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The elevator

Pedagogical guidelines and construction instructions

This guide includes:

- How the toy can be used to learn STEM areas
- How to construct the elevator

How the elevator can be used to learn STEM areas

What is the elevator?

The elevator is a small house made from a milk or juice carton. The house contains a winch that is used to lift and lower an elevator. It has two open doors, one door at the ground floor and one at the top floor on the opposite side of the building. The toy can be used to play Kim's game. Kim's game is an exercise in observation, memory and classification. There are also many different possibilities for the children to explore and play with the mechanical mechanisms used in this toy.

Figure 1. The elevator

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The following are ideas how to introduce STEM concepts when constructing the elevator. The teacher can adapt these suggestions to their own class and context and plan their own activity (Plan template).

Target group

The elevator described here is designed for children from four to seven years old. Teachers can adapt the proposal to other ages. Teacher guidance is necessary when constructing the elevator.

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 and playing with the elevator several learning goals can be achieved:

- To learn about physics and mechanisms
- To develop engineering competencies of analysis and construction.
- To learn mathematical concepts within the construction and assembly process, including shapes, geometric terms and numbers.
- To practice measuring
- To train observational skills
- To learn classification
- Other soft-learning goals can be included; problem solving and creativity.

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How to introduce STEM concepts during construction

Observing and making hypothesis

The first thing the teacher does is to show a model of the elevator. After demonstrating the mechanism, the children can make hypothesis on why the elevator is moving, and why it can lift things to the top floor of the building. The children can then investigate the mechanism and see if their hypothesis were correct.

Exploring and learning about physics and mechanisms.

When you apply a force to the handle of the crank of the winch in order to turn it, you do work. This mechanical energy is transformed into the rotational kinetic energy of the winch spool. The rotational energy is transformed into translational kinetic energy of the string. The translational energy is transformed into gravitational potential energy of the raised elevator. The force needed, and the time it takes to lift the elevator is dependent on the thickness of the spindle.

Starting to construct the elevator, and learning mathematics and physics

Continuing with learning about shapes: During the construction of the elevator, the doors must be cut to the proper size and the size of the doors must be adapted to the size of the elevator floor (matchbox) and the size of the things one want to play with. The length of the spindle must be adapted and the string that lifts the elevator must be cut to a suitable length. The centre of the wheel must be identified as well as the periphery, so these two terms can be introduced to the children.

Constructing the mechanism to develop engineer competences

The children can identify the different parts of the elevator after studying it. Together with the teacher, they can plan the building of the elevator.
The teacher continues talking with the children about the pieces and materials to construct the mechanism.
Children construct the mechanism following the method described in "How to construct the elevator".

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Playing with the elevator

One possibility for play is Kim's game. Kim's game is played in the following way: One child is presenting several toys, five or more, depending on the age of the children. A second child studies the toys for a while and then turns away. The first child puts one toy in the elevator at the ground floor and mixes the order of the toys that are left. The second child can now guess which toy is in the elevator. After the child has decided which toy is missing, he or she can turn the elevator and see who is appearing at the door in the top floor. For this to work the two entrances of the elevator must be on opposite sides of the building. By playing Kim's game the children will train memory, learn classification of objects and they will learn names e.g. if toy animals are used.

The children should be encouraged to find other ways to play with the elevator as well.

Variations on the elevator

The elevator can be made from cartons of different size. We would recommend using large cartons (1.5 – 2 Litres) to make it easier to build and play with the elevator.

