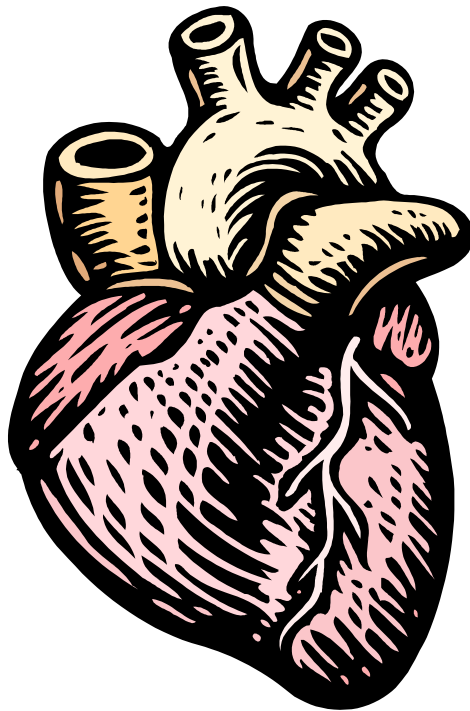




**centre de
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*pour la formation générale
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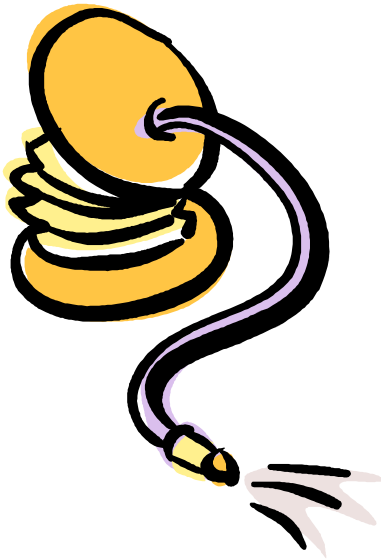
THE CARDIAC PUMP (Heart and circulatory system)



STUDENT BOOKLET

Working Document

February 2007



Context:

These days, many objects necessitate pumping apparatus: automobile, pool, sprayer, syringe,...The matter that we pump may be liquid or gaseous.

Our heart is in itself a system that uses a pump. Our body must allow the blood to circulate throughout all our organs and cells. The only way it can travel is to be pumped.

Mandate:

1. Study the workings of a water pistol in order to understand how a pump functions.
2. Build a pump from the supplied information (exploded view drawing, manufacturing range).
3. Design an activation mechanism connected to the pump you have built, using systems of transmission or transformation of motion.
4. Establish similarities and differences between the water pistol you studied, the pumping system you manufactured and the workings of the cardiac system.



HERE IS A WATER PISTOL

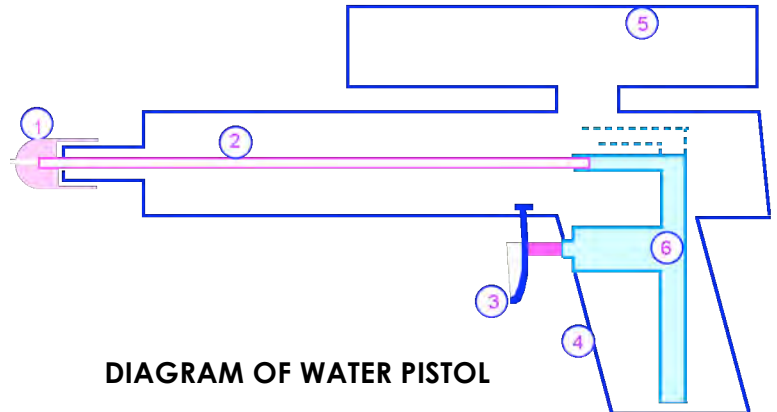
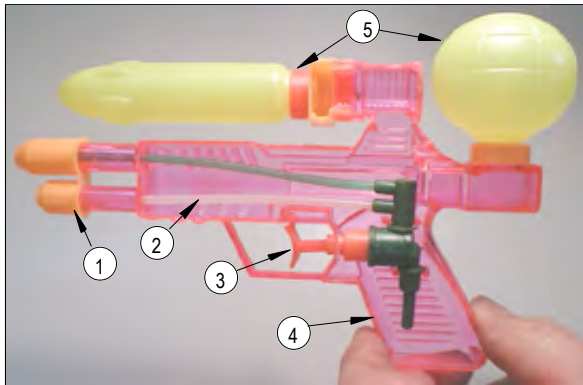


