Snapping Crocodile for AutoSTEM

Pedagogical guidelines and construction instructions

This guide includes the following parts:

- 🌀 How the Snapping Crocodile can be used to learn STEM contents
- 🌀 How to construct a Snapping Crocodile

How the Snapping Crocodile can be used to learn STEM contents

What is the Snapping Crocodile

A cardboard moving toy, which makes use of the scissors arm mechanism. It has the face of a crocodile but can be changed into a dinosaur or any other animal. With the help of the scissors arms, the child can make the crocodile's mouth open and close, snap, pinch, and grasp light objects. It allows children to analyse the mechanism and use it as a toy while gaining educational insights.

Developed by Ana Isabel Cobra, Beatriz Rodrigues, Catarina Sampaio, Jéssica Ribeiro, and Maria Beatriz Medina

Figure 1. Examples of the Snapping Crocodile

The following are ideas on how to introduce STEM concepts when constructing the *Snapping Crocodile*. Teachers can adapt these suggestions to their class and context and plan their own activity.

Target group

The Snapping Crocodile example described here is designed for children from 4 to 7 years of age. Teachers can adapt the proposal to other ages.

The teacher can decide depending on her/his knowledge of the children whether the children should work in groups or individually.

Learning goals

When constructing the Crocodile several learning goals can be achieved:

- To learn about physics and mechanisms, in particular, linkages.
- To develop engineering competencies of analysis and construction.
- To learn mathematical concepts within the construction and assembly process, including patterns, shapes and numbers.
- To learn biology concepts about the animal and its environment
- Other soft-learning goals can be included like problem-solving and creativity.

Guide on how to introduce STEM concepts during construction

The starting point is the Crocodile, how it functions, and how to construct it.

Observing

The first thing the teacher does is show a model of the Crocodile. The teacher can ask, why and how does it move.

Exploring and learning about physics and mechanism

When introducing the Crocodile, the teacher should challenge the children to observe and analyse the movement and especially the possibility to pinch objects. The teacher can ask the children how they think the mouth is opening. The teacher can also pretend to talk for the crocodile, for example, 'Hello class, I am a snapping crocodile' while moving the mouth to match the speech. Perhaps the children can make a drawing of how they think the mouth is opening. This can be a first contact with the mechanism, using a playful approach. Teachers can talk about linkages in a very simple way. A linkage is a rigid element with a hinge at each end to connect it to other elements. Linkages are used to link different elements together and to transfer motion to one place to another.

Starting to construct the crocodile and learning mathematics, physics and biology

The construction and use of the crocodile allow the teaching of several STEM contents within the construction and assembly process.

Children will observe the toy ask questions and try to explain how it moves. Examples of similar movements can be shown. When you move the ends of the two rectangles on one side against each other, the other side moves away (the arm stretches out) and the ends on the other side move against each other, too (the crocodile bites). This is illustrated in figure 2.
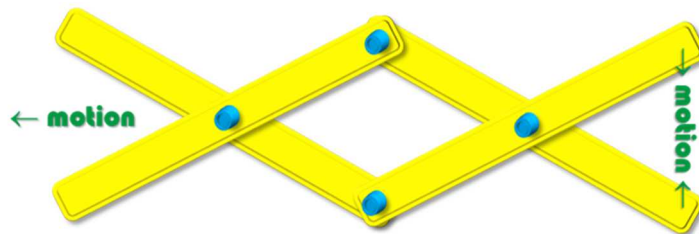

Figure 2. The linkage of the scissor arm and its motion mechanism

The teacher talks with the children and asks them about the shapes they are using to build the body and how many do they need. You need six or eight rectangles that have to be of same length and width. The children explore how to find the centre of each rectangle. The teacher scaffolds this exploration. One way to find the centre point is to draw the two diagonal lines of the rectangle. The centre point is where the lines intersect.

