centre de développement pédagogique
pour la formation générale en science et technologie

Animated cards

GUIDE

Thanks

For experimenting with the *Animated Cards* LES and for their collaboration in producing them, we would like to thank the following people:

- Mrs. Patricia Dumont, teacher at école Mont-de-La Salle from the Commission scolaire de Laval
- Mr. Érick Sauvé, pedagogical adviser at the Commission scolaire de Laval
- Mrs. Julie Grenier, teacher at the Commission scolaire de Rouyn-Noranda
- Mr. François Gallier, teacher at the Commission scolaire des Hauts-Cantons

Translation of the document: Winter 2015

Note: In this document, the masculine is used to make the text more readable.

The Animated Cards at a glance

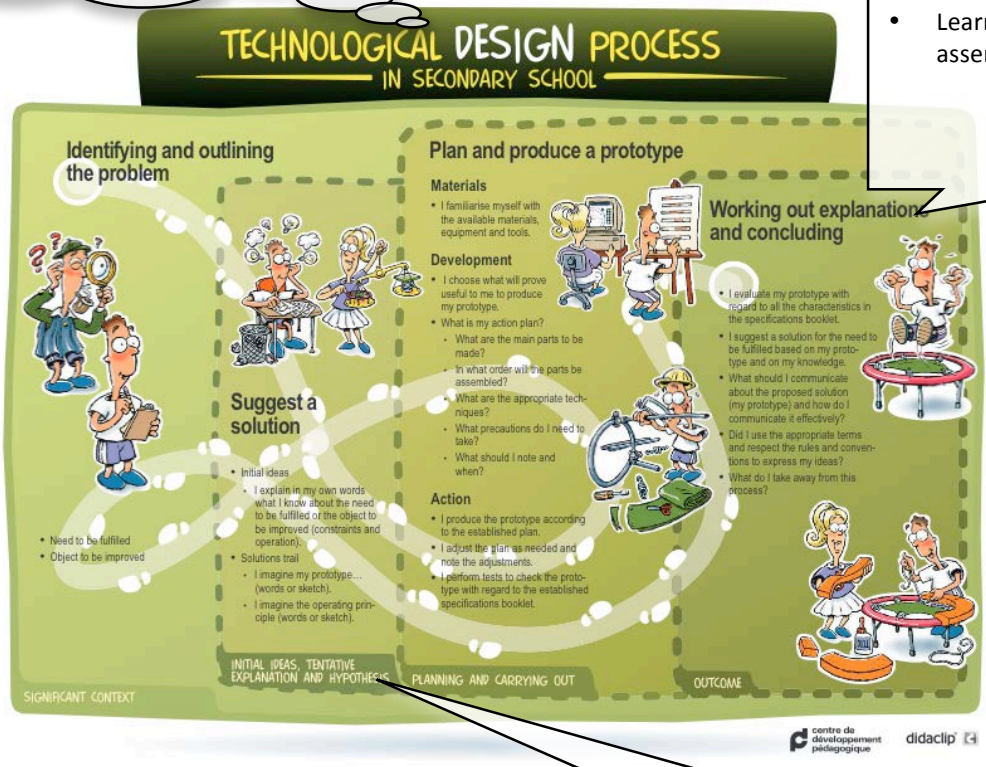
This LES was designed to support *Science and technology* teachers from the 1st cycle of high school in their appropriation of teaching strategies for the technological world, while allowing their students to experience this activity, in part or in its entirety. The choice of the theme allows several concepts from the *Progression of Learning* in the technological world to be worked on within the framework of a complex task where the student will have to implement a design procedure. The student booklet also allows for traces to be collected for each of the evaluation criteria in Competency 1 in science and technology.

Main targeted learning (p. 4 to 8)

- Initiation to the design procedure
- Learn various concepts related to mechanisms
- Learn various concepts related to the Living World and to Earth and Space
- Learn various fabrication and assembly techniques

As learning activities:

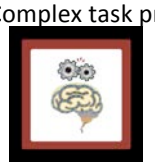
- Mechanisms



Targeted erroneous conceptions (p. 15)

- Motion vs. mechanism
- Concepts related to motion and alternating motion
- Distinction between the pivot and the slide

Complex task proposed to students



Design an animated card to explain a scientific concept

Animated cards
Science and technology - 1st cycle of high school
Overview

Pedagogical intentions

This learning situation allows the student to:

- Implement the technological design procedure in science and technology in the 1st cycle of high school. This procedure aims for the appropriation of a problem resolution process in the context of the design of an object.
- Enrich his technological culture by observing, manipulating and making a functional prototype of a mechanism.
- Appropriate the complexity of motions and recognise different characteristics of mechanisms.
- Put linkage and guidance concepts into application.
- Appropriate scientific concepts in a context related to the technological world.

Suggested context

The student takes on the role of a designer for a producer of didactic materials who wants to offer animated cards to explain various scientific concepts.

The student must produce a prototype consistent with the proposed specifications. To do so, he must become familiar with and put into practise fabrication and assembly techniques. He must also become familiar with a scientific concept in order to represent it properly.

Broad area of learning

Orientation and entrepreneurship

- Self-knowledge and awareness of his potential and how to fulfill it: recognition of his talents, strengths, interests and personal and career aspirations; motivation, challenge and awareness of personal responsibility for his successes and failures; familiarity with the resources of the school system and the options offered and their requirements; awareness of factors related to success in school subjects; satisfaction for work well done.
- Familiarity with the world of work, social roles and occupations and trades: understanding of the nature and demands of roles in society and family and community responsibility; knowledge of occupations and trades related to different school subjects or to the immediate community; knowledge of goods and services associated with these occupations and trades; work locations (factories, business, and local companies); main work functions and entry condition related to a job; legal framework regarding employment; how to balance work, family and social responsibilities; demands of the working world.

Competencies in *Science and technology* (1st cycle)

- Seeks answers or solutions to scientific or technological problems
- Communicates in the languages used in science and technology

Statements from the *Progression of Learning*

As a complement to the statements below, a vocabulary and useful references have been added on pages 10 and 11.

Legend:

✶ : Worked on

↻ : Previous cycle(s)

+: If desired

The Living World

B. Life-sustaining processes

In elementary school

↻ Students explain the essential needs of living organisms (e.g. food, respiration) and describe metabolic activity (transformation of energy, growth, maintenance of systems and body temperature). They describe the function of photosynthesis, which they distinguish from respiration.

In the 1st cycle of secondary school

f. Photosynthesis and respiration

+ i. Names the inputs and outputs involved in photosynthesis

+ iii. Names the inputs and outputs involved in respiration

E. Survival of species

In elementary school

↻ Students describe the growth and reproduction of flowering plants and different animals.

In the 1st cycle of high school

f. Fertilization

+ i. Describes fertilization in humans

The Earth and Space

A. Characteristics of the Earth

h. Types of rocks

+ i. Describe the formation of three types of rock: igneous, metamorphic and sedimentary

B. Geological and geophysical phenomena

In elementary school

↻ Students explain the water cycle (evaporation, condensation, precipitation, runoff, infiltration) and describe different types of precipitation (rain, snow, hail, freezing rain).

