

MECHATRONIC FISH

Basic (coding preset)

Stimulate problem solving

Gold

Stimulate creativity

Gold

Stimulate critical thinking

Bronze

Stimulate group work

Platinum

Stimulate entrepreneurship

Gold

Informal learning environment

Gold

Technology use

Gold

Practicalities



Preparation: 3-6 hours



Duration: 4 - 8 hours



Group size range: 3 - 24

Ideal sub-group size: 3-4



Workshop made for: -12

Easily transferable to workshops for ages between: 12-16



Material needs:

- Styrofoam 40x600x1200mm
- Styrofoam Cutter (see below)
- 1mm wire
- Jute cloth
- Styrofoam chips
- Spray Paint (10 colors)
- Laptop
- Projector
- Whiteboard marker
- Plywood (4mm - 6mm)
- Arduino Uno (with USB-cord)
- Popsicle sticks
- 2mm and 4mm drills
- Drilling Machine
- Knife



Environment FabLab necessary: No / But some facilities



Educational area:

- * Biology
- * Computer science
- * Mechanics
- * (Visual) Arts

Precognition

Fish come in many different shapes and sizes. This workshop is about making a mechatronic fish and adding one (or two) mechanical movements. When deciding what fish they choose to make, the participants also decide what movement is most interesting about that fish. Is it a fish that has a very strong jaw, is it a fish with an unusual tail fin movement or is it a fish with some other interesting property?

The mechanical movements can be accomplished by different mechanisms. The movement for a fin or the jaw can be simplified as angular movement around an axis. This movement is also used for example for steering a RC-car. (see box 'content links' below).

Student Preparation:

Before the day of the workshop there are some necessary preparations that need to be done:

Divide the pupils into a number of small groups, approximately 3-4 pupils in each group.

Ask the groups to choose what kind of fish they want to create. Regarding the task itself, it doesn't matter which fish they choose. It's up to you as a teacher if you for some reason want the pupils to work with a specific kind of fish.

Now let the pupils study the fish of their choice based on different aspects: colour, thickness and movement patterns.

The fish the pupils are making will be able to move when done. Therefore the groups must pick two different movements they want their fish to perform, for instance movement of the eye, of the mouth, of one or two fins, or even simple body movements (note that it has to be a one joint movement).

Finally the groups must find a good, high resolution image of their fish. They should then bring the digital image, or a link to the image, on the day of the workshop. The arranging institution might also want you to email the images in advance.

If you so wish, you may want to instruct the pupils to write a short factual text, to be used as a sign next to the completed fish. Of course, if you haven't got the time to do this in advance you let the pupils do it later on.

Workshop Preparation:

Prepare the fish brain (Arduino)

Upload the code from the file fishy.ino to the Arduino board

<https://www.karlstadmakers.se/fishy.ino>

Prepare the fish muscles (Servo board)

3D-print two servo holders

<http://karlstadmakers.se/servoHolder.stl>

Make/Test the foam cutter(s)

If you are using a DIY (Do It Yourself) cutter with a power supply: Turn up the effect until the thread turns red. Then turn it down slightly so the thread stops glowing.

Workshop Guidelines

Projecting, drawing and cutting



Material needs:

Essential: Digital image of fish , computer, projector, styrofoam, styrofoam cutter, whiteboard marker



Goals:

Skill Goals (**Blue**)

(S1) Projection method of image copying

(S2) Melting point of plastic


Content Goals (**Green**)

(C1) Using projection to paint.

(C2) Using a foam cutter.



