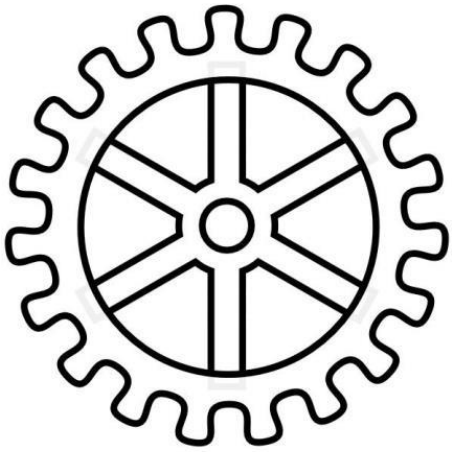
ENGINEERing challenge workshop for science museums in the field of Mechanics

For children from 9-11 years



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ENGINEERing challenge workshop in the field of Mechanics

Workshop ID card

Name of the workshop: Become a designer of mechanical toys

The Challenge: Imagine and create a mechanical toy using simple materials.

The Engineering field: Mechanics

The science field: Energy

Target audience: Families with children from the age of 9 to 11 years and / or pupils from 9-11 years

Type of activity: workshop

Duration of activity: 60 minutes

Specific notes: tables and chairs are needed.

Context

The final objective of the workshop is to transform a cardboard box in a mechanical toy. Each participant has to bring one. He has to choose a character and decide its motion. Then he could experiment other toys to define exactly the mechanical elements he has to use. Finally he realizes his toy he could go off.

Maximum number of participants: 10
Number of facilitators (intern): 1
Location: inside of the Museum, in a workshop space
Set up time needed: 15 minutes to prepare materials (cut cardboard, print characters, gather materials)

General objectives

The Engineer Museum Activities:

- ✓ Offer the participants to find and experiment different solutions to solve a "real" engineer problem
- ✓ Give a new perspective on Engineering as a field, a process, a way of thinking and working
- ✓ Introduce and exemplify the EDP (Engineer Design Process: Ask, Imagine, Plan, Create, Improve), or part of it
- ✓ Give the participants the possibility to reflect on what they have done and how the Engineers work.
- ✓ Are based on IBSE - Inquiry Based Science Education and are not gender oriented.

Specific unit objectives

- ✓ Discover how to transmit and transform motion using mechanical elements,
- ✓ To build a mechanical machine to solve a problem

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Resources

Material	Total amount	Expendable (on peut s'en passer)	Non- expendable
Tables	For 20 participants		✓
Chairs	20		✓
Scissors	20		✓
Elastic	40		✓
Glue sticks	10		✓
Blu-tak	120 g	✓	

Dowels	40		✓
Straws	40		✓
Duck tape	10		✓
A glue pistol	2		✓
A tendril	4	✓	
Pencils	20		✓
Cardboard boxes	20	✓	
Some cardboard			✓
A cutter for the facilitator	1		✓
Some paper		✓	
A mechanical toy		✓	

The facilitator could prepare some mechanical toys to be presented as models. He has also to choose some characters to propose them to the participants. He can select characters for the toys. They can come from cartoons, fairy tales, etc.

The workshop

Introduction

Welcome the participants and tell who you are.

Remember to the participants that they are going to solve a challenge: transform a cardboard box into a mechanical toy.

Define if necessary what is a mechanical object (or more precisely a mechanical toy). It could be the first main activity.

Distribute the materials for each family: scissors, a pencil, a ducktape, a box (if necessary), some paper, a glue stick.

The main activity

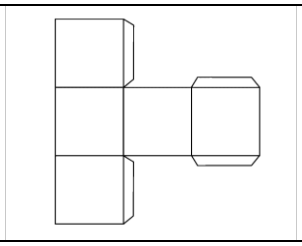
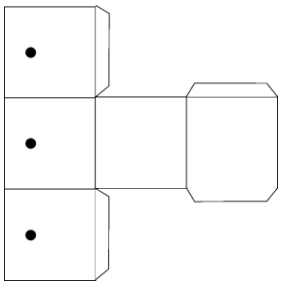
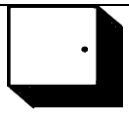
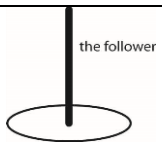
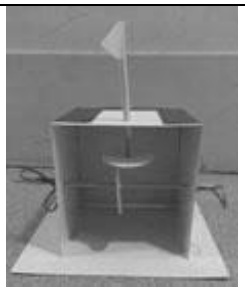
1. Define mechanical elements to transmit or transform a motion: explore the cams