In the 1st cycle of high school

Orogenesis

+ i. Describes the formation of mountains, folding and breaks (tectonic plate movements)

c. Volcano

+ i. Describes a volcanic eruption

g. Water cycle

+ i. Explains the water cycle (phase changes, energy exchanges)

Technological World

A. Graphical language

In elementary school

↻ Students learn symbols associated with motion and parts and use them to produce or interpret diagrams or drawings.

In the 1st cycle of high school

a. Diagram of principles

✶ iii. Explains the operation of a simple technical object by drawing a diagram illustrating the active forces and the resulting motion

✶ iv. Names the subassemblies and parts essential to the operation of a technical object.

B. Mechanical engineering

In elementary school

↻ Students describe the characteristics of motion (direction, speed). They describe the effect of a force on an object and on certain materials or structures. They become familiar with simple machines. They identify mechanical parts (e.g. gear assemblies, cams, springs), distinguish between translation and rotation and describe a simple sequence of mechanical parts in motion (e.g. in a door lock, the lever rotates and the motion of the bolt is rectilinear translation).

In the 1st cycle of secondary school

1. Forces and motion

Types of motion

✶ i. Identifies parts that move in a specific way in a technical object (rectilinear translation, rotation, helical)

3. Engineering

a. Basic mechanical functions (links, guiding control)

✶ i. Describes the role of links and guiding controls in a technical object

✶ ii. Identifies a guiding control in a technical object, as well as the related links (e.g. a pizza wheel is guided by a pivot, which links it to the handle)

h. Motion transmission systems

✶ i. Identifies motion transmission systems in technical objects

k. Motion transformation systems

✶ i. Identifies motion transformation systems in technical objects

E. Manufacturing

In elementary school

↻ Students are introduced to the design and construction of instruments, tools, machines, structures (e.g. bridges, towers), systems (e.g. water filtration), models (e.g. glider) and simple electrical circuits. They trace parts and cut them out of different materials using the appropriate

tools. They use a variety of assembly methods (e.g. screws, glue, nails, round-head fasteners, nuts) and tools to obtain an aesthetic finish.

In the 1st cycle of secondary school

a. Specifications

- i. Defines specifications as a set of constraints associated with the design of a technical object
- ii. Evaluates a prototype or technical object based on the environments described in the specifications (human, technical, industrial, economic, physical, environmental)

Techniques

A. Technology

In elementary school

- Students use some symbols associated with motion

In the 1st cycle of secondary school

1. Graphic communication

Drawing diagrams

- i. Chooses the best view to describe a technical object
- ii. Uses different colours for each part of a technical object
- iii. Indicates all the information needed to explain the operation or construction of an object

1. Manufacturing

a. Safely using machines and tools

- i. Uses tools safely (e.g. retractable utility knife, hammer, screwdriver, pliers)

c. Safely using machines and tools

- i. Chooses the appropriate materials, tools, techniques and processes
- ii. Draws the necessary reference lines
- iii. Immobilizes the part to be formed
- iv. Forms the part in accordance with the steps in the following machining processes: sawing, drilling, sanding, filing

d. Finishing

- i. Sands the sides or deburrs the edges of each part after forming

c. Assembling

- i. Marks the references (holes, points or guidelines)
- ii. Immobilizes parts during gluing
- iii. Drills to the diameter of the screws, nails or rivets used

Strategies

Exploration strategies

- Distinguishing between the different types of information useful for solving the problem
- Becoming aware of his or her previous representations
- Anticipating the results of his or her approach
- Taking into account the constraints involved in solving a problem or making an object (e.g. specifications, available resources, time allotted)

- Ensuring that the procedure is appropriate and safe and making the necessary adjustments

B. Instrumentation strategies

- Using technical design to illustrate a solution (e.g. diagrams, sketches, technical drawings)
- Using different tools for recording information (e.g. diagrams, notes, graphs, procedures, logbook)

D. Communication strategies

- Comparing different possible explanations for or solutions to a problem in order to assess their relevance (e.g. full-group discussion)

Evaluation of learning

The evaluation criteria as well as elements fostering understanding of the criteria related to the proposed activities are an integral part of the student booklet. Since this is a task in context and calling upon the development of a procedure, all the criteria may be used for the teacher to provide feedback.
When an activity presented in the booklet is replaced by an activity which is very closely supervised by the teacher (which imposes a process), we suggest that the criteria be grayed out in the student booklet. This indicates that it is not desirable to evaluate the student on that element.

Animated cards - Glossary

Glossary directly related to the Progression of Learning

Photosynthesis
Respiration
Inputs
Outputs
Fertilization
Gametes
Rock
Igneous
Metamorphic
Sedimentary
Orogenesis
Folding
Breaks
Tectonic plate
Volcano
Volcanic eruption
Water cycle
Change of state
Energy
Diagram of principles
Technical object
Part
Link
Guiding
Type of motion
Rectilinear translation
Rotation
Transmission system
Transformation system
Materials
Equipment
Specifications
Constraint
Prototype
Finish
Assembly

Glossary associated to the procedure

Need
Initial idea
Solutions trail
Sketch
Planning
Plan
Adjustment
Solution
Testing
Evaluate
Report

Complementary glossary
This vocabulary is not subject to formal evaluation, but it is recommended that you present it to the students.

Ovule
Spermatozoa
Precipitation
Seepage
Infiltration
Runoff
Condensation
Lava
Magma
Crank
Crank plate
Pulley
Belt
Pivot
Tongue depressor
Washer
Countersinking, countersink

Useful complementary references

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The Earth animation
http://www2.cslaval.qc.ca/cdp/UserFiles/File/previews/earth/

Mechanisms animation
http://www2.cslaval.qc.ca/cdp/UserFiles/File/previews/mechanisms/

Specifications
http://www2.cslaval.qc.ca/cdp/UserFiles/File/telechargement/cahier_des_charges.pdf
(Available only in French)

Design process poster
http://www2.cslaval.qc.ca/cdp/UserFiles/File/downloads/affiches_sec/design_sec_8x11.pdf

Techniques
Cutting wood
http://www2.cslaval.qc.ca/cdp/UserFiles/File/telechargement/tech_cutting_wood.pdf
Drilling
http://www2.cslaval.qc.ca/cdp/UserFiles/File/telechargement/tech_drilling.pdf
Gluing using a hot glue gun
http://www2.cslaval.qc.ca/cdp/UserFiles/File/telechargement/tech_gluing.pdf

Loiselle, Brigitte**, «** Actualiser l'enseignement des sciences par l'apprentissage de la technologie **», dans Potvin, Patrice et autres,** *Apprendre et enseigner la technologie : Regards multiples*, pages 19 to 29, Québec, Éditions Multimondes, 2009.

