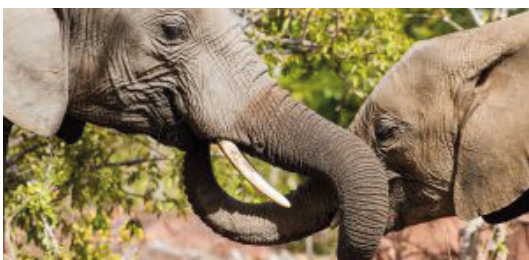
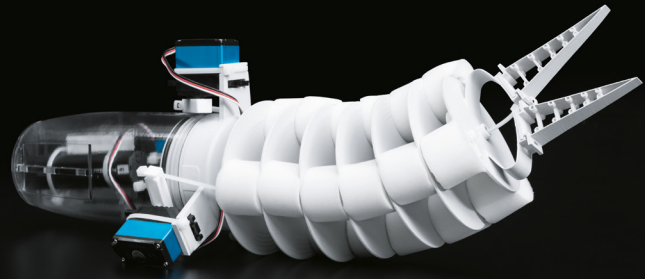


# Curriculum Activities

## Bionic Elephant



### Structure & Function

The Elephant uses its trunk in many different ways. The intake of food and water can only be carried out with its help. Grass is clasped with the trunk, torn out and led to the mouth. Elephant trunks are characterized by a flexible and yielding bellows structure. It consists of about 40,000 muscles and is a real wonder tool. Lengthwise and crosswise striated muscles make the trunk strong and mobile. The trunk is used for breathing, grasping, smelling, sucking and touching.

#### Ideas for activities

Think about which materials are suitable to realize a flexible bellows structure? Foam rubber, wood, springs, ...?

### 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.

### Biodiversity

Elephants are mammals and live in herds. Bull elephants can be 3.5 m tall and weigh 7,000 kg. They eat up to 200 kg of plants a day. Today, three species of elephants exist. The African elephant lives in Africa, and the Asian elephant can be found in India and around Southeast Asia. Lastly, the forest elephant which for a long time was considered a subspecies of the African elephant. The African Trunks have finger-grippers that are used to grasp plants to retrieve food. Here the gripping technology differs depending on the type of elephant. African elephants have a trunk with two gripping fingers, while Asian only have one gripping finger. The bionic elephant trunk has a two finger gripper with two fin ray gripping jaws. In fact this design is able to grasp and securely hold very different objects. The gripper can adapt itself to the shape of fruit, eggs or workpieces.

#### Ideas for activities

Try to grip different objects with the gripper element? Try: round, square, flat, soft objects and analyse.

On the website you find a CAD model for a three finger gripper. Print it and experience the difference between the three and the two finger gripper. If you combine the interaction of several Bionic Elephants, for example, an object can be moved around as in a real production environment.





## Robotics / Cobot

Most Common robots consist of steel or other hard materials, and are often heavy and strong. To prevent injuries to humans, industrial robots have had to work within protective fencing therefore in a „cage“. Working with people is often dangerous. Cobot is a sub-concept of robotics. Thanks to recent advance- ments in sensor/safety technology, that is changing. Humans and robots are not separated in the production process. Now we they work directly alongside one another together. A collaborative robot, or “cobot” for short, is an industrial robot that works together with and supports humans and supports them by increasing efficiency and production volume in the manufacturing process. Following the example of the elephant’s trunk, robot arms can be made pliable and thus interact with hu- mans for gripping, stacking, and assembly purposes.

### Ideas for activities

Cobots & Robotics:

- Experience the dexterity of an elephant’s trunk.
- Where could this type of robot be used? Discuss and exchange your ideas!
- Advantages and disadvantages compared to classical industrial robots. Collect and discuss!
- Benefits of Cobots: Collect and discuss.

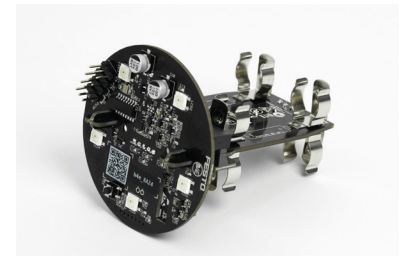
## Microcontroller

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 the many different programming programming languages like Assembler, C or C++.

### Ideas for activities

Microcontroller / Programming

- Getting to know the controller and its features
- Programming with Open Roberta Programming with C++ <https://lab.open-roberta.org/> and <https://github.com/Festo-se/Bionics4Education>



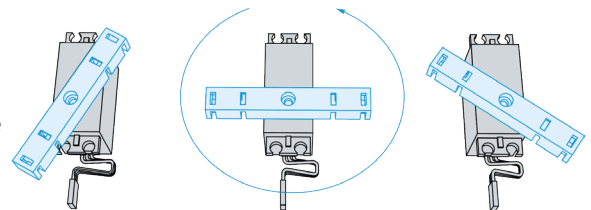
## Actuator System

A servomotor consists of a motor, sensors and a controller. The sensors measure the position of the shaft, and the controller moves the motor until the desired position is reached. The bionic kit contains 4 integrated servo motors to drive the bio inspired robots.

### Ideas for activities

Explain, compare and evaluate actuator system:

- How does the servo work?
- Which alternative drives do you know?



## Optimization

Elephant trunks are characterized by a flexible and yielding bellows structure. It consists of about 40,000 muscles and is a real wonder tool.

### Ideas for activities

Optimization

- Getting to know the mobility of an elephant’s trunk
- Can the mobility of the trunk be improved by optimizing the trunk structure?
- Collect ideas & realize them if possible

## Mechanical Design

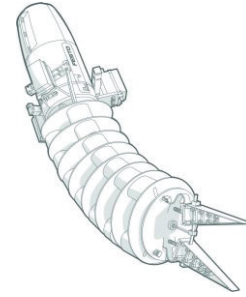
Design is about creating new things, e.g. CAD software tools (Computer-Aided Design) are often used to make the design process faster and achieve digital twins of the product more easily. Festo Didactic recommend to use the web based 3D CAD System Onshape ([www.festodidactic.onshape.com](http://www.festodidactic.onshape.com)).

### Ideas for activities

Designing with CAD

Redesign of the elephant body or other parts.

3D CAD files available on our Website



## 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

Control and Closed Loop Control

Control of the elephant during the gripping process. Accompanying courseware:

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

You will find all download material here:

<https://www.stem.festo.com/downloads>

Any further information about the Bionic Elephant:

<https://www.stem.festo.com/bionicelephant>