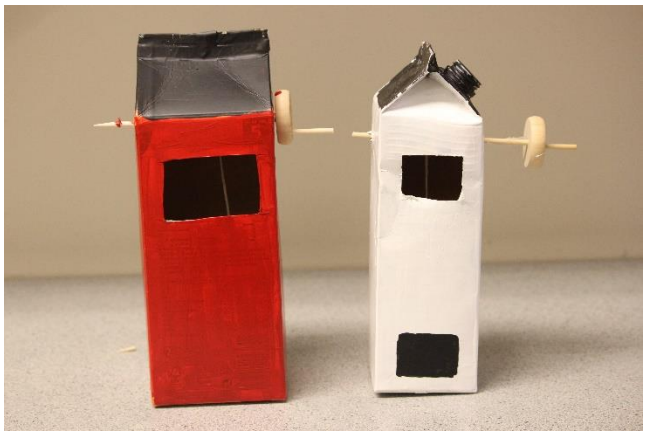

Figure 2. Variants of the elevator. We reccomend using a large carton.

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How to construct the elevator

Figure 3 Parts and tools required

Parts and tools required

- A carton used for juice, milk or similar
- A plant stick or a wooden skewer
- A wheel made of wood (other solutions like the cap of the carton or a disc made of thick cardboard, can be used)
- A matchbox
- Sticky tape
- String
- Paint and paintbrush
- A drill with a drill bit matching the diameter of the plant stick
- A saw
- A carpet knife or other sharp knife
- Glue (not shown)
- An awl can also be handy (not shown)

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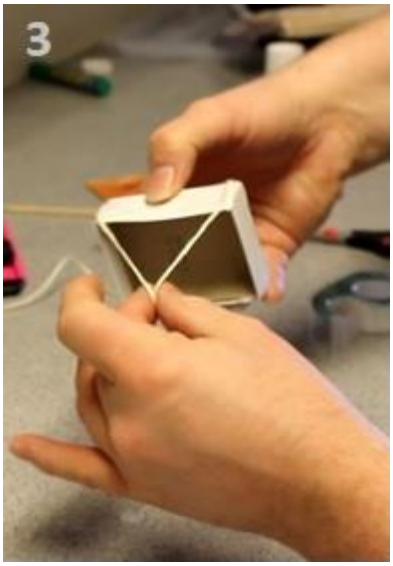
Method

It is best to watch the video at the Autostem youtube channel before starting to make your elevator(https://youtu.be/HNYxvmar4Ko). Figure 4 and the guidelines below is a step-by-step guide on how to build the toy.



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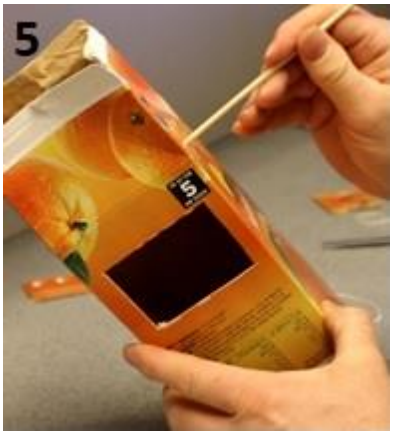

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Figure 4. Building the elevator

1. Make two holes on two opposite sides of the carton, almost at the top of the sidewalls.
2. Cut holes for the doors. Make sure the holes are large enough for the things you want to put inside the elevator. The children could use the matchbox as a template for the size of the holes. Place one door at the ground floor. The other door should be placed on the opposite wall on the top floor. By placing the doors on opposite sides of the building, you can use the elevator to play Kim's game.
3. Cut a piece of string approximately 3 times as long as the short side of the matchbox and attach each end to the two corners on the short side of the matchbox. Repeat on the opposite side.
4. Measure the height of the elevator, cut a suitable length of string (allow some extra length for the knots), and attach it to the two strings that are already attached to the matchbox. Make sure that the attachments to each of the four corners of the matchbox are of equal length so that the matchbox makes a level floor in the elevator.
5. Insert the spindle in one of the pre-made holes at the top of the sidewall
6. Attach the string to the spindle and put it inside the house together with the matchbox.
7. Drill a hole in the centre of the wheel and another close to the periphery.
8. Use a short part of the skewer or plant stick to make a handle and glue it to the hole in the peripheral part to the wheel. Glue the wheel to the spindle.
9. Close the top of the carton with sticky tape
10. Paint the house.
11. Play!

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