Videos on the web

MechaniCards™
Video presentation of mechanical (MechaniCards ™) greeting cards
by Bradley N. Litwin
http://www.youtube.com/watch?v=CIGa52qPVvA

Mechanics Alive!
Video presentation of an automata exhibit from the Scotland Street Museum in Glasgow
http://www.youtube.com/watch?v=kv1CpJi60xQ&list=PLbUTq43HtWraxtmnSY1yIFzeWZsPgLWQr

Description of the learning situation

Preparation stage	**Pages from the student booklet**
• Background and specifications • Your initial ideas - reformulating the problem	1 3 (questions 1, 2 and 3a)
Manufacturing stage	
• Formulating solutions trails • Planning (description of the prototype) • Planning (materials and equipment) • Manufacturing (adjustments) • Report (diagram of principles)	3 (question 3b) 4 5 6 7
Integration stage	
• Evaluation (testing, review of specifications and initial ideas)	8
Learning activities (at a time judged appropriate)	**Optional**
• Mechanisms (mechanisms, motions and symbols) • Techniques (wood cutting , gluing, drilling) • Fertilization • Photosynthesis • Respiration • Orogenesis • Water cycle • Types of rock • Volcano	

Animation guide
Important!

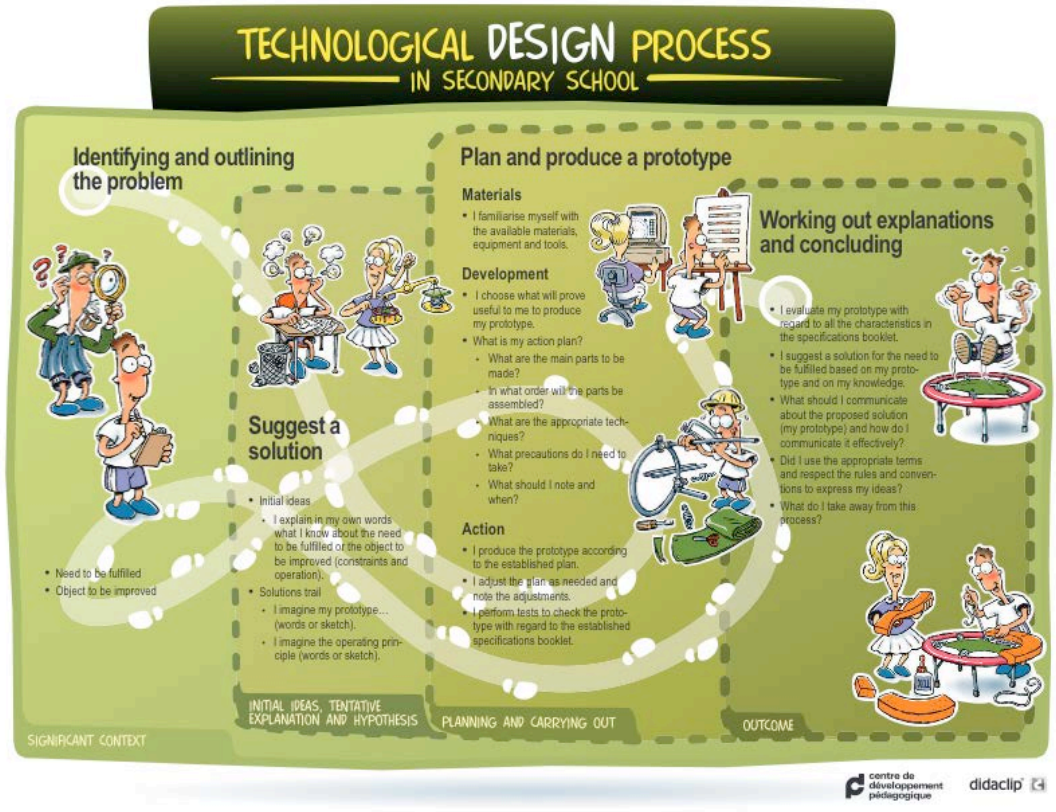
The following pages in the guide are related to the student booklet. There are suggestions for animation.

For the *Animated cards*, there is a single version of the student booklet: an "open" booklet. There is a blank page on page 2 of the student booklet. We highly recommend keeping it, so pages 4 and 5 are side by side when the booklet is copied on two sides. It will make the work of the student easier during the planning stage, as well as making teacher feedback easier.

To respond to specific pedagogical intentions, the booklet may be adapted based on the targeted class, the timing in the cycle and the experience (or autonomy) of the students. The teacher must teach the student in such a way as to allow him a certain degree of autonomy. Using the open booklet is the ideal to be reached, but some activities in the booklet may be replaced by elements that guide the student where necessary. This will need to be taken into account when comes time to evaluate, however.

We have produced an animation guide that presents how the activities unfold in their entirety (overview, animation, materials preparation, etc.) in order to avoid the multiplicity of documents. While allowing the students to experience a technological design procedure, the following pages propose animation suggestions related to the student booklet.

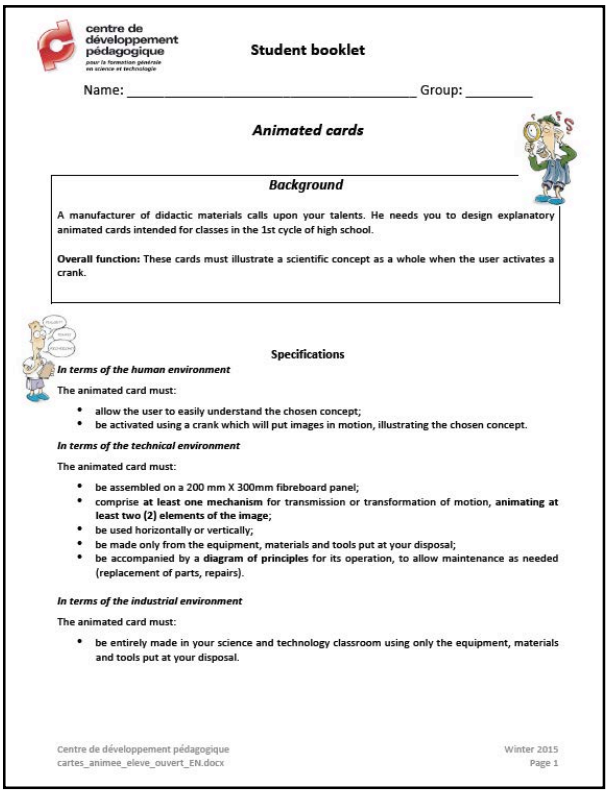
The proposed animation may appear linear. Nonetheless, as scientists and technologists do, it is possible, and even preferable to allow the students to go back over certain elements in order to readjust them.



Preparation stage

Background and specifications

Estimated time: 15 to 30 minutes (to be validated)



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Student booklet

Name: _____ Group: _____

Animated cards

Background

A manufacturer of didactic materials calls upon your talents. He needs you to design explanatory animated cards intended for classes in the 1st cycle of high school.

Overall function: These cards must illustrate a scientific concept as a whole when the user activates a crank.

Specifications

In terms of the human environment

The animated card must:

- allow the user to easily understand the chosen concept;
- be activated using a crank which will put images in motion, illustrating the chosen concept.

In terms of the technical environment

The animated card must:

- be assembled on a 200 mm X 300mm fibreboard panel;
- comprise **at least one mechanism** for transmission or transformation of motion, **animating at least two (2) elements of the image;**
- be used horizontally or vertically;
- be made only from the equipment, materials and tools put at your disposal;
- be accompanied by a **diagram of principles** for its operation, to allow maintenance as needed (replacement of parts, repairs).