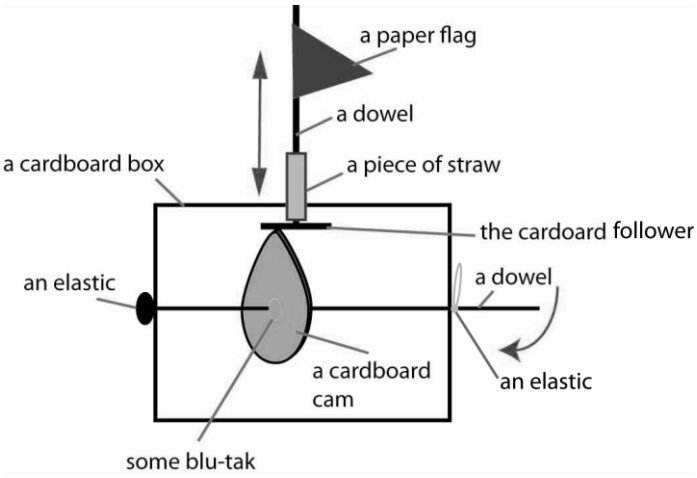
The facilitator could show some objects to explore levels, pulleys (a bicycle, a clock, a mechanical toy…) and more precisely the cams. He could show some models using different shapes of cams. We suggested a cam mechanism to be realized by the facilitator during the preparation of this activity.

To realize this mechanism, the facilitator needs:

- a piece of card (40 cm x 50 cm) or a cardbox
- cardboard
- glue
- scissors
- pieces of dowel
- blu-tack
- elastic

Then the steps of the realization are described.

Use a cardbox or draw out a net for an open cube with 10 cm the slide on the piece of card. Cut it out and score the folds.	
Measure and mark three holes at 5 cm from a side and 2 cm from the other. Here is the scheme.	
Make up the cube, sticking the tabs with glue. You can use paperclips if necessary.	
Draw a wheel of 2 cm of diameter, cut it. Stick the wheel onto the bottom of the piece of dowel: it will be your follower.	
Thread a cam onto the thicker dowel and thread this through the holes in the frame, securing it in place with blu-tack so that the cam turns with the axle, not by itself. Thread the follower through the hole in the top of the frame so that the wheel is resting on the cam. To be sure to obtain the correct motion, we suggest using a straw.	 Here is our realization.



At the end of this activity, participants have to undesrtand that the motion depends on the shape of the cam.

