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The Grabbing Hand for AutoSTEM

Construction instructions and pedagogical guidelines

This guide includes the following parts:

- How the Grabbing Hand can be used to learn STEM areas
- How to construct a Grabbing Hand

How the Grabbing Hand can be used to learn STEM areas

What is the Grabbing Hand?

The Grabbing Hand is a toy that is a mechanical hand. The **AutoSTEM** Grabbing Hand is made from a standard paper cup, threads, straws and sticky tape. It will move depending on the movement caused by pulling the ropes.

It results in a toy that can be used by the children in many ways and opens up a number of subject areas for further learning. Grabbing hands are very motivating and exciting toys for children. It is fun for the children to be allowed to play with their Grabbing Hands once they have made them.

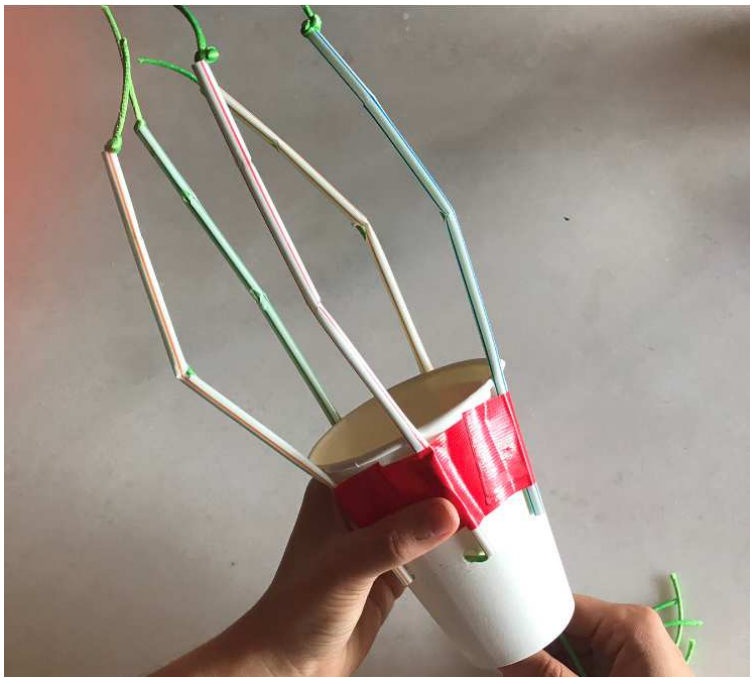

Figure 1: An example of the Grabbing Hand

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Target group

The Grabbing Hand example described here is designed for children from 4 to 7 years old. Teachers can adapt the proposal to other ages.

Depending on the children's knowledge, the teacher can decide whether they should work in groups or individually.

Learning goals

When constructing the Grabbing Hand, several learning goals can be achieved:

- To learn mathematical concepts within the construction and assembly process, including shapes and numbers.
- To practice measuring
- To use a ruler for measuring
- To know about human body parts, namely, the hand
- To develop engineering competencies of analysis and construction
- Other soft-learning goals like problem solving and creativity can be included

Guide on how to introduce STEM concepts during construction

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

Observing the Grabbing Hand and learning about biology

First, the teacher shows a Grabbing Hand model and makes it move and grab something, like a rolled sheet of paper. The teacher can ask, 'How and why did it move?'

When children are observing the Grabbing Hand, the teacher can talk about the **human hand** and ask several questions about how it functions. Children may explore or analyse other images and their own hands

Starting to construct the Grabbing Hand and learning mathematics

The teacher talks with the children and asks what is needed to make the Grabbing Hand. During the construction, many mathematical concepts can be used, introduced, or discovered.

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- **Counting:** one cup, five straws and five threads are needed.
- **Measuring length:** Straws have to be cut at three points. The children shall analyse how to measure the distance between them. Also, threads shall be cut into pieces of the same length. The children can use direct comparison, arbitrary units (e.g. fingerbreadth and cubit) or a ruler with standard units
- **Locating:** use spatial concepts like over, under, top, bottom, centre, around when constructing the Grabbing Hand.