In terms of the industrial environment

The animated card must:

- be entirely made in your science and technology classroom using only the equipment, materials and tools put at your disposal.

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cartes_animee_eleve_ouvert_EN.docx — Page 1

1. Context and specifications.

Read the context and the specifications with the students. Depending on the students' experience, it is pertinent to specify that it is a specifications booklet and to observe its characteristics. There is a reference document on specifications on page 11 of this guide. This LES presents a good context for teaching this concept.

2. Trigger video

It is normal that the students be somewhat uncertain at this point. In order to generate student interest, we strongly suggest you present the "MechaniCards ™" video, available on You Tube and cited in the references on page 11. They will notice then that the proposed specifications are a lot simpler and more user-friendly than they appear. The second proposed document is also engaging and fun.

3. Specifications: the technical environment

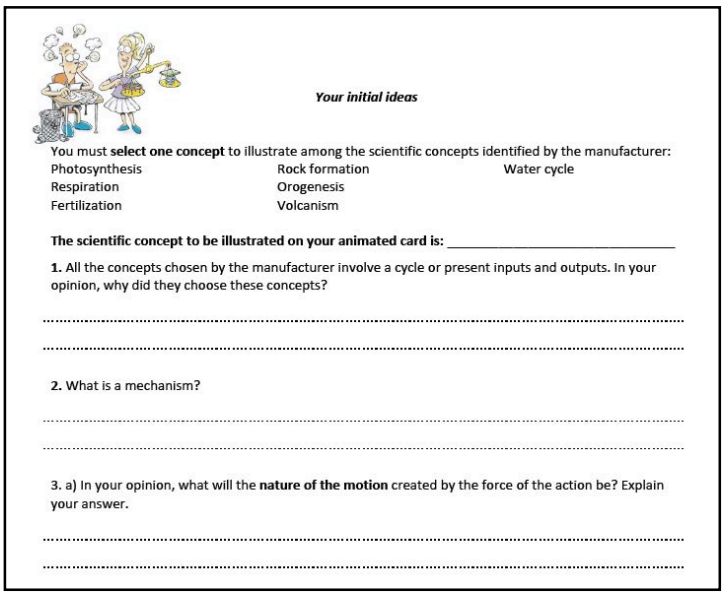
Given the time recommended for the LES and the desired level of difficulty, we have chosen to impose a single mechanism. One mechanism will, in fact, enable two different elements to be animated. It is allowed, however, to combine several mechanisms. It is possible to modify this constraint depending on the student group to be addressed.

4. The materials and equipment

It is desirable that the students be able to see all the materials and equipment allowed in the design. This may inspire some and reassure many. Suggestions for materials, equipment and organisation are presented on pages 21 to 26 of this document.

1. Scientific concepts to be illustrated

It is the teacher's responsibility to adapt the proposed list of themes for the design. It is also up to him to decide if these themes will be formally taught or not, before the design procedure. The nature of the concepts also allows for pedagogical differentiation. Thus, some concepts could have been taught, and others, not.



Your initial ideas

You must **select one concept** to illustrate among the scientific concepts identified by the manufacturer:

Photosynthesis	Rock formation	Water cycle
Respiration	Orogenesis	
Fertilization	Volcanism	

The scientific concept to be illustrated on your animated card is: _____

1. All the concepts chosen by the manufacturer involve a cycle or present inputs and outputs. In your opinion, why did they choose these concepts?

.....

.....

2. What is a mechanism?

.....

.....

3. a) In your opinion, what will the **nature of the motion** created by the force of the action be? Explain your answer.

.....

.....

2. Representation of the situation

In the student booklet, three questions are addressed to the students. These questions ensure that the student grasps the elements of the proposed problem.

The intention related to the first question concerns the "cyclical aspect" of each of the proposed concepts. These concepts are, in fact, difficult to explain using a static image.

The second question pertains to the definition of a mechanism. It allows you to ensure the student masters this concept. It also provides the opportunity to introduce a learning activity on mechanisms, motion and symbols so as to talk about some erroneous impressions many believe. An activity with eight (8) stations, accompanied by a correction guide, is proposed to this end. It allows the students to quickly grasp several concepts in a fun context.

Three frequent erroneous impressions

It's not because it moves that it is a mechanism

It is pertinent to seize the opportunity to review the definition of a mechanism. In fact we notice that many people confuse mechanisms with certain types of linkages. A pivot link such as a hinge allows a motion without being a mechanism as per the definition. The learning activity on mechanisms allow these concepts to be learnt.

Concepts related to motion and alternating motion.

When we want to distinguish between a motion transmission system and a motion transformation system, it is important to observe a change in the nature of the motion. A motion may be rotation, translation or sometimes helical.

We notice that many people associate transformation of motion in cases where there is continuous rotation transformed into alternating partial rotation, while this is in fact motion transmission.

The learning activity on mechanisms that accompanies the LES also allows the student to become familiar with these concepts.

Distinction between the pivot and the slide

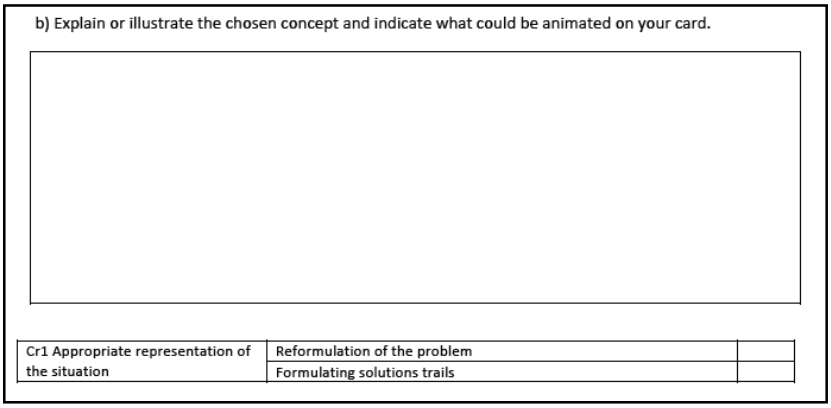
In many mechanisms, there are parts assembled by a pivot allowing the part to rotate on itself. In other cases, we may be observing a crank and slide mechanism. A part may thus carry out a rotation motion as well as defining a translation motion or partial rotation. It is often essential to be able to observe it to understand it. The selection of one assembly rather than another will enable the parts to carry out the appropriate motion.

The articulated models in the learning activity comprise pivots as well as crank and slides. This allows this distinction to be made.

Manufacturing stage

Formulating solutions trails

Estimated time: variable


b) Explain or illustrate the chosen concept and indicate what could be animated on your card.

Cr1 Appropriate representation of the situation	Reformulation of the problem	
	Formulating solutions trails	

1. Solutions trail

We suggest each student carry out this stage of the task alone even if you have chosen to have the students work in groups. The team will in fact be able to evaluate and choose one explanation for the concept rather than another. The method of representation (drawing, sketch, text or other) is up to the student.