Background story:

Goals	Activities	Duration
S1	Project the image of the fish onto the styrofoam.	10
S1, C1	Draw the contours using a whiteboard marker 	20
S2, C2	Cut out the fish and the fins with a styrofoam cutter. Separate the fins from the body	20



Put the fins away for now



Skin and flesh



Material needs:

Essential: Fish, jute fabric, whiteboard marker, wire, nippers, foam chips



Goals:

Skill Goals (**Blue**)

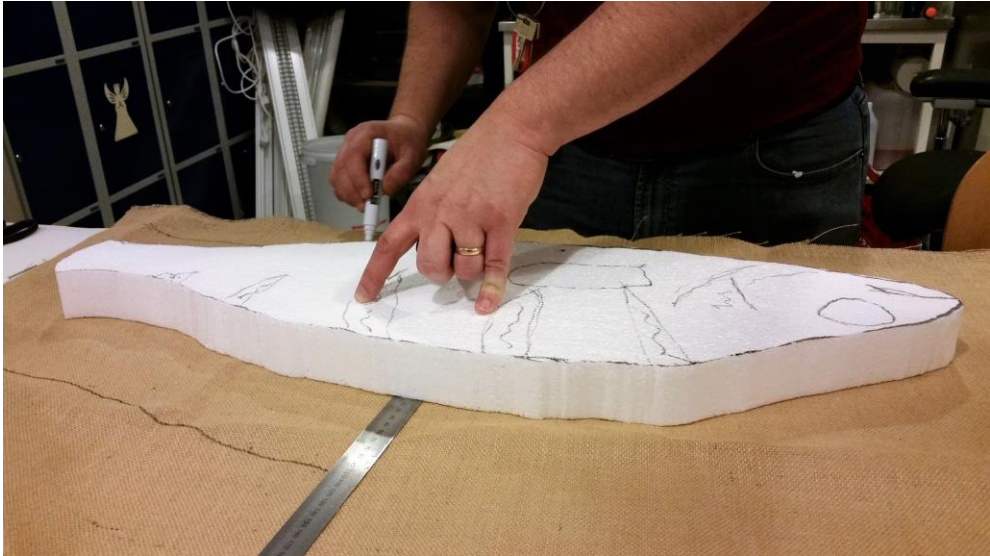
(S1) Drawing and Cutting



(S2) Surface area / volume relation

Content Goals (**Green**)

(C1) Draw the fish

(C2) Fill and mount the fish

Goals	Activities	Duration
	Place the fish, without the fins, on a piece of jute fabric	2
S1, S2, C1	<p>Draw a line on the cloth 10 - 15 cm outside the fish.</p> 	10
S1, S2, C1	Cut the fabric = the skin of the fish	10

		
S2, C2	<p>Attach the fabric to the styrofoam using pieces of wire, bent to U end loops. Leave an opening for the filling</p> 	20
S2, C2	<p>Fill the fish to desired thickness by putting styrofoam chips in between the body and the skin</p>	10



C2

Attach the remaining opening with wire loops

5



Mounting the Fish body



Material needs:

Essential: fish, fins, skewers, popsicle sticks, 4mm drill



Goals:

Skill Goals (**Blue**)


