

Curriculum Activities Bionic Flower

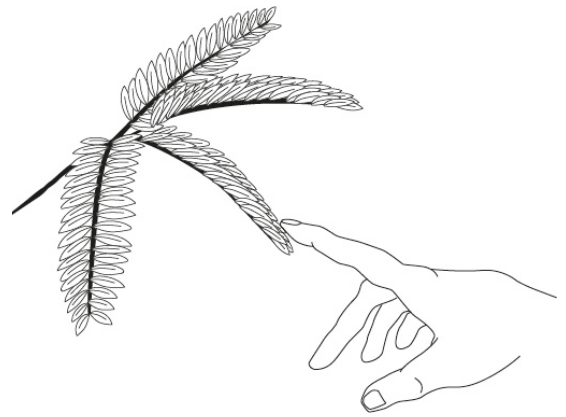


Plant world

The operating principle of water lilies and mimosa are unique in the plant world. These plants have one thing in common: They open and close their leaves or petals due to external stimuli. The effect serves for reproduction and protection against natural enemies. Water lilies have a screw-like structure to open and close their leaves depending on the light intensity. Mimosa Plants, on the other hand, close their leaves one after the other in response to mechanical stimuli such as touch or vibration.

Ideas for activities:

- Motion control in the plant world
- Survival strategies and protection mechanisms
- Which leaf forms are the most stable?
- Which materials are suitable for the leaves?



Art

The petals of the bionic flower comes made from plain white card board material.They get their rigidness by folding. Students can experience how to strengthen mechanical structure by folding structures by simple experiments and by making the flower. In addition to that students can color the petals according to their taste. The bionic flower comes with three color RGB LED lights. Students can experience the effect of different colors.

Ideas for activities:

Theory of colours

- Colours in the plant world
- Realizing light color and light mixing with RGB LEDs

Folding structure

- Design of the sheets with different materials, folding mechanisms, shapes and colours
- Getting to know lightweight construction principles, especially folding mechanisms

Creativity

- Design Your Own Petals:(Festo LX Course: Festo Learning Experience <https://lx.festo.com/de>)

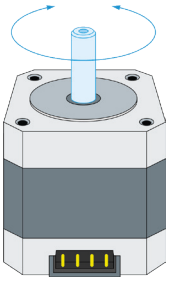
Assembly

In Manufacturing assembly is an essential step in the production, joining all the single parts into one product.

The essential sub-operations of an assembly process are: joining, handling, testing, adjusting or auxiliary operations (e.g. cleaning, heating or cooling for press connections, deburring, unpacking, sealing, oiling, ...) The opposite of assembly is disassembly with appropriate disassembly techniques.

Ideas for activities

Assemble the Bionic Chameleon according to the instructions.



Actuator System

Flowers and mimosa plants actuate their leaves by making use of differences in liquid pressure in cells or growth processes. The bionic Flower uses a stepper motor instead. A stepper motor converts digital impulses into a rotational movement. One motor revolution is divided into X equally sized steps. Each digital impulse causes a „step“ that defines the motor position at any point of time. The more impulses are sent, the faster the motor turns.

Ideas for activities:

- Getting to know fast plant movements
- Understanding how a stepper motor works
- Control of a stepper motor

Microcontroller

A microcontroller is a single-chip computer system. Microcontrollers are semiconductor chips that contain a processor and a peripheral function at the same time. Microcontrollers are usually programmed in different languages like Assembler, C or C++.

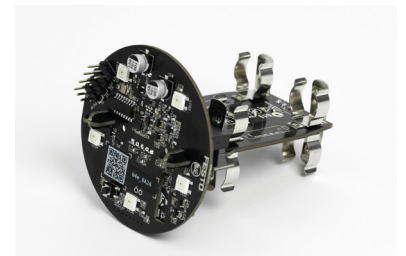
Ideas for activities:

Decide how your microcontroller should react:

- Process sensor signals (light, proximity sensor)
- Applying logic functions
- Controlling a stepper motor and light effects (colors and brightness)

3 variants for programming the microcontroller:

- Control via web app (link to the manual)
- Graphical programming with Open Roberta <https://lab.open-roberta.org/>
- Embedded programming with C++ <https://github.com/pm-b4e/Bionics4EducationKit>



Control and Closed Loop Control

Control means to influence a physical value of a system in open loop. Closed loop control means to measure the physical value and react to any change immediately in order to keep this value in a desired range. For the chameleon you can serve as a human controller with your smartphone.

Ideas for activities:

Understanding how plants process signals and transmit them for movement.

Accompanying courseware: Visit Festo LX <https://lx.festo.com/de>



Mechanical Design

Design is about creating something technical. CAD software tools (Computer-Aided Design) are often used to make the design process faster and achieve digital twins of the product more easily. Festo Didactic recommend to use the web based 3D CAD System Onshape (www.festodidactic.onshape.com).

Ideas for activities

Designing additional parts with CAD

Redesign of the chameleon body or other parts.

3D CAD files available on our Website

You will find all download material here:
<https://www.stem.festo.com/downloads>

Any further information about the Bionic Flower:
<https://www.stem.festo.com/bionicflower>