How to construct the Grabbing Hand

To make the Grabbing Hand, you will only need seven necessary parts and tools that are found in every school or preschool. Below we list the materials required and alternatives.

Parts and tools required

- Paper cup
- five straight straws (not bending straws)
- Thread (about 2-3 m)
- Sticky tape
- Scissors
- Ruler (optional)
- Pencil or pen

Since the materials that can be used are very wide and easy to find, the teacher can ask the children to find objects that might otherwise be thrown away (e.g. straws, paper cups). In this way, we can add sustainability and recycling into the teaching.

Method

It is best to watch the video https://youtu.be/NTSMzVkndvM before starting the construction.

1. Measure three fingerbreadths from one end of the straw and fold it at that place (see Figure 2 and Figure 3). If the children are already familiar with rulers, they can measure the length in centimetres. Three fingerbreadths are about 4 cm, and two fingerbreadths are about 2 cm.

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Figure 2: Measuring three fingerbreadths

Figure 3: Folding the straw at the measured place

2. Cut diagonally in the fold, only up to 1/3 of the straw (Figure 4). The straw should end up with a hole (Figure 5) shaped like a diamond after you opened the fold (Figure 6).

Figure 4: Cut the straw diagonally at the fold

Figure 5: Already cut straw

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Figure 6: After you opened the fold, the straw has a diamond-shaped hole

3. Measure two fingerbreadths from the first cut and repeat process 2. Make sure you are folding in the same way since all three cuts must be facing the same direction. A trick is to place the first cut facing sideways while folding upwards (see Figure 7, Figure 8, and Figure 9).