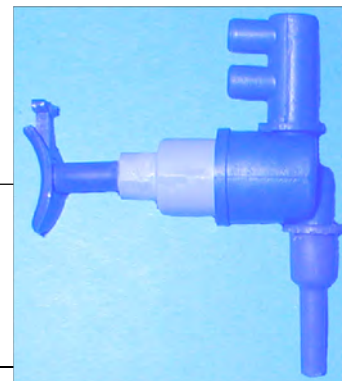
DIAGRAM OF WATER PISTOL

- 1 Tubes
- 2 Water conduit
- 3 Trigger
- 4 Handle
- 5 Reservoirs
- 6 Pump

A) What do you know about how it works?

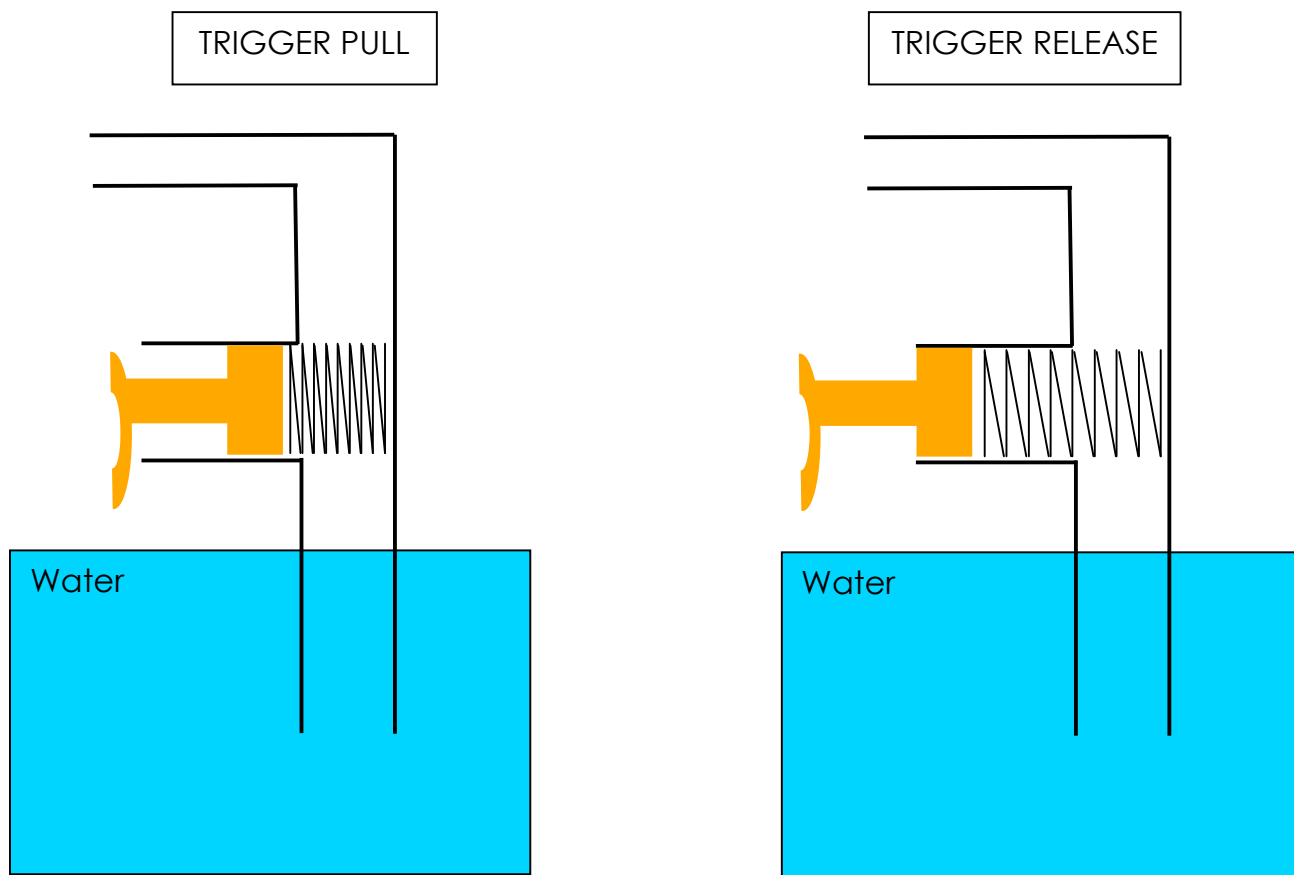
B) The questions I ask myself about how it works and my assumptions...