(S1) Mechanics Static attachment

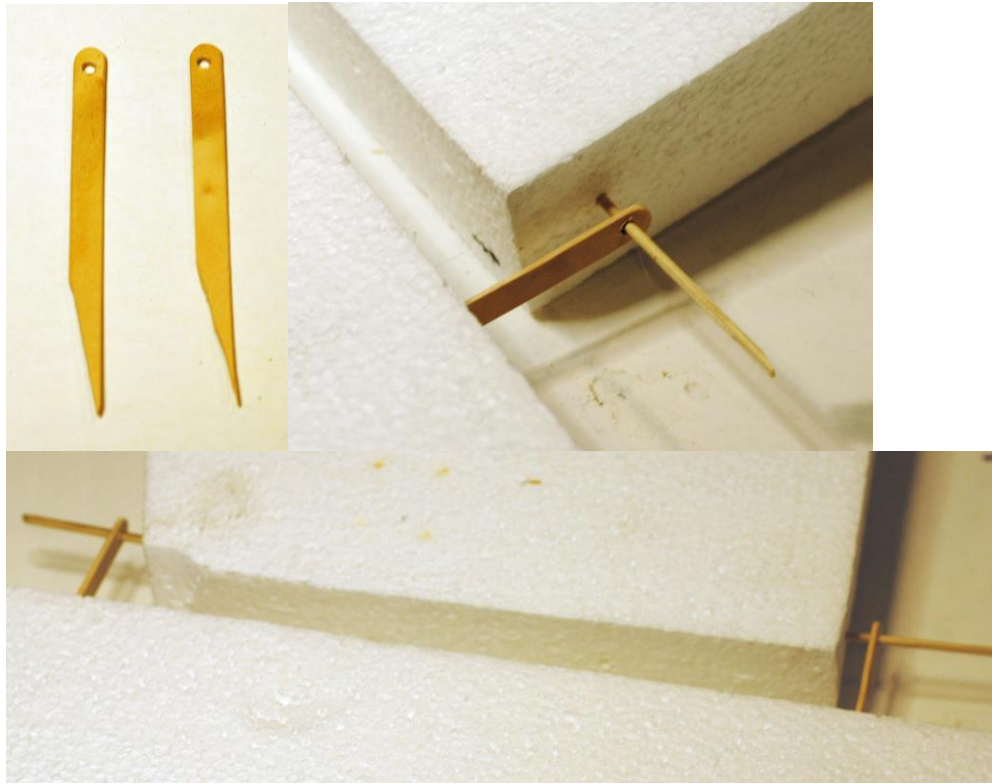
(S2) Mechanics Angular movement

Content Goals (**Green**)

(C1) Attach fins

(C2) Make a functional hinge

Goals	Activities	Duration
S1, C1	<p>Mount the static fins on the fish body using skewers sharpened i both ends.</p> 	5
S1.S2, C2	<p>Mount the moving parts using hinges. Mage a hinge by: Cutting a popsicle stick in half. Sharpening the strait side of a popsicle stick Drill a hole in the round side of the part.</p>	10



Mounting the brain and muscles



Material needs:

Essential: Arduino uno, plywood board, 2mm drill, wire U end loops, micro servo with arm , servo holders, cables



Goals:

Skill Goals (**Blue**)

(S1) Micro computer layout

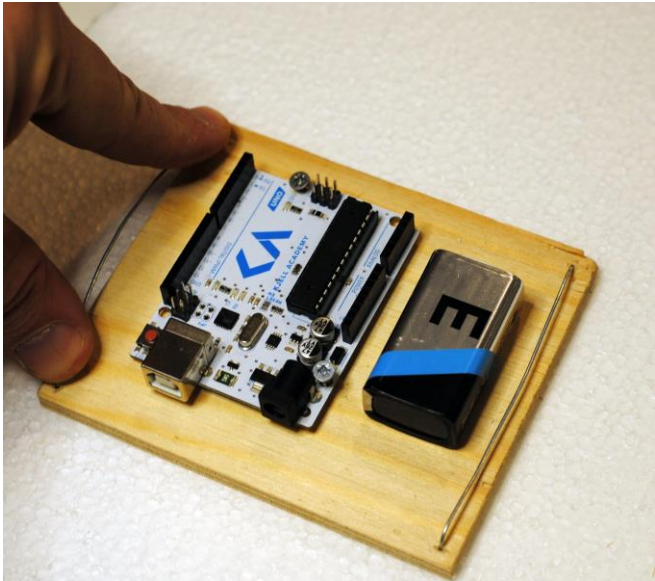
(S2) The functionality of a servo

(S3) Transmission of a movement

Content Goals (**Green**)

(C1) Rigid Mount of the boards

(C2) Build a functional movement

Goals	Activities	Duration
S1, C1	<p>Mount the brain (Arduino board)</p> <p>Download the arduino file Fishy.ino from https:// www.karlstadmakers.se/fishy.ino Upload the file to the arduino (If you don't know how to upload a file to the arduino: google it. There are lots of tutorials online)</p> <p>Make a 120mm x 100mm plywood board (4 or 6 mm plywood) drill 2mm holes in all 4 corners Mount the arduino onto the Brain board with screws. Attach the battery to the brain board using a rubber- band.</p> 	15 - 30
S2, C1	<p>Mount the muscles (servo board)</p> <p>Cut a popsicle stick in half. Drill a 2mm hole in the rounded end of the stick.</p>	15 - 45

