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STEM
E-CONTENT
3D VIRTUAL REALTY

The Key To Global Life,
Digital Change Of Nature

Total Duration: 4 hours

Student's Age: 12-18 Years

Application Area:
- plastic recycling
- design
- technology
- CAD design
- materials science

Keywords: Recycling, plastic, re-use, melting, design, life cycle assessment, engineering.

E3 - Business from waste! (It's garbage! Turn bottle caps into household items and sell them!)

Module
- Environmental pollution
- Global Warming
- Renewable energy

E3 - English Version

Materials:
- **Presentation**
- **Bottle caps**
- **Heater: oven, panini grille, heat press, waffle iron, etc.**
- **Baking paper or teflon plate**
- **Heat resistant gloves**
- **Mouth mask**
- **Molds**
- **Machines for making the mold: Laser cutter, water jet.**
- **2D design software (e.g. inkscape)**
- **Plexiglas**
- **Laser cutter**
- **Optional: 3D files for small molds, 3D handprints, 3D printers PLA filament.**
- **Optional: aluminum plates, CNC, water jet.**

Notes:
- When combining different types of plastic, please be careful because the melting temperature of each plastic is different, small particles can blend into the air from low-temperature. Because of this dissoluble plastics can penetrate the human body with a breathing path and damage the health.
- Students should be assisted when melting plastic.
- The types of plastic must be PE and PP.
- The temperature at which plastic materials are melted should not exceed 180-190 degrees Celsius.

Summary of the activity:

The students organize a market to sell a limited series of products to raise money for their school. The products are meant to be functional or decorative and their production process is meant to raise awareness on waste management and upcycling of plastic waste. The products are made exclusively of plastic from waste plastic.

The students work out a business plan for the selling of the product including a strategy to invest money afterwards and above all a good strategy to collect plastic waste in a circular manner.

Introduction

Picture 1. Pollution (Educba, 2022)

Pollution is one of the most serious problems facing humanity and other life forms on our planet today. The rapidly increasing production and plastic pollution of disposable plastic products has become one of the most urgent environmental problems in the world. While the recycling rate of pet bottles we use to drink daily water is high, about 70% of all plastic bottles are still thrown into the trash can, which pollutes nature. PE, located on plastic bottle caps, is known to cause serious damage to the surrounding natural life. Students will do a project in their schools to recycle the PE. Each group uses waste plastic products to recycle and create projects. Plastic waste will be in our lives for reuse (Picture 1).

The use of natural resources is at a higher rate than nature's ability to self-renewal results in air, water and soil pollution. These damage the living system. In our schools, it is important that this consciousness is given from a young age. The recycling project can be prepared in our schools based on damage to the environment by plastic and plastic waste. In this study, students focus on recycling the PE (polyethylene) found on the bottle caps. The collected plastic materials and bottle caps are parsed, plastic materials are laser-cut and styled with pressing devices.

Picture 2. Stop plastic pollution (Freepik, 2023)

Considerations

- When combining different types of plastic, please be careful because the melting temperature of each plastic is different, small particles can blend into the air from low-temperature. Because of this dissoluble plastics can penetrate the human body with a breathing path and damage the health.
- Students should be assisted when melting plastic.
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Aim of the Activity

During the different stages of the activity they reflect and learn about disposable plastic use in everyday life (keep a 3 day diary, to map your own plastic footprint), how to collect and classify waste plastic, how to build machines, how to use fabrication techniques available in FabLabs and makerspaces to produce products locally, to work collaboratively, etc. . They research methods to reuse plastic and to recycle it into new products. They tackle different design challenges, one of which is: design and make a mold that can be used to produce a small series of household objects made out of melted bottle caps.

Students work in teams and they focus on upcycling PE (polyethylene), found in bottled caps and experiment with laser cutting to create the molds. The students should find solutions for pressing devices. The following checklist can be used to formulate specific learning goals.

- Defines environmental protection
- Explains the importance of reuse and recycling and their environmental protection.
- Applies the engineering design process
- 2D or 3D digital drawings
- Designs the product

Activity Process

Before Activity

- Prepare the space and collect the materials you want to use (materials, p.1)
- It is useful to divide students into groups by their interests.
- Task distribution is performed within the group.
- PE is separated from the materials collected for the event.
- Watch the video in this link (Make, 2022; University, 2022)

Whatch this videos:
https://www.youtube.com/watch?v=UzWIgZSiX9E
https://www.youtube.com/watch?v=HZC_fLBQOXI

Go through this presentation.

