

- Learn about organic waste
- Discover how much it is produced in restaurants and bars
- Understand how it is treated in their municipality after disposal
- Measure quantities
- Follow procedures
- Be introduced to the chemistry of biomaterials.

The topic was chosen by students during a session facilitated by the teacher at school. Students were interested to learn more about food waste and how it could be turned into a resource. They visited a bar and a restaurant in their neighbourhood to collect food waste (eggshells, coffee grounds and orange peels) and talk to the owners about disposal of organic waste. After having produced biomaterials at Onl'fait, the students continued to explore the topic in class and another group worked on a compost bin fed by the school cafeteria to grow aromatic plants.

RECOMMENDED EXPERTISE:

- Chemist
- Cook, bar owner, food expert

SDG LINKS:

- **Goal 4:** Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all
- **Goal 11:** Make cities and human settlements inclusive, safe, resilient and sustainable
- **Goal 12:** Ensure sustainable consumption and production patterns

TIME IT TAKES TO COMPLETE:

- Co-creation session: 1.5 – 2 hours
- Waste collection: 1 – 3 hours
- Introduction about biomaterials and their advantages: 1 hour
- Producing biomaterials: 3 x 2 hours
- Fabricating objects: 3 hours
- Preparation of the miniexpo: 2 – 6 hours
- Mini-expo: 6 hours
- Evaluation: 2 – 4 hours

MATERIALS / RESOURCES NEEDED:

- Eggshell
    - 15 ml water
    - 24 g eggshell
    - 7 g gelatin
    - A saucepan
    - Heating plate
    - Grinder
    - Spoon
    - Moulds (eg. Ice tray)
    - High precision balance
- Coffee
    - 35 ml water
    - 5 g glycerin
    - 5 g coffee ground
    - 5 g sodium alginate
    - 5 g olive oil
    - 100 ml water
    - 10 g of calcium chloride
    - High precision balance
    - Bowl to mix
    - Frame
    - Spoon

    - Spray bottle
    - Heating plate
    - Saucepan
- Orange
    - 5 Litres water
    - 420 g glycerin
    - 120 g orange peels
    - 125 g sodium alginate
    - 55 g olive oil
    - 20 g wool fibre
    - 100 ml water
    - 10 g calcium chloride
    - High precision balance
    - Bowl to mix
    - Frame
    - Spoon
    - Spray bottle
    - Heating plate
    - Grinder or mixer
    - Heating plate
    - Saucepan

CONTENT FOR LEARNERS:

External resources can be found later on within the activity description

TIPS FOR SCALING FOR DIFFERENT AUDIENCES:

The activity can be adapted to primary school students by simplifying the object to create.

Activity

Introduction: Co-creation

Start the activity with a presentation about Open Schooling (check out 5. Educator Training to learn more about Open Schooling). Use examples of local issues that are tackled with smart solutions developed by the youth and citizens. Show examples of technology for sustainability.

Divide the class in smaller groups and distribute A3 cards with a list of issues (traffic, climate change, etc…) and ask the group to rank them from the most concerning to the least and to add one more issue specific to their community. Let the students motivate their choice and find a consensus to select the topic to work on.

Once the topic has been chosen, you can decide to propose an idea (more or less defined) or facilitate a second session to come up with a technological solution.

Part 1: Waste collection

Contact restaurants, bars or a supermarket in your neighbourhood to organise a visit to collect food waste, explain the project (motivation and objectives) and interview the food professionals regarding food waste.

Part 2: Introduction to biomaterials

Prepare a presentation to explain the sustainability issues related to the overproduction of fabrics for textile and the fabrication of synthetic composites for furniture and buildings. Explain the potential of biomaterials for manufacturing and the fashion industry and the limits that researchers are trying to overcome. Inspiration may be taken from here.

Part 3: Producing biomaterials: Eggshell composite

- Boil eggshells to kill bacteria and work safely
- Dry the eggshells (either naturally or in the oven for 10 mins)
- Grind the eggshells with a grinder to obtain a fine powder
- Pour the gelatin powder in hot water in a saucepan.
- Add the eggshell powder and mix until you have a slightly viscous and granulous paste. Note: gelatin molecules break more easily when the water is hot, so be sure to pour in the eggshell powder before the mixture is too runny.
- Pour the eggshell mixture into a mould and let it dry and voila!

Part 4: Producing biomaterials: Coffee grounds bioplastic

- Weigh all the ingredients with a precision scale.
- Mix the ground coffee and the sodium alginate with the glycerin and olive oil.
- Add the warm water and mix well to obtain a homogeneous solution.
- Cast the liquid in a frame (you can make your own using any waterproof textile for the base and wood for the frame – see External Resources for assistance)
- Mix calcium chloride with water in a spray bottle. Then spray the material surface with the calcium chloride solution.
- Let the calcium chloride act for 5 minutes and rinse with clear water.
- Let the composite sample dry in a dry, warm place for one week. Depending on the thickness and size of the sample, this may take longer. It will also vary due to local temperature and humidity.
- When the product is dry, you can remove it from the frame.

Part 5: Producing biomaterials: Orange peel bioplastic

- Dry the orange peels
- Grind the orange peel with a shredder or blender then sift it into a powder
- Mix the warm water, gelatin, sodium alginate, oil and orange peel powder in a saucepan
- Let the mixture rest in a cool environment to avoid bubbles for 24 hours.
- Add the wool fibre to the mixture and mix
- Pour the mixture into a frame (you can make your own using any waterproof textile for the base and wood for the base – see External Resources for assistance)
- Mix calcium chloride with water in a spray bottle and spray the surface of the material
- Let the bioplastic dry for 3-7 days in a dry environment to avoid mould and when the product is dry you can remove it from the frame.

Part 6: Fabricating objects

- Use silicon moulds to make small objects (i.e. small pots) with the eggshell composite
- You can use the coffee fabric to make objects like a keyholder, a foldable bag or a notebook cover
- You can use the orange peel fabric to make objects like a keyholder, a bag or a notebook cover and you can use a sewing machine to assemble the object

EXTERNAL RESOURCES:

These resources will assist with the biomaterial fabrication process

- *Biomaterial Design Casting*
- *Bioplastic Cook Book by anastasia pistofidou – Issuu*
- *Bioplastics – materiability*

Part 7: Conclusion

Show the artefacts in the school or in a local science museum. Contact the bar, supermarket or restaurants to explain what you did and explore further collaboration.

Credits: This activity was developed by Fab Textile – IAAC Barcelona, Fabricademy and Materiom, and was submitted by Onl'Fait Makerspace, OSHub Switzerland.