HERE IS THE ENVELOPE OF THE INTERIOR MECHANISM (#6) OF THE WATER PISTOL



C) The photo on the right represents the conduits allowing the water to circulate inside the water pistol. When I pull the trigger, why does the water go in only one direction?

D) Complete the diagram to show what happens inside the conduits, at first when you pull the trigger, then when you release it. Make assumptions by sketching on a separate sheet of paper and write your final proposal in this space. Use the legends necessary to the explanation of the principle of its function.



**SPECIFICATIONS
REGARDING THE DESIGN OF A MECHANISM
TO ACTIVATE THE PUMP**

Global function (service function)

The activation mechanism must simulate the muscular contraction that activates the cardiac pump.

In terms of the human aspect, the mechanism must:

- Be easy to use;
- Be manually activated by an input organ made up of a crank (wheel) that rotates 360°; (see note at bottom of page)

In terms of the physical aspect, the activation mechanism must:

- Be made from durable materials;
- Be affixed to a pre-built frame, placed on a horizontal surface;

In terms of the technical aspect, the activation mechanism must:

- Be equipped with a mechanism to transform and/or transmit motion;
- Allow for regular, efficient pumping requiring the least amount of effort;
- Use the pegboard, as is, to affix the mechanical components;
- Be assembled in such a way as to allow for certain parts to be replaced in case of breakage;

In terms of the industrial aspect, the activation mechanism must:

- Be able to be entirely built in a science and technology laboratory of the 2nd cycle of secondary school;
- Be entirely built with the available materials and with the raw materials put at your disposal.

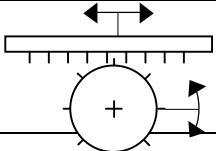
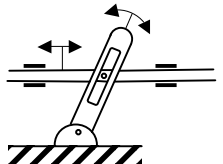
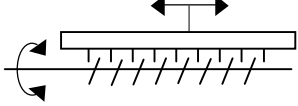
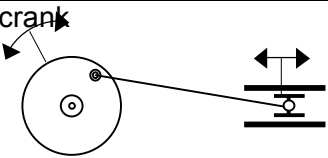
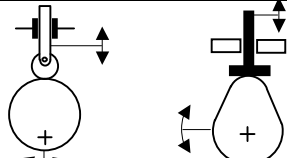
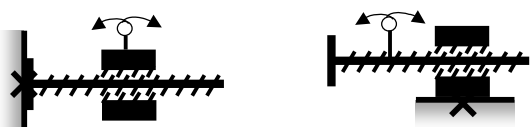
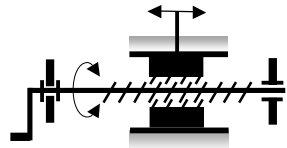
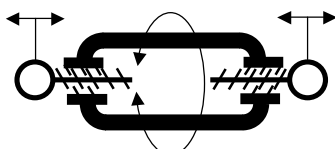
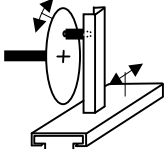
Note: Pressure-tack, adhesive tape and elastics are not allowed as technical connections.

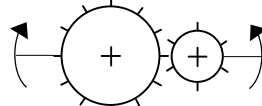
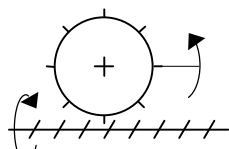
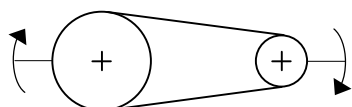
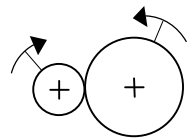
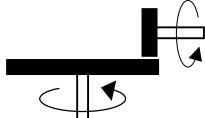
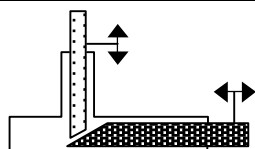
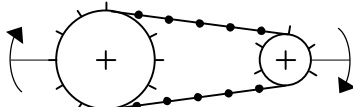
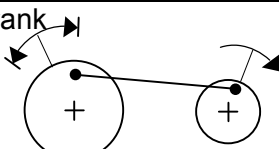
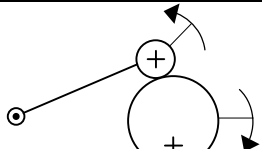
In terms of the economic aspect, the cost of the mechanism must:

- Be inferior to \$4.00.