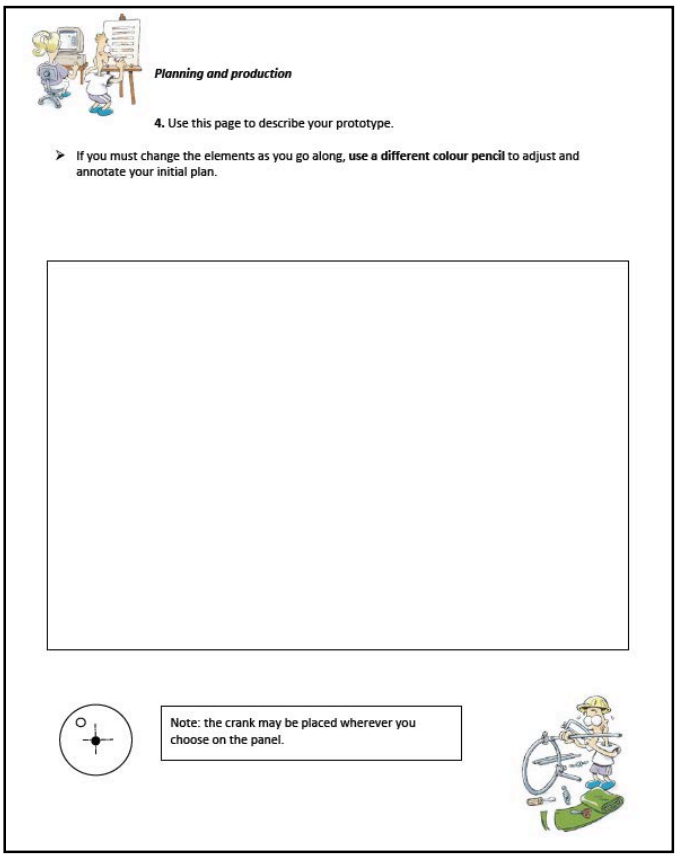
It is interesting to note that to find an idea for a mechanism, you may take one of two paths. The first consists in imagining or choosing a mechanism and dressing it up with the elements of the concept to be animated. The second, based on the concept to be illustrated, consists in imagining the mobile elements and desired trajectories, then to design the mechanism based on these elements.

One or other of these avenues is equivalent and will allow the design to be completed. We don't suggest you recommend one approach rather than the other. It is useful to be aware of the difference, however, in order to be able to help those that having chosen one avenue rather than the other, arrive at a dead end. Proposing the learning activity on mechanisms or placing models of mechanisms in the class may be the source of inspiration for many students.

Manufacturing stage

Planning and production

Estimated time: 75 minutes



1. Planning

The production of a drawing or sketch of the prototype is recommended. This may not necessarily be a principles diagram: that is requested on page 7 of the student booklet.

The crank is shown on the view presented because it is an imposed element. It could, however, be withdrawn from the image and printed separately in order for the student to position it where he chooses.

2. Evaluation

The element from the evaluation criteria associated to methods of representation is greyed out, because we ask that the initial plan be annotated using different colour pencil for adjustments during the fabrication process. In addition, the requested drawing is not standardised.

3. Adjustments during the design process

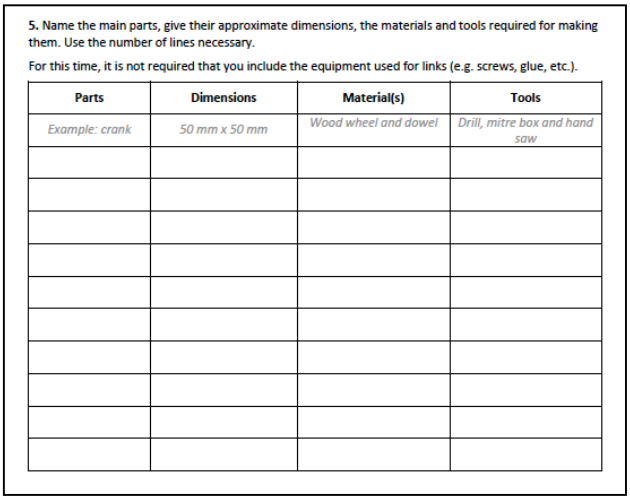
We suggest that the student use a different colour pencil to annotate his initial plan or drawing during the design process. This allows for traces of the student's work to be shown, while reducing the time he has to take for a written explanation.

3. Description of the parts

As indicated in the student booklet, the description of the main parts does not include linkage elements such as screws, glue, the vinyl tube etc. This is only the plan. It is possible that some secondary parts are not on the list.

In the proposed table, the students must associate the parts to be made with the materials and tools required to do so. This will allow the teacher to judge the choice of resources and techniques carried out by the student.

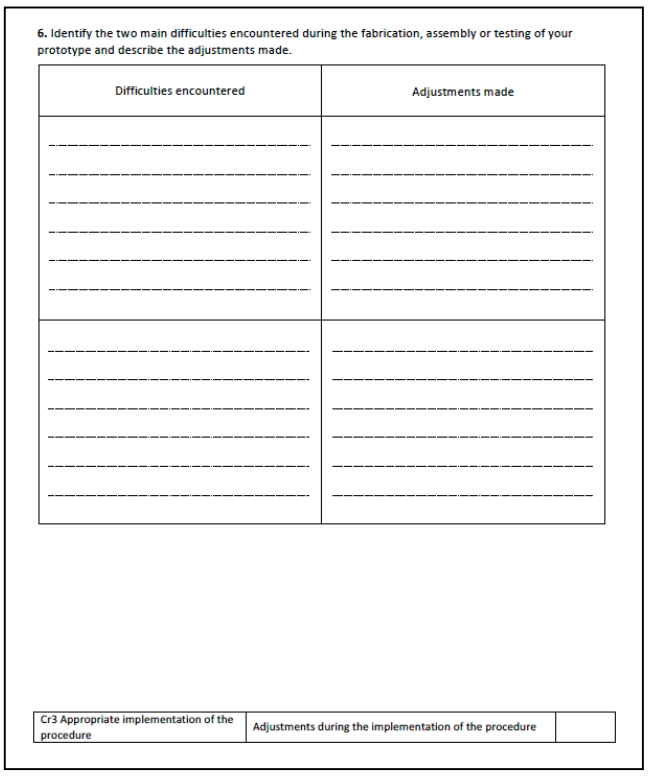
Sometimes it is also possible to provide feedback on working safely by observing the tool choices relative to the materials to be fashioned.



5. Name the main parts, give their approximate dimensions, the materials and tools required for making them. Use the number of lines necessary.

For this time, it is not required that you include the equipment used for links (e.g. screws, glue, etc.).

Parts	Dimensions	Material(s)	Tools
Example: crank	*50 mm x 50 mm*	*Wood wheel and dowel*	*Drill, mitre box and hand saw*



6. Identify the two main difficulties encountered during the fabrication, assembly or testing of your prototype and describe the adjustments made.

Difficulties encountered	Adjustments made

Cr3 Appropriate implementation of the procedure	Adjustments during the implementation of the procedure	

1. Difficulties and adjustments

It is important to train the students to note the difficulties encountered and the solution implemented to counter them.