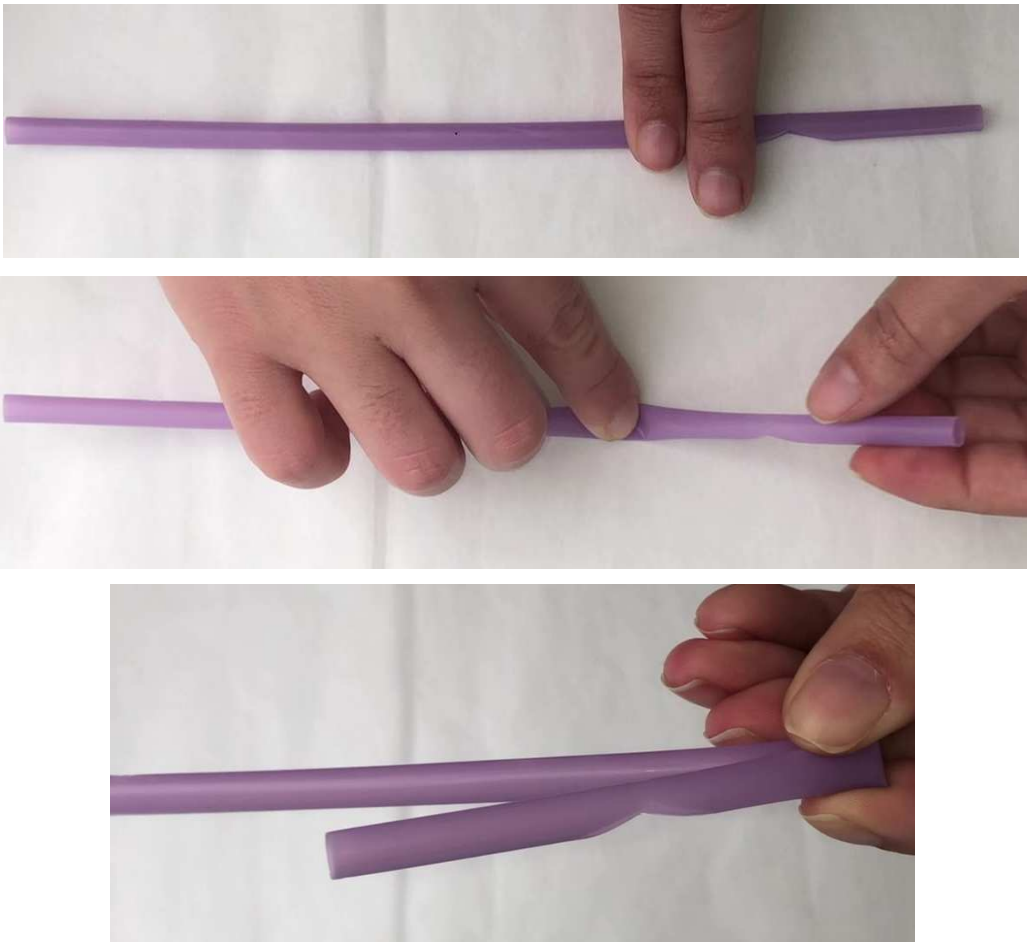

Figure 7: Measuring and folding for the second cut

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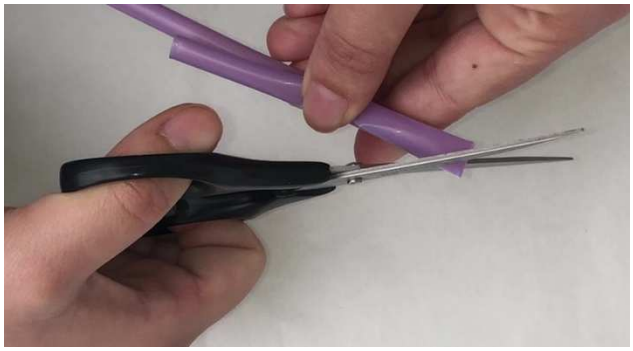

Figure 8: Cutting the straw a second time

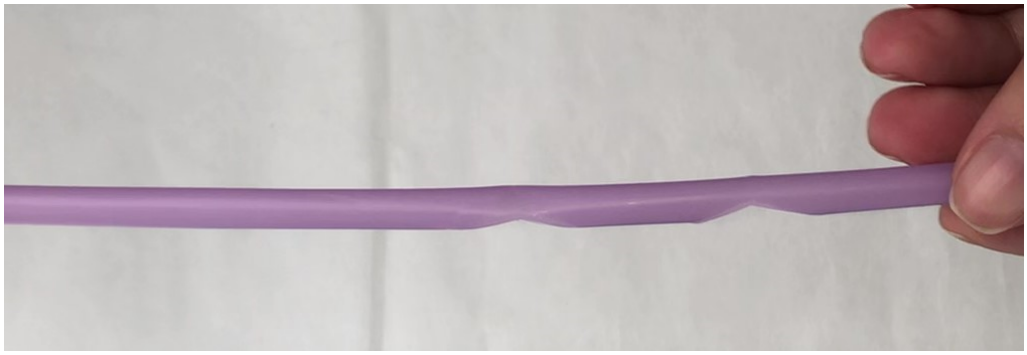

Figure 9: The straw with two holes

4. Repeat process 3 one more time. Finally, the straw has three diamond-shaped holes (see Figure 10)

Figure 10: A straw with three holes

5. Repeat the whole process 2-4 with the remaining four straws.
6. Cut the thread into five pieces of about 50 cm each. You can use a ruler for measuring (see Figure 11) or a cubit (i.e. the length from the middle finger's tip to the bottom of the elbow).

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Figure 11: Measuring the thread with a ruler