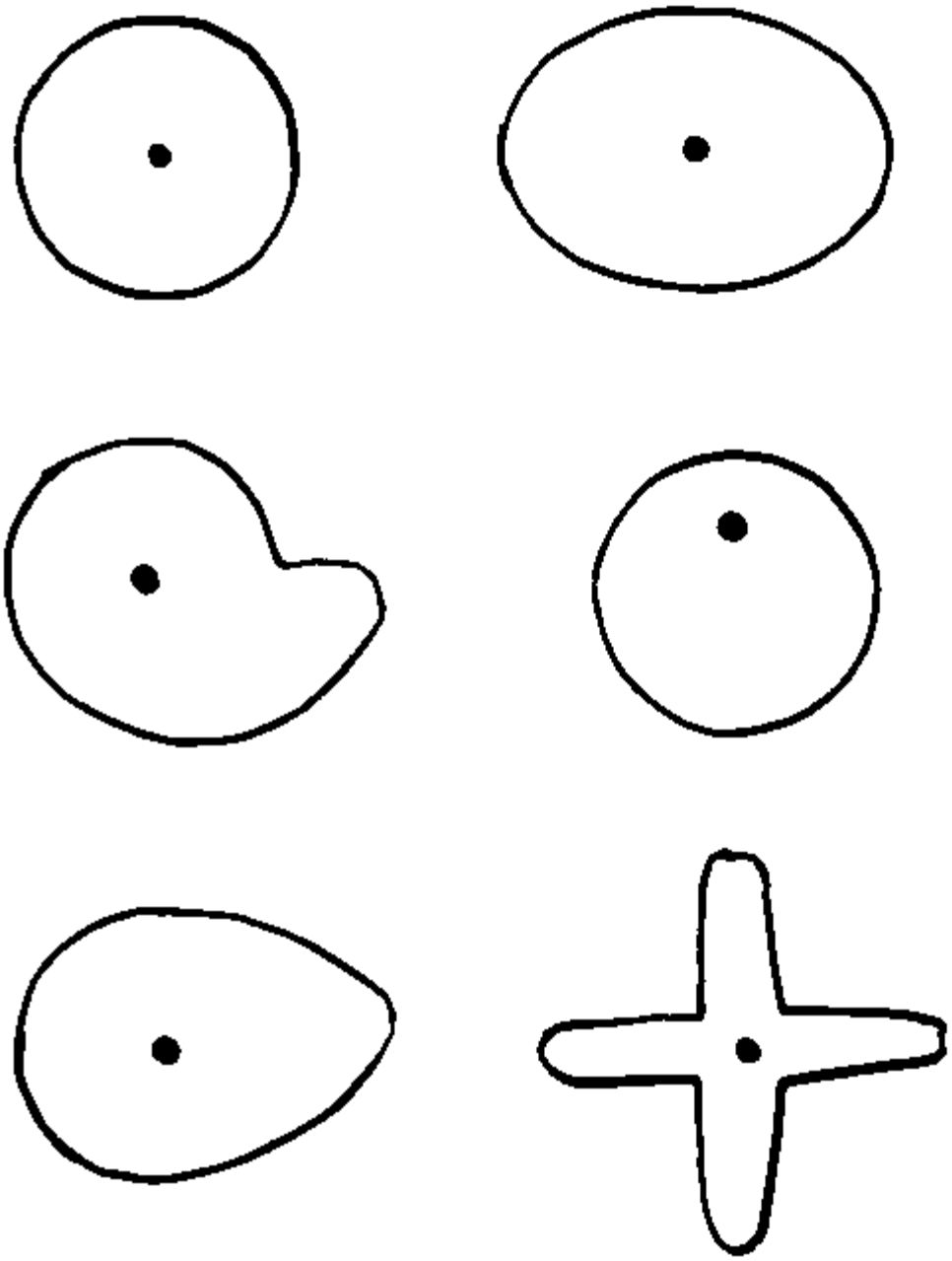
2. Solve the challenge

Participants work in team, choose a character and decide how their character will move. They could draw a scheme and list the materials they need.

Let the material to each participant could take some if he needs. We suggest preparing some elastic, some blu-tak, dowels, straws, some cardboard and others materials chosen by the facilitator.

Participants could then solve the challenge and realize a cam mechanism as we suggested in the previous activity (from the step 2). They could imagine and create their own shape of cam according the motion of the character. The facilitator could also suggest templates for the cams.

Templates for cams



These sizes of the templates are available for box 10 cm side.

Conclusion

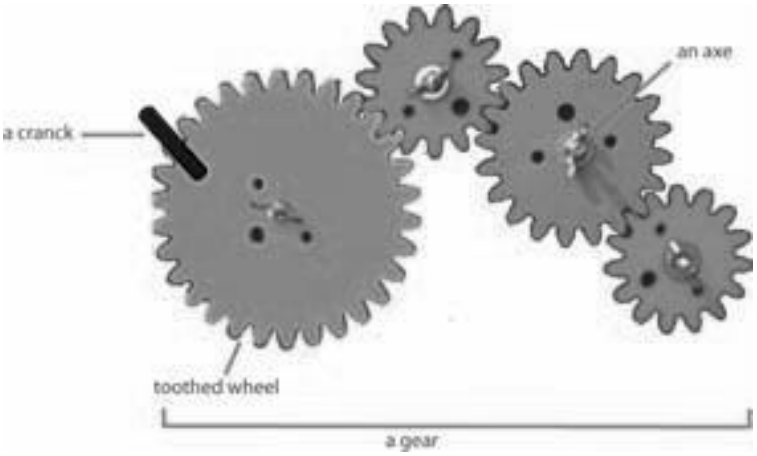
Each participant could present his toy to discuss about possible improvements. If there are some time left (and if the materials are available), they can test suggested improvements.

Information for the facilitator

Background information

Some mechanical vocabulary

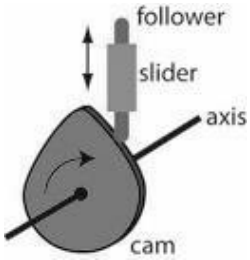
1. Some vocabulary to discover gears.



Using these gears, we can accelerate (or decelerate) a motion: it is transmitted but not changed.

If we need to transform the motion, we have to use a spur gear.

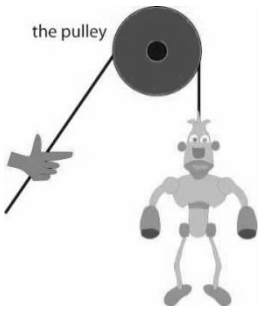
2. Some vocabulary concerning the cams.



When the cam turns, the follower goes up and down following the cam's profile. The slide allows the follower to move freely. The follower's motion depends on the cam's profile. Pupils will experiment it in the lesson 2.

Using cams, the input motion is transformed: the input motion is a rotary one and it'll become a linear one.

3. There are many other mechanical elements like pulley or level.



The pulley does not transform the motion, but it would make us easier to rise up a heavy object. Look with only a hand, I can rise up a robot.

4. To read more :

http://www.brainpop.com/technology/simplemachines
http://www.hometrainingtools.com/learn-about-gears/a/1658/
http://www.jeuxclic.com/jeux.php?id=243490

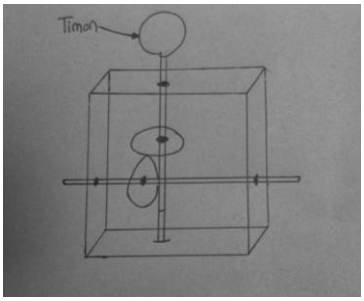
How to build the mechanical toy?