Next, the children make a hole in the centre of each rectangle and form a cross with two rectangles by putting the holes on top of each other. They attach the rectangles to each other with a split pin through the centre holes. Each rectangle needs two more holes, one on each end with about the same distance from each of the three closest sides of the rectangle. Then the children attach each cross to the next one with split pins. Guided by the teacher, the children can discover that there is a right and a wrong way to assemble the parts of the crocodile. This is an opportunity to teach how a mathematical feature (a pattern) is related to aesthetics and functionality. Figure 3 illustrates this:

   a) This is the right way. It is a pattern with all the orange rectangles being above the yellow ones.
   b) This is not as nice as a) because the pattern is broken. The yellow rectangle in the middle is above and not below the orange ones. It still works fine.
   c) This does not look nice and it works not as good as a) and b). The yellow rectangle in the middle is above the orange rectangle in the middle but

below the other two rectangles. There is a tension between the two rectangles in the middle. This increases friction. It is harder to move the scissors arm.
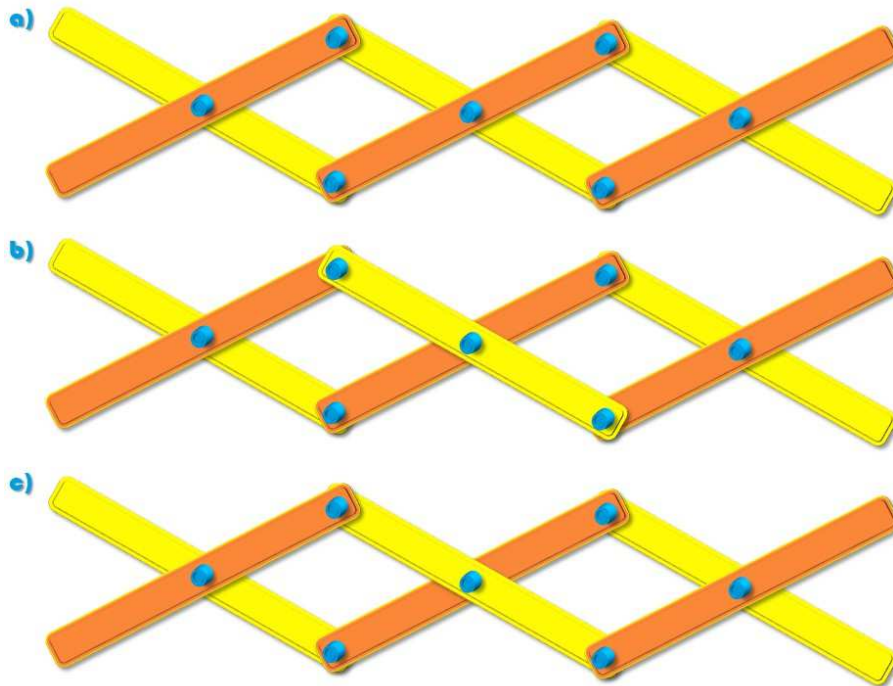

Figure 3. Different ways how to assemble the parts of a scissors arm

The crocodile (or other animals) can be used to explore biology and other science content, for example, the crocodile's

- Environment where it lives
- Physical characteristics of its body
- Movement (walking, swimming)
- Eating habits
- Reproduction
- Affinities with other species (reptiles)

Constructing the mechanism to develop engineer competences

Once the different parts are completed, it is time to put them together! Children construct the mechanism following the method described in the section *How to construct a Snapping Crocodile* and explore how linkages function.

Variations on the crocodile and adding scenarios and narratives

Other themes and characters can be used instead of a crocodile and different scenarios can be developed. The scenario can be used at the beginning of the activity or the end and, overall, can be co-built with the children. For example, a river can be used to contextualise the activity (see https://www.autostem.info/the-river-nile/)

Figure 3. Example of another toy using the same mechanism, developed by Ana Beatirz Figueiredo, Ana Rita Ferraz, Inês Lopes, Jaqueline Sacramento, and Raquel Silva

How to construct a Snapping Crocodile

Parts and tools required
- Crocodile's head (see template) or other narrative elements
- Cardboard to cut out 6 or 8 rectangles size 3 x 15 cm
- A wooden skewer or an awl to make holes
- Scissors or a knife for cutting
- 7 or 10 split pins

Since the materials that can be used are easy to find, the teacher can ask the children to find objects that might otherwise be thrown away (e.g. a cardboard box). In this way, we can teach conservation and reusability in the workshop.

Method

It is best to watch this video first: https://youtu.be/ZyEbItnjeJY

1. Cut out the 6 or 8 rectangles from cardboard (3 x 15 cm)
2. Find the centre of each rectangle and make a hole
3. Make two more holes at the two ends of each rectangle (see template)
4. Attach pairs of rectangles to each other with split pins through the centre holes
5. Attach the pairs of rectangles with split pins to each other as shown in figure 3a)
6. Stretch the scissors arm to its full length
7. Put the parts of the crocodile's head together so that the teeth fit into each other
8. Glue the head to one end of the scissors arm so that the upper part is attached to one rectangle and the lower part to the other rectangle

Templates