Gears (ages 5-7)

Authors

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Summary

4-sequence module to study movement transmission using gears.

Using cogged wheels, the students learn to repair axes and rotation paths.

Programme Points

The world of matter and objects: using common technical objects; assembling and disassembling simple technical objects; designing and producing basic technological objects for utilitarian or entertainment purposes; using battery-operated devices.

Materials

Celda equipment (http://www.celda.fr) (or Lego kits) for 6 to 7 groups of four children:

- 12 base plates, 24 frames, 72 rods, 6 pink cogged wheels and 6 adapters, 24 yellow cogged wheels,24 blue cogged wheels, 24 red cogged wheels, 6 peg removers,30 large turning axes, 24 small turning axes, 24 free-running axes, 150 pegs, 24 large pulleys, 24 medium-sized pulleys,24 small pulleys, 24 axis stands, 24 handles, 63 assorted connecting parts.

As part of a scientific support programme to La Main à la Pâte , with primary schools in the Loire-Atlantique Region, the Nantes Ecoles des Mines has been working in conjunction with teachers, since school year 1996, to produce toolkits containing all of the equipment needed to perform experiments in the classroom, along with a guiding document.

For each topic covered, the document describes a range of experiments and suggests a general sequence of events, list of equipment used and list of required knowledge from the National School Board("Inspection générale") related to the topic of study. This can be a foundation for setting up science activities, in line with the La Main à la Pâte approach. The general sequence of events is provided for guidance purposes only. Intentionally, the document does not elaborate on the pedagogical approach to be adopted, rightfully leaving it to the initiative of the teacher – the specialist.

This seven-sequence module was taken from the guidance document included with the toolkits.

Sequence 1: Opening Questions

Opening questions about movement (1 session).

Opening Questions (session 1)

Group discussion during which the teacher writes on the board the responses students offer to the following questions:

- What is a movement? What purpose does it serve? Name phenomena involved in movement transmission. What are the various factors that enter the picture? Name different types of movement. What does "a moving object" mean?
- The terms move, travel, go quickly, run, etc., should emerge.

Sequence 2:Studying Gears

Introduction to materials, then use of cogged wheels (or gears) for movement transmission.

Concrete application: studying common objects that use cogged wheels.

Reproduce functioning of said objects with materials (2 sessions).

Session 1: Use of Cogged Wheels

Objective

Learn about the function of cogged wheels as a means of movement transmission.

Invent geared devices, describe how they work and their various parts.

Materials per group:

All of the Celda equipment required.

Procedure

The students are divided into groups.

- Initially, they make attempts with the equipment they chose and the teacher lets them handle freely. This is the equipment introduction phase (around 10 min).
- Then, to guide them, the teacher issues the following challenge: you now have two cogged wheels; make the two wheels turn, with the condition that you are allowed to only touch one.

They must observe and describe as accurately as possible what they have built.

- Lastly, the teacher suggests a group summary to the entire class so that all of the students gain a common scientific culture.

They need to gain vocabulary specific to movement transmission: cogged wheel, cog, crank, movement transmission, pull, gear, turn in one direction, lock in, etc.

Upon completing the session, the students are invited to bring in from home, for the next session, objects from their environment that use the same gears.

Session 2: Concrete Application

Objective

Redeploy knowledge gained in previous session.

Understand the operating mode of common objects using cogged wheels or gears.

Materials per group:

- Celda equipment,
- objects brought in by students.

Procedure

- The students will likely bring in: a hand-held whip, a music box, a salad drainer, a watch gear or a dismountable camera.
- The teacher suggests to the children that they look at the various objects, clearly state how they work (with a drawing, if possible) and classify them according to whether they really have a gear system (some of the objects brought in will not actually work that way). The teacher then asks the children to try to reproduce the movements of some of the objects that work with gears.
- Comments shall be made on the various attempts to check that they do reflect how the objects studied work.

Sequence 3: Use of Gears: Rotation

Using gears and identifying rotation axes

Producing a merry-go-round by using rotations on different yet concurrent planes (2 sessions)

Session 1: Initial Approach

Objectives

- to study gears using a simple merry-go-round.
- identify the rotation axes:
- a rotation axis is vertical when rotation occurs on a horizontal plane.
- a rotation axis is horizontal when rotation occurs on a vertical plane.

Materials per group:

- Celda equipment, in particular for cogged wheels, stands and rods.

Procedure

The teacher asks the students whether they know of games or toys involving gears.