Let's Start

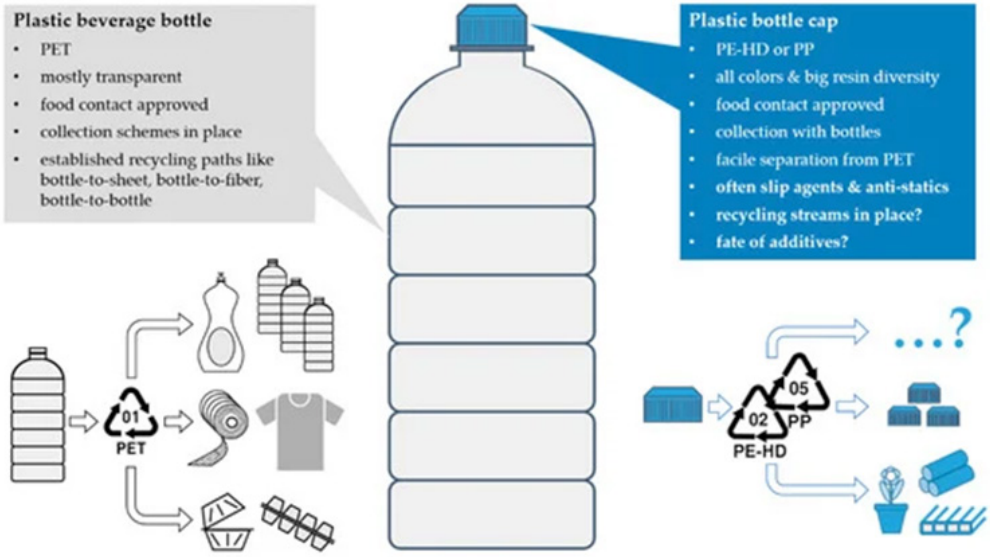
1 **Identify the types of plastic:**

Plastic is a general term. The recycling of each plastic depends on the characteristics of the plastic. For this purpose, students are given a brief understanding of plastics. Plastic types are shown in Picture 3.

Picture 3. Plastic types (Educba, 2023)

2 Collect and separate:

Teacher wants to collect and classify plastic. The teacher asks the students the following questions (Picture 4).

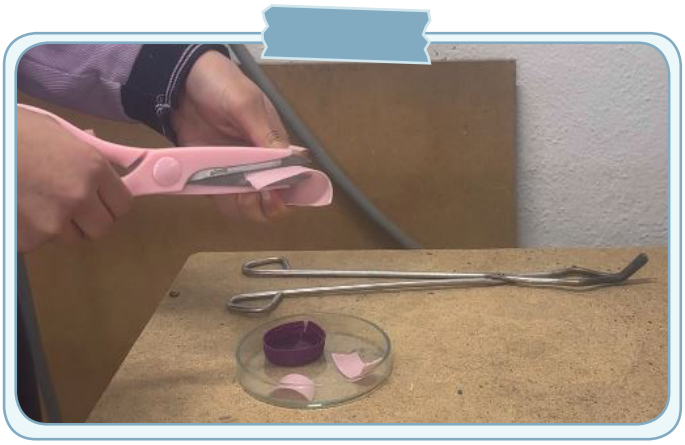


Picture 4. Not only plastic bottles

1. How can you identify a plastic type?
2. What is polyethylene and how is it made?
3. What products from PE?
4. What other products are made besides polyethylene (besides bottle caps) ?
5. What are the properties of the material?
6. What are the pattern operations for plastic bottle covers?
7. How can polyethylene be recycled?

Different types of plastic do not mix. It is therefore only necessary to focus on 2 types of plastic (PE and PP). These plastic types are the least harmful and have a relatively low melting temperature. They are identified by a small mark placed on PE and PP plastic and can be parted. You can see this in Figure 5.

Picture 5. PE and PP types of plastic (Instructables, 2022)



Picture 6. Break into pieces collected PE and PP plastics

Break into pieces collected PE and PP plastic types with a chopper. When splitting, it is important to do it with the machine and break it into small pieces. Please be careful because this chapter is required as there are hard materials (Picture 6).

3 Heating and melting:

Heat the device to which the plastic is to be melted. The ideal temperature is around 180-190 degrees Celsius. Melting plastic will melt quicker in a panini press than in a convection oven because there is direct contact with plastic (Picture 7).

Picture 7. Heating

Picture 8. Cast

4 Cast:

Heated plastic waste is taken into another process. Plastics are shaped as you want. Attempts are made to find the best way to keep plastic in shape. This is done with heat-resistant gloves, pressing in the mold and finishing the product (Picture 8).

5 Brainstorm:

Brainstorm with the students to organize a market to sell their limited series of products to raise money for their school. The products are meant to be functional or decorative and their production process is meant to raise awareness on waste management and upcycling of plastic waste. The products are made exclusively of plastic from waste plastic.

The students work out a business plan for the selling of the product including a strategy to invest money afterwards and above all a good strategy to collect plastic waste in a circular manner (Picture 9).

Picture 9. Brainstorm for selling

Closure

- Different outputs can be obtained, the pictures give some examples.

Assesment

Evaluation

- The design of students can be displayed within the school. Different products can be created by diversifying waste materials used.

Goals	Must be Improved (1)	Medium (2)	Good (3)	Very Good (4)
Introduce yourself	(.....)	(.....)	(.....)	(.....)
Join discussion	(.....)	(.....)	(.....)	(.....)
Follow Application Steps	(.....)	(.....)	(.....)	(.....)
Design of originality	(.....)	(.....)	(.....)	(.....)
Operability of the application	(.....)	(.....)	(.....)	(.....)
Total				

Links

- Gall, M., Schweighuber, A., Buchberger, W., & W. Lang, R. (2020). Plastic bottle cap recycling—Characterization of recyclate composition and opportunities for design for circularity. Sustainability, 12(24), 10378.
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