It is difficult to imagine that no difficulty was encountered during the procedure or during the fabrication of the prototype. You may have to give examples of adjustments so the students know what is expected of them:

- enlarge a hole to reduce friction;
- guide a part to avoid it jamming;
- elevate an element using a block in order not to hamper the movement of a mechanical part;
- change a material for making a part because no tool allows it to be properly fashioned;
- etc.

2. Frequent review of the specifications

Before undertaking the production of the final diagram of principles (mechanism) of the operation of the prototype, it may be necessary to remind the students to ensure that the prototype must be consistent with the desired characteristics from the specifications. This is an important step in the design procedure (see the technological design procedure poster). Frequent reviews of the specifications throughout the procedure should be encouraged to avoid straying during production.

Integration stage

Evaluation (testing, review of specifications and initial ideas)

Estimated time: 30 minutes (variable)

Outcome

7. Make a diagram of principles of the operation of your prototype. Indicate the motion of the parts and add the necessary symbols.

Part free in rotation and linked in translation	Part free in rotation and in translation	Complete link	Part free in translation and linked in rotation

Diagram of principles

Cr4 Development of relevant explanations, solutions or conclusions	Formulation of explanations in accordance with (...) knowledge acquired	
	Use of appropriate terminology, rules and conventions	

1. The diagram of principles of the operation

Each student is asked to produce a diagram of principles for his mechanism. The symbols associated to parts are described in the student booklet. The latter are not required to be learnt off by heart.

We suggest the diagram of principles be started before having dressed up the mechanism with all the graphical elements, since it will be difficult for the student to see the mechanism once the prototype is finished.
The mechanism can easily be photographed and the image printed in black and white. It can then serve as a reference or the symbols for the parts could even be associated directly on the photo rather than carrying out a diagram.

2. Evaluation of the prototype by the student

The evaluation of the prototype is done visually, using tests to ensure the correct operation and validating that the prototype is consistent with the desired characteristics. The student may also compare his prototype to those designed by his peers.

We rarely have the leisure of making several prototypes in class, as is the case in business. It is important to remind the students that based on the time required, the "perfect" prototype is rare. A good evaluation, which underlines the aspects to be improved, alleviates a certain number of shortcomings.

Outcome (Continued)

8. Evaluate your prototype based on the proposed specifications. Identify one positive aspect and one aspect that could be improved. Explain your answer.

Positive aspect:	Explanations:
----------	----------
Aspect to be improved:	Explanations:
----------	----------

9. Hand your prototype in to your teacher. Don't forget to identify it by indicating your name and that of your teammate.

The evaluation

The evaluation criteria as well as elements fostering understanding of the criteria related to the proposed activities are presented in the student booklet throughout the process.

The table below will allow you to trace the evaluation elements found in the student booklet.

Summary of traces

Evaluation criteria	Elements fostering understanding of the criteria	Pages	Result
Cr1 Appropriate representation of the situation	Reformulation of the problem	3	
	Formulating solutions trails	3	
Cr2 Development of a suitable procedure	Planning the procedure	4 and 5	
	Selection of resources (materials, equipment, tools, etc.)	4 and 5	
Cr3 Appropriate implementation of the procedure	Use of materials selected	5	
	Observances of safety rules[1]	5	
	Use of appropriate strategies and techniques	5	
	Adjustments during the implementation of the procedure	4 and 6	
	Using appropriate types of representation (diagrams)[2]	4	
Cr4 Development of relevant explanations, solutions or conclusions	Formulation of explanations in accordance with (...) knowledge acquired	7 and 8	
	Use of appropriate terminology, rules and conventions	7 and 8	
	Production of a prototype in compliance with the specifications	Prototype	
	Proposal of improvements or new solutions	8	
Proficiency of subject-specific knowledge targeted in the *Progression of Learning*	Technological World - mechanical engineering	Learning activity on mechanisms	

[1] This element may be evaluated by observing the association of tools/techniques to the materials on page 5 of the student booklet and by direct observation in the heat of the action. The process is "negative": we start with the assumption that all the students respect the safety rules and note only those who present a problem.

[2] This criteria is greyed out, because we ask that the initial plan be annotated using a different colour pencil for adjustments during the fabrication process. In addition, the requested drawing is not standardised. Finally, a diagram of principles of the mechanism is also required on page 7 relative to the production of explanations using their knowledge.

Suggestions for materials and tools

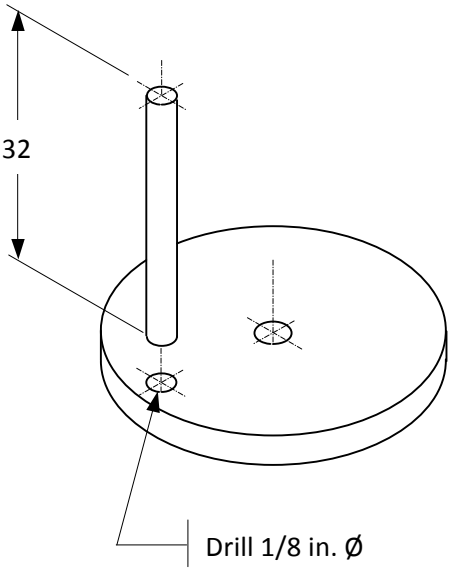
Materials to be put at the students' disposal for a class of 32 students
Note: The equipment to be prepared and examples of assemblies are illustrated on pages 23 to 25

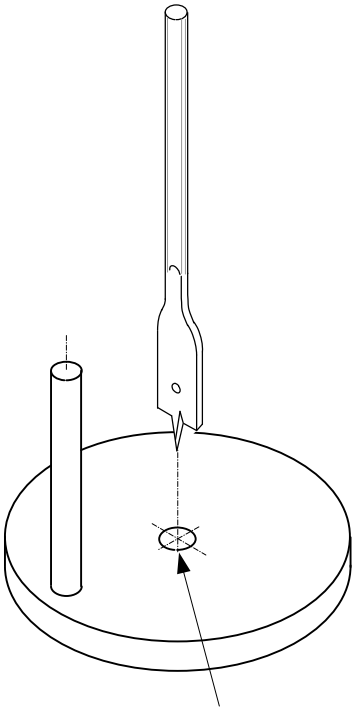
Articles	Notes
16 fibreboard (Masonite) mounting plates featuring 6 legs.	The plates are approximately 200 mm x 300 mm (8 in x 12 in), allowing 48 plates to be cut out of one 4' X 8' sheet. The legs are made from ¾ in x 5/16 in pine mouldings cut to a length of approximately 30 mm and glued to the plate using wood glue. The legs may be glued to the plate by the students. They make the assembly of the mechanical components onto the plate easier.
16 pre-assembled cranks • 16 1/8 in x 32 mm dowels • 16 - 50mm wheels	The cranks may be pre-assembled or made by the students. The fabrication and assembly to the plate are explained on page 23 and 24.
Machine screws: 50 x no. 8 - ½ in 32	The size of the mechanical screws is important: the wheels have a hole in the centre. The no. 8 screw is inserted into this hole with some play allowing the wheel to spin easily. The crank requires a screw to affix it to the plate. We allow for extra screws for those students who decide to affix wheels or pulleys to their plate.
Washers: 50 x no. 8 and 50 x no. 10	These washers are used to adjust the height of the mechanical parts, to reduce friction and to assemble parts using the vinyl tube. (See images on page 25)
1/8 in diameter dowels 50 x 25 mm long	It is strongly suggested you precut these in 25 mm lengths in order to avoid waste.
¾ in x 5/16 in pine moulding 50 x 50 mm long	It is strongly suggested you precut these in 50 mm lengths in order to avoid waste.
10 mm square dowels: 50 x 50 mm long	It is strongly suggested you precut these in 50 mm lengths in order to avoid waste.
Vinyl tube with 1/8 in inside diameter 32 x 30 mm long	It is strongly suggested you precut these in 30 mm lengths in order to avoid waste.

