

STEMkey

Module 108



Electricity

Activity 2 - Circular Economy for Toys

This Worksheet document is based on the work within the project “Teaching standard STEM topics with a key competence approach (STEMkey)”. Coordination: Prof. Dr. Katja Maaß, International Centre for STEM Education (ICSE) at the University of Education Freiburg, Germany. Partners: Charles University, Constantine the Philosopher University, Hacettepe University, Institute of Education of the University of Lisbon, Norwegian University of Science and Technology, University of Innsbruck, University of Maribor, University of Nicosia, Faculty of Science of the University of Zagreb, Utrecht University, Vilnius University.

The project STEMkey has received co-funding by the Erasmus+ programme of the European Union under Grant Agreement Number 2020-I-DEO1-KA203.005671. Neither the European Union/European Commission nor the German Academic Exchange Service DAAD are responsible for the content or liable for any losses or damage resulting of the use of these resources.

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II. Circular Economy for Toys

Activity 2. Circular Economy for Toys



Work in pairs



120 min

Learning Outcomes

Knowledge: Understand the principles of electronics by designing and prototyping different applications with Arduino. Build electronic circuits on breadboards and use different components. Compile code through different applications.

Skills: Observe, discuss and apply the principle of reverse engineering to investigate how things work. Use the engineering design process to develop new products.

Attitudes: Foster a creativity mindset in the development of new applications. Discuss the benefits of a circular economy for toys. Sustainability on the recycle of old products.

Pre-service and in-service teachers should apply previous knowledge on series and parallel circuits. Describe the function of different components of a circuit and use proper symbolic representation.

Session description

In this activity pre-service and in-service teachers apply the principle of reverse engineering to an unused toy. They should gather a set of toys which is no longer used. It's important that these toys have electronics inside which would be our base for work and improvement. They can dismantle and describe each component, explaining their function, how they are connected and why they were chosen. After understanding the inner electronics of the toy, pre-service and in-service teachers should provide a list of possible innovations. These should give to the toy a new or improvement utility. To achieve this, we purpose the use of an Arduino Microcontroller which can communicate with different components to design an autonomous and innovative toy. Possible components that can be used includes sensors, step motors, switches, led, displays and so on. The educator can provide a list of materials that the students can use or if possible, display them on a table so the students can freely pick what they need. It is recommended to have one full Arduino kit per group plus a few spare parts if needed.

Interdisciplinary Approach

This activity presents an opportunity for pre-service and in-service teachers to reflect on environmental issues of global waste and the importance of recycling old toys. Pre-service and in-service teachers apply the engineering design process to the development of a new product, use technology as a vehicle for creativity, writing and testing their own code and applying previous knowledge on building electronic circuits.



Activity 2: Circular Economy for Toys



Worksheet



Driven by rapid urbanization and growing populations, global waste generation is expected to jump 70% by 2050, up from 2.01 billion tones in 2016. Toys are prime examples of items that are designed to 'spark joy' but often end up as waste when a child's play interests change. The value of the global toy market exceeded 80 billion EUR in 2019 but with some claiming as much as 80% of all toys end up in landfills, incinerators, or the ocean much of this value is lost when toys are thrown away. With waste and pollution causing damage to the environment and to our health, and valuable materials being lost from the economy, many toymakers are rethinking the future of their business. This involves redesigning not only how toys are made and played with, but also toy ownership. Together, these are critical steps towards a circular economy.

Adapted from What a Waste 2.0 (World Bank, 2018) and "Creating a circular economy for toys" by Ellen MacArthur Foundation.

1. Apply the concept of Reverse Engineering to a toy that is no longer used.
2. Describe the function of the different components that you have found in the toy. Organize data in a table.
3. Use the components of our toy to create an innovative product (prototype). Brainstorm with your colleagues and write your plan, including the material needed. (Note: Arduino can help you in the creation of the innovative product - See Appendix 1).
4. Test and evaluate your plan. Does it work as you expected? Write your results.
5. Iterate your prototype until you reach a good solution. Detail your steps and explain how the prototype improved for a previous version(s).
6. Communicate the process of designing the prototype and present your final product.
7. Discuss how a circular economy for toys could be beneficial for the planet.

Appendix 1.

What is Arduino?

The Arduino project began in 2005 as a tool for students at the Interaction Design Institute Ivrea, Italy, aiming to provide a low-cost and easy way for novices and professionals to create devices that interact with their environment using sensors and actuators. Arduino consists of both a physical programmable circuit board (often referred to as a microcontroller) and a piece of software, or IDE (Integrated Development Environment) that runs on your computer, used to write and upload computer code to the physical board.