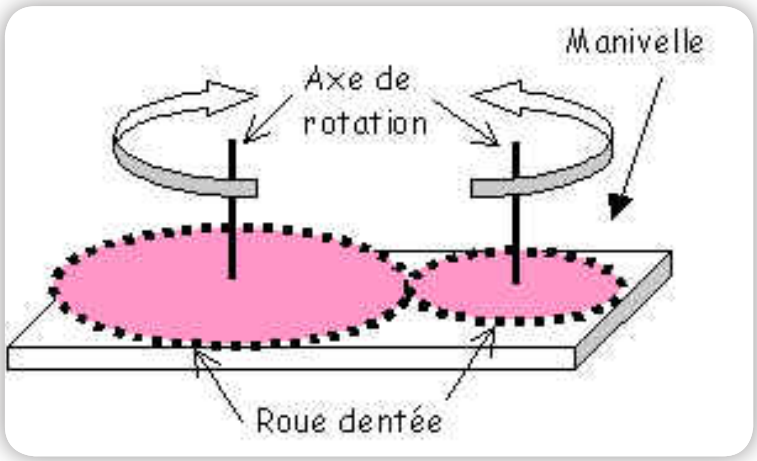
Then he announces to them that they are going to build a merry-go-round (one merry-go-round per group).

First, let them think about how they are going to design their merry-go-round, what equipment will be used, etc.

Then, place some constraints on them:

- using a crank to make the larger wheel turn
- determining the larger wheel's rotation path
- placing several cogged wheels.

Sample suggestion:



Crank

Rotation axis

Cogged wheel

Session 2: the merry-go-round

Objective

To identify rotation axes:

- a rotation axis is vertical when rotation occurs on a horizontal plane.

- a rotation axis is horizontal when rotation occurs on a vertical plane.

Materials per group:

- Celda equipment

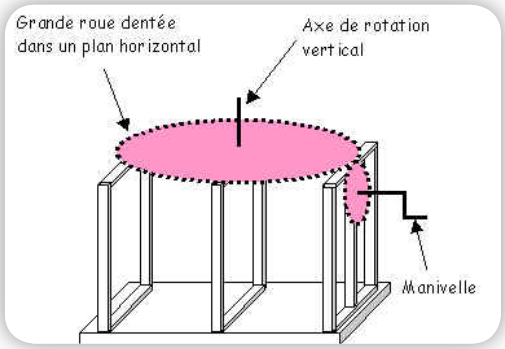
Procedure

The students use the merry-go-round made in the previous session.

The teacher issues an additional constraint: the crank must turn on a horizontal plane, and the large wheel on a vertical plane.

Lastly, the children may decorate the merry-go-round (with animal on the large wheel, and a dome, for instance).

Possible merry-go-round:



Large cogged wheel on horizontal plane

vertical rotation axis

crank

At the end of the session, the teacher asks the students whether they know of ways for making the merry-go-round run without using the crank. Examples include wind, water and electricity.

Going farther: using an energy source

The merry-go-round may be improved using an energy source (water, electricity). The teacher may suggest using an engine or a waterwheel to make the merry-go-round run.

- With an engine

Depending on how advanced the students are, they can be asked to put the engine in the set-up themselves. Then, they are asked to make it turn in the opposite direction.

- With water

The students build pales out of sheets of wood, which will replace the crank. Then, they will have to look at what set-up should be used to make the pales turn.

Sequence 4: Studying Pullies

Studying pullies and how they work.

Comparing with gears (1 session).

Objective

To study pullies and how they work.

To compare pullies and gears.

Materials per group:

- Celda equipment.

Procedure

The students identify, then explain how a pully works.

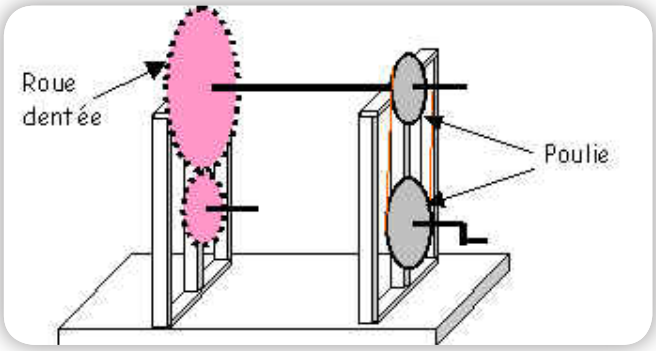
Then, the teacher asks them to compare a pully with a gear : number of wheels, direction of wheels, how to reverse the rotation direction.

To conclude, an object composed of both a pully and gear can be made.

Sample:

Cogged wheel

Pully



Going farther

The children can be asked once again to name everyday objects involving pullies, then describe and draw them.