100 brads	To be used as needed, to articulate two tongue depressors.
Wood wheels: 50 x 32 mm diameter 50 x 50 mm diameter	These wheels are offered in various sizes at most *Science and Technology* equipment suppliers.
100 tongue depressors of various sizes.	They can be found in pharmacies, but are often much cheaper in the arts and craft section of other stores.
100 wooden coffee stir sticks 180 mm x 5 mm (long)	These long sticks, not to be confused with *Popsicle* sticks, are used to make slides as illustrated on page 25.
Dental floss	The dental floss may be replaced with fishing line. It is used to make the pulley when the fibreboard wheels are transformed into pulleys (see triangular file, page 26).
Various elastics	They may be used to make a recall mechanism on a mechanical part.
Wood glue	It may be useful to perform a demonstration for the students. A thin coat of wood glue is sufficient to ensure that the parts to be assembled adhere properly. Too much glue requires a very long time to dry and reduces precision.
Hot glue guns and glue sticks	This is foreseen for the graphical elements. Wood glue is a better choice to glue the Masonite, the mouldings, the tongue depressors and the dowels.
Drills equipped with 5/32 in bits	You will need 2 or 3 drills equipped with each drill bit. The students only need them occasionally. You will save time by avoiding having to change the drill bits.
Drills equipped with 1/8 in bits	
Drills equipped with 3/8 in spade bits	
6 mitre boxes and hand saw	
6 square head (Robertson) screwdrivers	
Triangular files to transform the wheels into pulleys. 2 stations for the group	The wheels may be transformed into pulleys in less than 2 minutes. You need only make a groove at the centre of the edge, over the whole perimeter of the wheel, with a hand saw. This groove is slightly enlarged using a small triangular file. A technique is suggested on page 26 to make this operation easier.

Utility knives (X-acto) and safety rulers (shaped)	Cutting mats are necessary to protect the furniture.
Scissors	

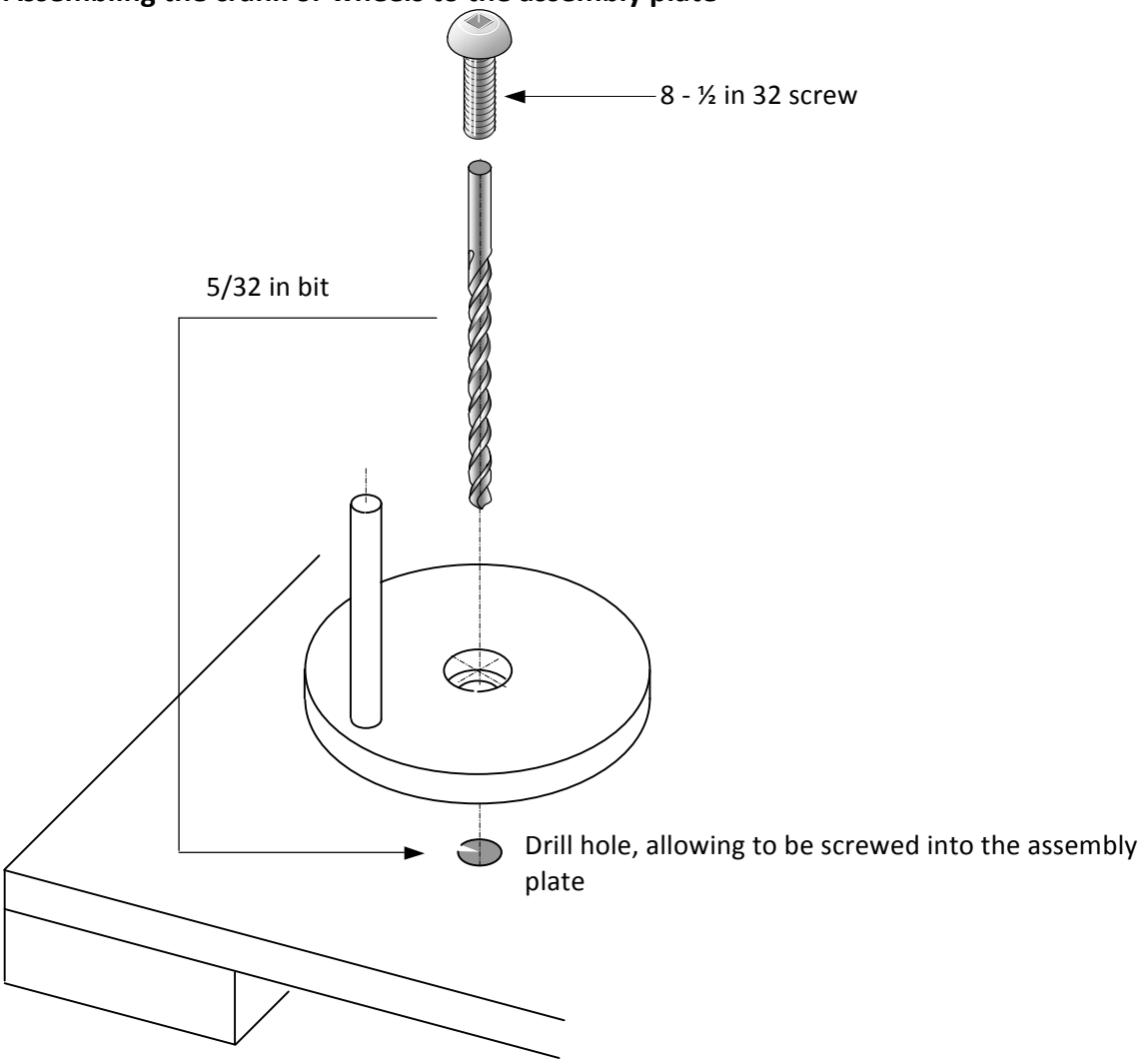
Making the crank



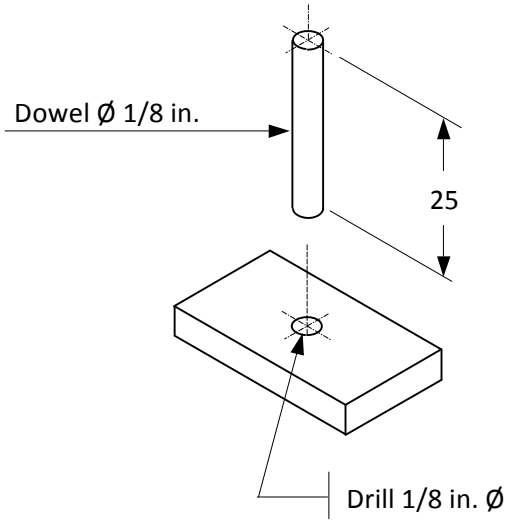


Drill (countersink) with a 3/8 in spade bit to receive a no. 8 screw head.