7. Push each thread through one of the straws (see Figure 12).

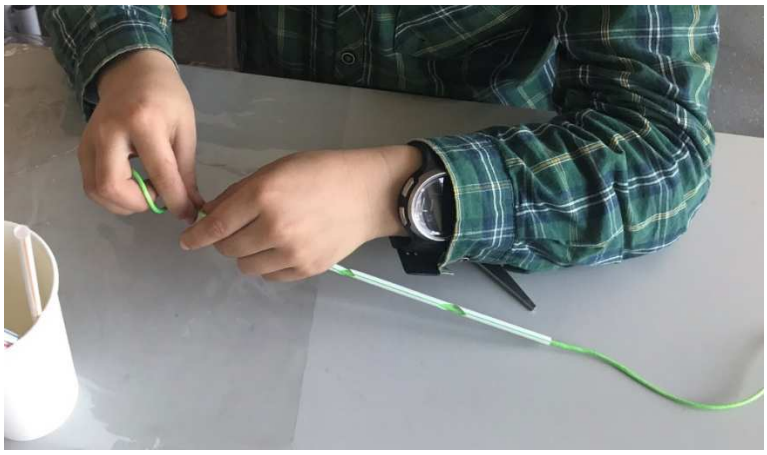

Figure 12: A Thread pushed through a straw

8. Tie a knot in one end of each piece of thread (see Figure 13). The knot must be at the end of the straw that is closest to the first cut, and it must be big enough so that it will not pass through the straw. You may have to make several overlapping knots.

Figure 13: Making a knot in one end of the thread

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9. Take the paper cup and cut away the bottom (see Figure 14). You can start by making a hole in the middle and cut around it until you reach the edge.

Figure 14: Cutting away the bottom of the paper cup

10. Use a pencil or a pen to make five holes around the paper cup equally spaced between them. These holes should be placed halfway up the paper cup (see Figure 15).

Figure 15: Making five equally spaced holes around the paper cup

11. Take the free end of one of the threads. Push it from the outside through one of the holes and finally through the big hole in the bottom of the cup.
12. Use sticky tape to attach the straw to the cup. Pay attention to the following two conditions: (1) Do not glue the thread to the cup. It is essential that the thread can move freely. (2) Locate the straw's three holes in a way so that the straw can freely bend towards the cup (see Figure 16).

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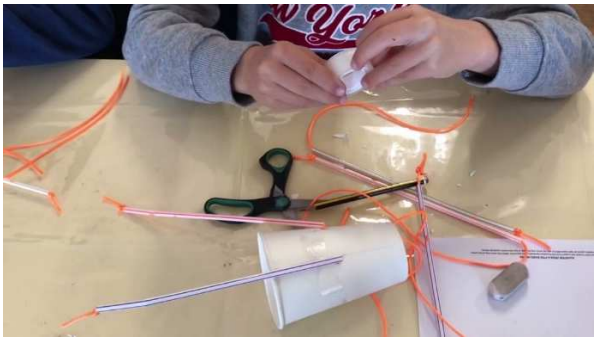

Figure 16: Attaching the straws to the cup

13. Repeat process 11-12 with the remaining four straws (see Figure 17).

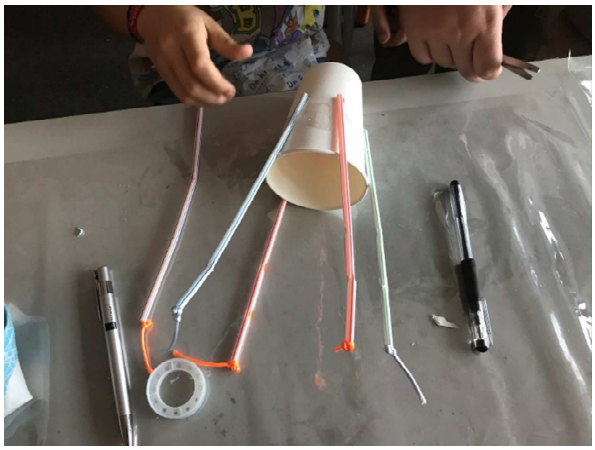

Figure 17: Paper cup with four straws already attached

14. Finally, you completed the Grabbing Hand. By pulling the five threads simultaneously while holding the paper cup, the straws bend towards each other like gabbing fingers (Figure 18).