Sharpen the



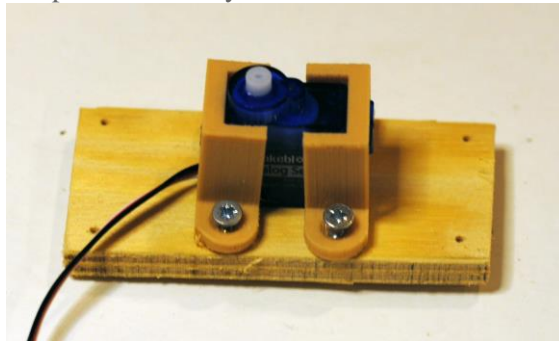
Glue och s

o arm.

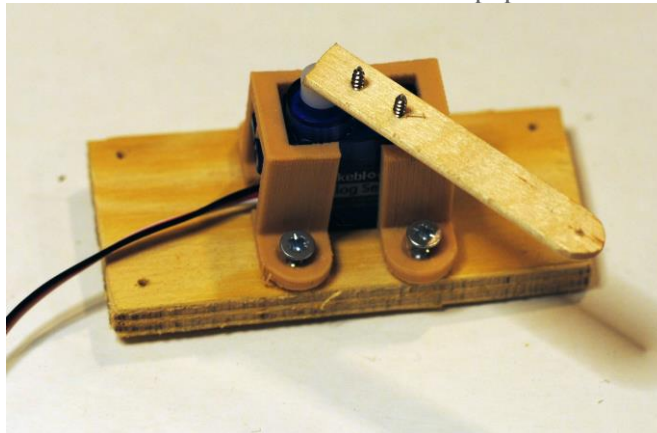


Cut a 40mm x 80mm plywood board.
Drill 2mm holes in the corners of the board.

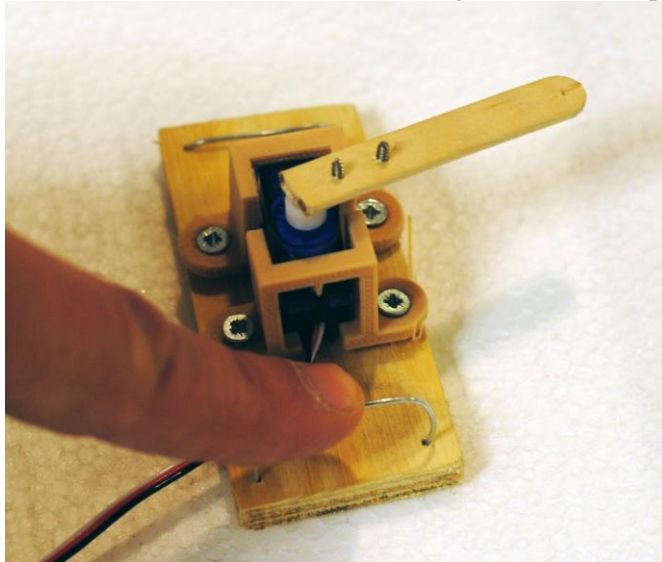
3D-print/Make/Buy Servo holders and attach the servo to the board.



Attach the modified servo arm with the popsicle stick to the servo.