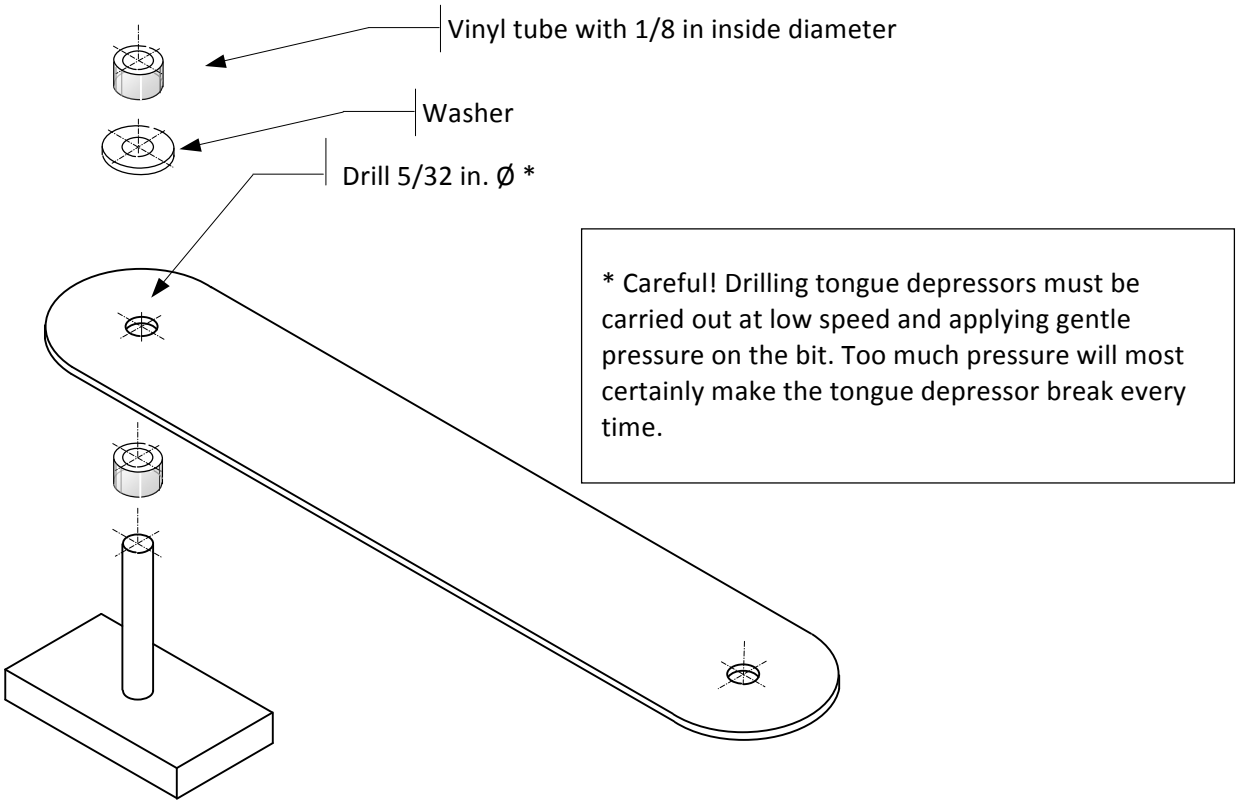
Assembling the crank or wheels to the assembly plate



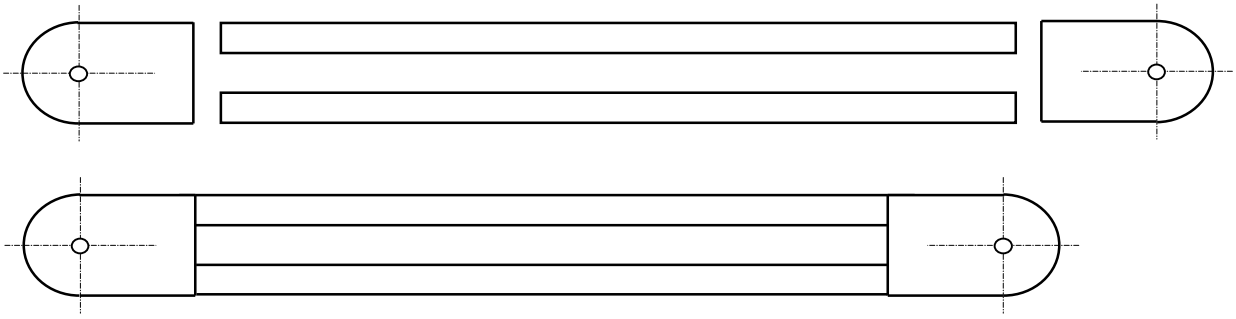
Making a pivot



Example of an assembly of mechanical parts

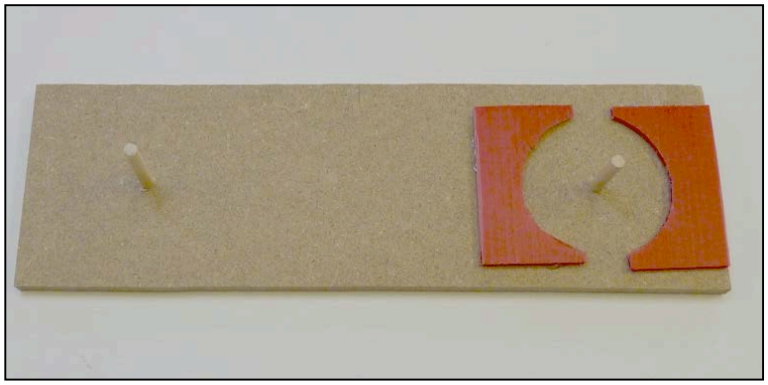


Making a slide using a tongue depressor and two coffee stir-sticks



Transforming a wood wheel into a pulley

Making the tool



Materials:

- Scraps of wood
- Scraps of *Coroplast* or a sheet material half the thickness of the wheel
- Appropriate diameter dowel for the fibreboard wheels

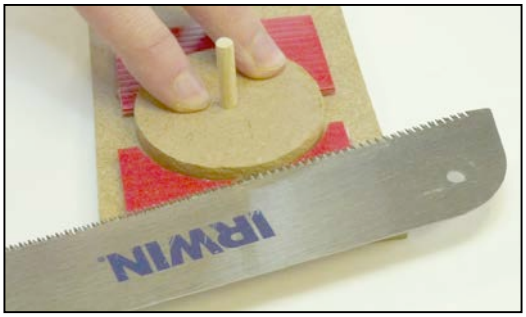
1. Drill the wood, insert and glue the dowel, which will be used as a pivot for the wheel

2. Cut out the imprint of the wheel in the *Coroplast*

3. Glue the *Coroplast* wheel imprint around the pivot

Making the pulley

1. Insert the wheel into the pivot and make a groove using a hand saw.



2. Using a triangular file, slightly enlarge the groove.