1. **Step 1: Which character and which motion?**

At first, participants have to choose a character and a motion. Then they define the shape of the cam they needed. They have to realise it:

In our case, we chose Timon from the Lion King (©Walt Disney Pictures), which is going to jump once when the cam rotates for one complete revolution and spin around. So we chose the pear shaped cam.

2. **Step 2: Assemble and organize the ideas**



For a better organization, participants could draw a scheme to decide where they are going to fix exactly the character on the box, where will be the mechanism. As they work in team it will be easier to list the materials.

3. **Step 3: Create the toy**

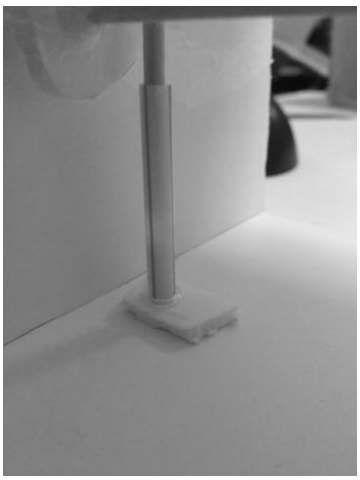
Now it is time to realize the toy.

1. The first thing to prepare is the box. You can take a shoes one and cut it in half. And if you don't have one, you can take 4 cardboards of 10cm long and make a box with them.

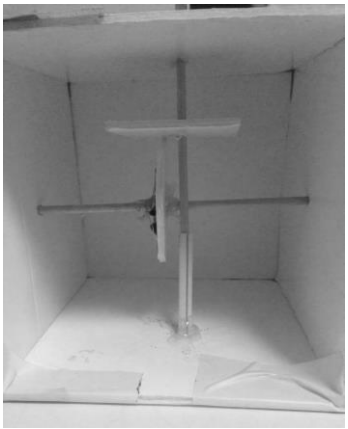
2. The character has to be fixed on a wooden stick.
   We used some ducktape but you can use glue pistol to fix your character better.

3. Mark on the box the place for the character.
4. Realize its mechanism.
5. Hole the box on each side in order to fix the "principal" axis.
6. Draw the cam chosen during the step 1. Cut it and fix it on the axis.
   In our case, we have to use a pear shaped one.

7. Place the character inside the box and check it's well fixed.
We used a straw to put inside the stick in order to be sure our character is straight. And it was sticked on the bottom of the box with the glue pistol.



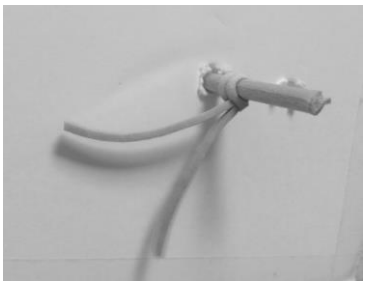
8. Fix the follower with blu-tack or the glue pistol. But be careful! It has to be in touch with the cam in order to transmit the motion.

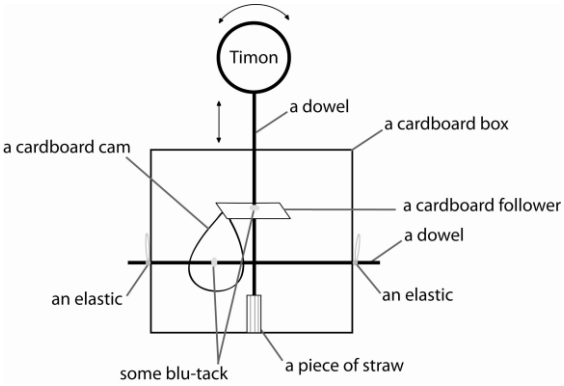


4. <u>Step 4: Test and improve</u>

Now, participants have to test their toy and check that the motion is correct while the axis rotates. Perhaps they need to adjust, if it's necessary. If everything is correct, we suggest securing the mechanism (the cam, the axis and the follower).

We suggest securing them with elastic bands or cardboard.





5. **<u>Step 5: Decorate the toy</u>**

If pupils have enough space in their box, they could put a background.
In our case, we decided to add one around the box.

FAQ participants can ask

[Anticipate questions that the public can ask. if you don't have any, than you don't need to write]

Problems you can encounter

[Think of problems of logistics, material s or about the science/engineering content. if you don't have any, than you don't need to write]

Tips & tricks regarding the materials

[f.e. Do not use a paper cup for … activity, it doesn't work, we tried. It is best to use….. if you don't have any, than you don't need to write]