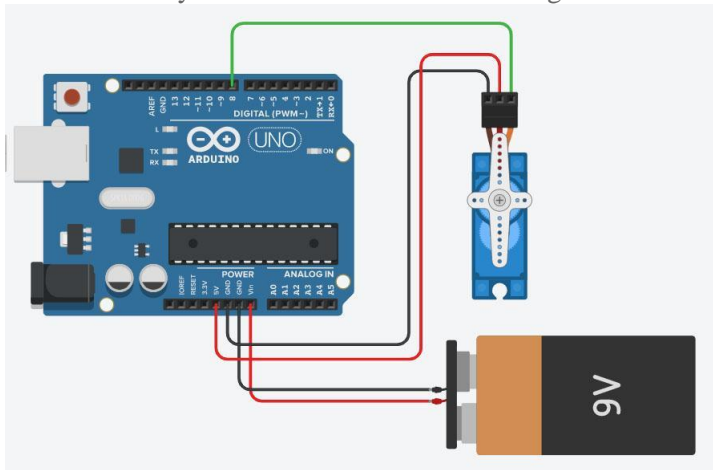


Attach the servo board to the fish using wire U end loops

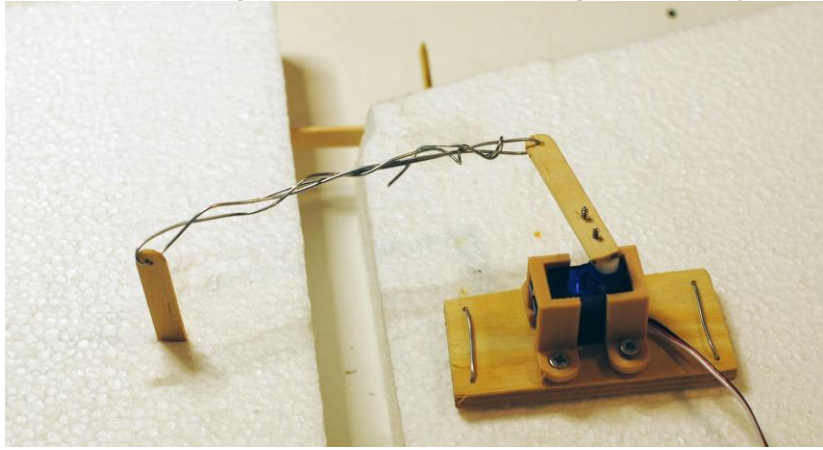


S1,C2

Connect battery and servo to the Arduino using cables.



15

<p>S1, S3, C1, C2</p>	<p>Attach the muscles</p> <p>Use the other part of the halved popsicle stick and: Drill a 2mm hole in the rounded end of the stick. Sharpen the strait end of the stick.</p> <p>Press the sharpened servo arm into the moving part (fin) Make a linkage arm with twisted wire and put it in the holes of the servo arms.</p> <p>Think about the length of the servo arm. You might need to adjust it later.</p> 	<p>15 - 45</p>
<p>S2, C2</p>	<p>Customize the movement</p> <p>The fishy.ino sketch allows you to connect a servo to three different pins with preprogrammed movements pin 8 = slow pin 10 = fast pin 12 = fast and wait</p>	<p>10</p>

Painting the fish



Material needs:

Essential: Fish, fins, Spray paint

Optional: Acrylic paint, brushes




Goals:

Skill Goals (**Blue**)

(S1) Copy a pattern onto a 3d-object

Content Goals (**Green**)

(C1) Have a 3d-copy of your 2d-image

Goals	Activities	Duration
S1, C1	<p>Paint your fish, if you use paint that smells strong maybe you need to Consider good ventilation.</p> <p>Use an image of your fish to guide you.</p> 	30



Pedagogical tips

Let the participants make mistakes. The equipment is cheap and can easily be modified if things don't work at first.

The exception from this is connecting the power to the arduino. Check that everything is connected properly before connecting both poles to the battery.



How to transfer to non-Fablab environment

Some of the processes require an extractor fan but can also be performed outside.

Do not cut styrofoam with a heated thread or use spray paint without proper ventilation.



Evaluation of achievements

The work with the fish is very much about the process. Participant groups can run into different problems depending on what movement they want to apply.

Try to listen and ask questions during the process to make a good evaluation of their achievements.



Content links

About servos: <https://learn.sparkfun.com/tutorials/hobby-servo-tutorial/all>

About fish: https://tpwd.texas.gov/kids/wild_things/fish/

Mechanical movements: <http://507movements.com/>

Arduino: <https://www.arduino.cc/en/Tutorial>

Software for Arduino IDE: <https://www.arduino.cc/en/Main/Software>

Foam cutter: <https://www.norwegiancreations.com/2017/06/building-a-quick-dirty-foam-cutter/>