N.B. *It would be possible to exploit partial rotation with the use of a lever, which would facilitate the task, but this alternative means that the compulsory concepts in terms of the use of systems of transmission and transformation of motion would not be covered.*

MECANISMS OF TRANSMISSION AND TRANSFORMATION OF MOTION


<p>TRANSFORMATION OF MOTION: Mechanical action that changes the nature of motion (rotation to translation, translation to rotation)</p>	<p>Rack and pinion</p> 
<p>Crank and slide</p> 	<p>Screw and rack</p> 
<p>Connecting rod and crank</p> 	<p>Cam and roller</p> 
<p>Screw and nut</p> 	<p>Screw and nut</p> 
<p>Screw and nut</p> 	<p>Crank and slide</p> 

<p>TRANSMISSION OF MOTION: Communication of the same movement from one part to another, with possible variations in speed</p>	<p>Gears</p> 
<p>Wheel and worm gear</p> 	<p>Pulleys and belt</p> 
<p>Friction wheels (side by side)</p> 	<p>Friction wheels (vertical and horizontal)</p> 
<p>Wedge system</p> 	<p>Chain and cog wheels</p> 
<p>Crank-connecting rod-crank</p> 	<p>Cam and roller</p> 

DESIGN STEPS FOR THE ACTIVATION MECHANISM


1. Outline my problem in terms of my specifications

Keep in mind available resources.

	
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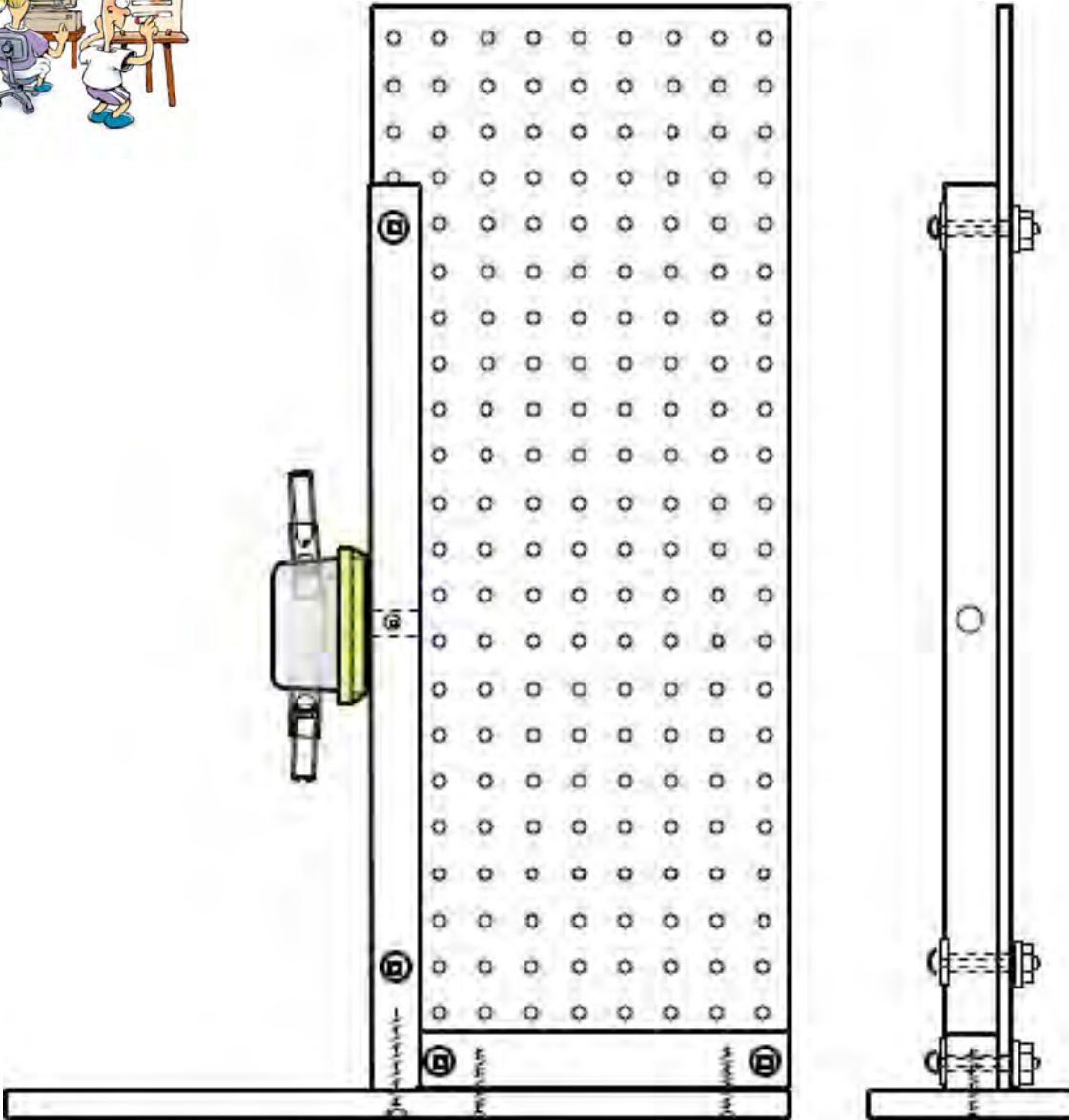
2. From what will I get inspiration?