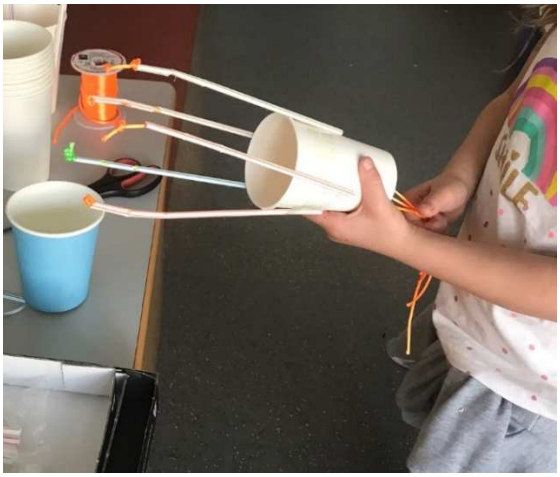

Figure 18: The Grabbing Hand is finished

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Making the Grabbing Hand move

Hold the paper cup with one hand, and pull all five threads with the other hand. This movement will make the straws to bend like fingers.

Advanced edition of the Grabbing Hand

Teachers developed a more advanced prototype of the Grabbing Hand (see Figure 19). You can watch it in action in the following video:

https://youtu.be/csXTpSfxXV4

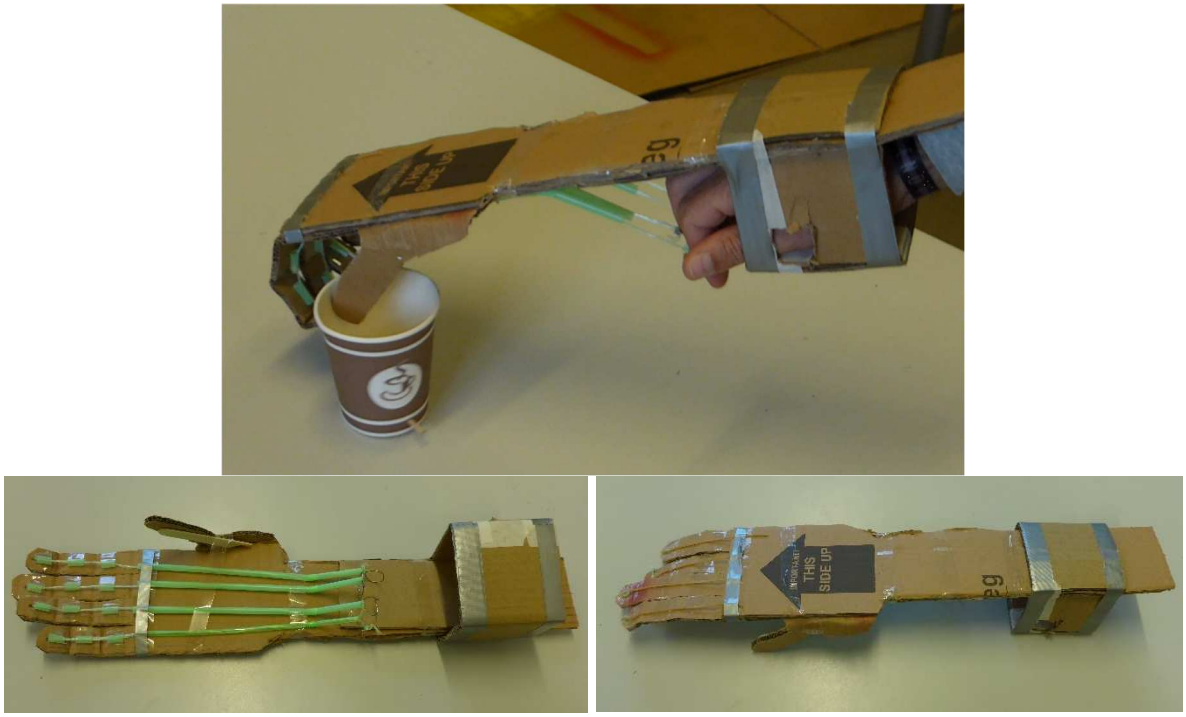

Figure 19: An advanced version of the Grabbing Hand

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