Where can I buy Arduino Starter Kit?

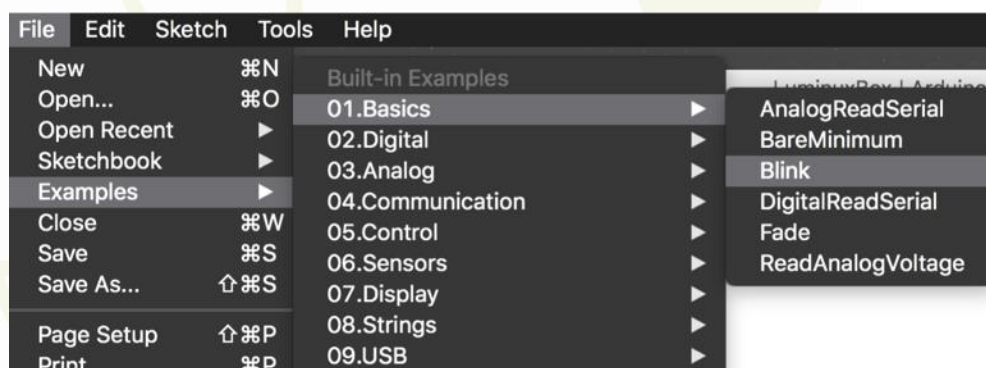
The Arduino starter kit can be purchased at the official website (<https://www.arduino.cc/>) or through other stores with unofficial kits (cheaper, same functionality). This kit is an example of a complete set of Arduino board and different components included: shorturl.at/bjFOU


Arduino IDE

Arduino IDE is an open-source software responsible for establishing the connection between the computer and the Arduino microcontroller. It is also in this application that all the programming code is developed, which will then be sent and run-on Arduino.

How to proceed with the installation? Download it on the official page, on the Software – Downloads tab, choosing the most suitable version for your Operating System (Windows, MAC OS or Linux). <https://www.arduino.cc/>

After installation, you will be able to run a simple code to verify if the computer is connecting with the Arduino microcontroller. For this, we access a previously written code (Blink), available in the ArduinoIDE application itself. File – Examples – 01. Basic – Blink. As shown in the figure:



Once we have the Blink code, we send it to the microcontroller through the upload button . In case of any error, confirm that the port is properly selected. In the main window, access Tools – Port and select the one available for Arduino (usually COM3 or COM7). Retry sending, if the LED that is integrated in the microcontroller blinks then we can proceed.

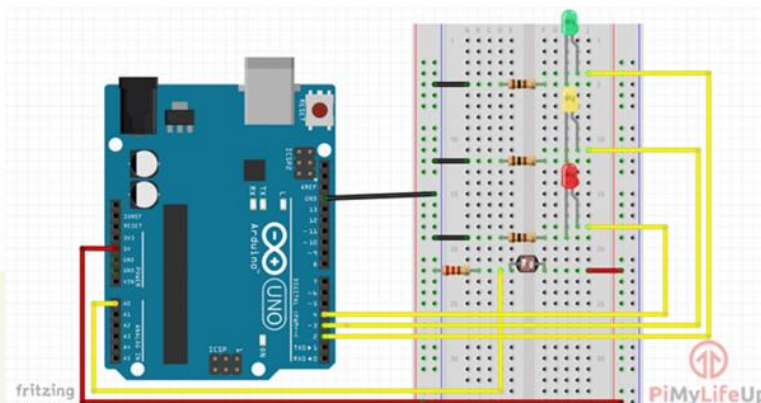
Project for the development of a light station controlled by luminosity levels

Here you can find the assembly diagram and the code used for this example project. Adapted from: <https://pimylifeup.com/arduino-light-sensor/>

Material:

- Arduino
- Breadboard
- Connecting wires
- 4 Resistors (3x 100 ohm and 1x 220 ohm)
- 3 Led Photoresist (LDR)

Schematic configuration:



Sample code:

```
#define greenLedPin 2

#define blueLedPin 3

#define redLedPin 4

#define lightSensorPin A0

int analogValue = 0;

void setup() {
  Serial.begin(9600);
  pinMode(greenLedPin, OUTPUT);
  pinMode(blueLedPin, OUTPUT);
  pinMode(redLedPin, OUTPUT);
}

void loop() {
  int lightLevel = analogRead (lightSensorPin);
  Serial.println(lightLevel);
  delay(200);

  analogValue = analogRead(lightSensorPin);
```