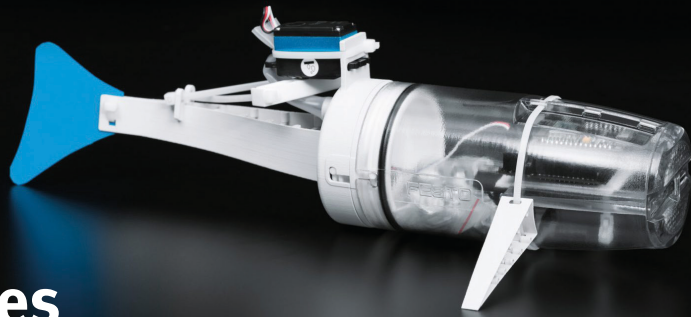


Curriculum Activities Bionic Fish



Fin Ray Effect

Tail fins of bony fishes behave not as expected when bent: Instead of bending in the direction of the pressure force, the fin but bends in the direction of the compressive force. This initially surprising feature allows fish a highly efficient power transmission in water. This effect is known as the „Fin Ray Effect“.

Ideas for activities:

- Interested in how the Fin Ray Effect works? You can make a Fin Ray by yourself.



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

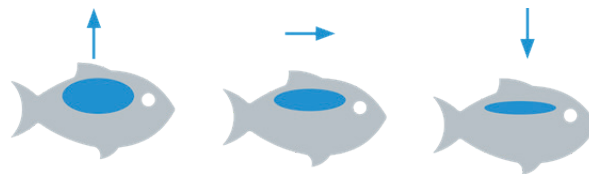
Assemble the Bionic Chameleon according to the instructions.

Swim Bladder

Most fish have a swim bladder, which is used for controlled buoyancy and floating in water. The swim bladder is balloon-shaped and consists of skin. It acts like a balloon filled with air.

Ideas for activities:

- Characteristics of bodies in water
- Why does the fish swim?
- How do fish regulate the diving depth?
- What would it take to make the Bionic Fish dive?

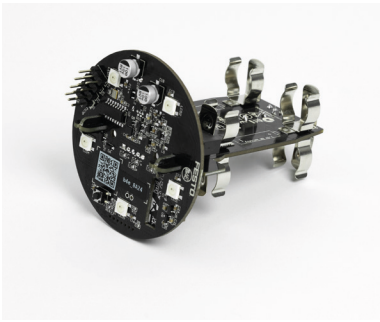


Swarm Behaviour

The term refers to the behaviour of fish, birds, insects and other animals that join together. Some fish species form groups to appear larger and more threatening. This is called shoal behaviour. Enemies are often confused by sudden changes in direction and shape of the shoal of fish.

Ideas for activities:

- Let your robot fishes swim together in a large pool filled with water.



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:

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>

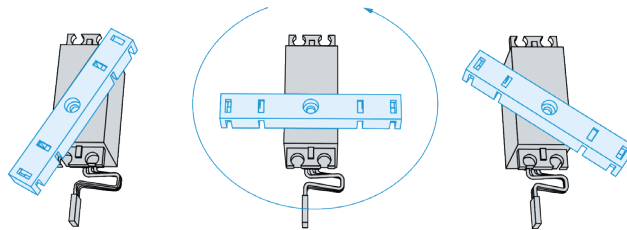
Actuator System

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 four integrated servo motors to drive the bio inspired robots.

Ideas for activities:

Explain, compare and evaluate actuator system:

- Understanding the Fin Ray Effect on locomotion
- How does the servo work?
- Which alternative drives do you know?



Optimization

In the course of evolution, various forms of caudal fins have developed. Some fish move only slowly and hide in caves or coral reefs. Others are very fast swimmers in open water. A high caudal fin can be useful in the open sea, but it is more of a disadvantage in narrow caves or crevices. For some fish, it is also more important to be agile than it is to be able to swim fast.

Ideas for activities:

Optimization

- Getting to know the types of locomotion in the underwater world
- Getting to know fin shapes in the underwater world
- Which fin forms are found in fish and marine mammals?
- Optimization of the fin shape to have the fastest fish (competition)

Mechanical Design

Design is about creating new things, e.g. the development of better quality and more economical products. CAD software tools (Computer-Aided Design) are often used as working tools. Festo Didactic recommend to use the web based 3D CAD System Onshape (www.festodidactic.onshape.com).

Ideas for activities:

Designing with CAD

- Redesign of the fish body or other parts. Design a box for balancing weights
- 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 fish in the water by changing the fin stroke

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 Fish:
<https://www.stem.festo.com/bionicfish>