How will it work? How will I build it?

	<p>(Hatch my ideas with explanations...) Principles diagram</p>

My chosen solution and justification thereof.

3. Draw the chosen solution and justify construction choices.
Construction diagram



Explanation:

**4. Construction details for the different components of my mechanism
(Links, guides, materials used...) as drawings.**





A large empty rectangular box intended for students to draw construction details for their mechanism components.

5. Manufacturing steps, design problems and adjustments during construction? (Materials, links, guides, tools...)



Description of the stages I will go through to build my mechanism	Construction problems and adjustments made during the manufacturing of my mechanism.

6. Testing of my prototype in terms of its efficiency and improvements to be made.

 <p>Tests carried out and results obtained</p>	 <p>Improvements</p>

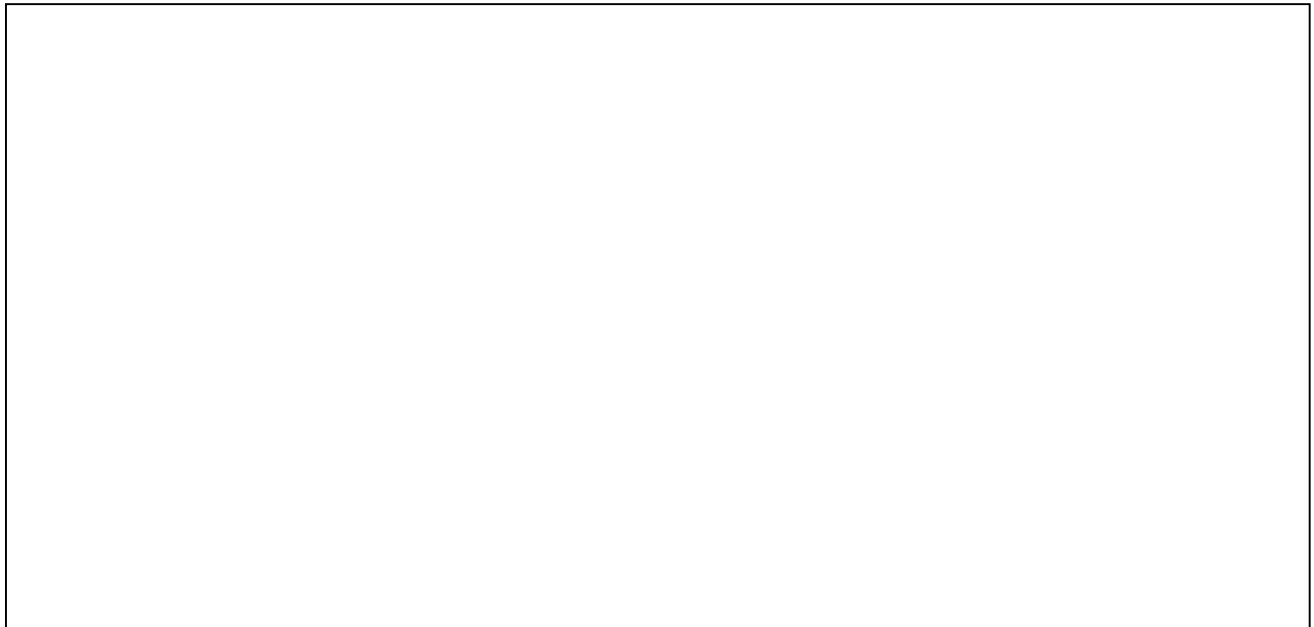
ANALOGY BETWEEN THE HEART, THE WATER PISTOL AND THE PUMP YOU BUILT

1. On the following page;

Explain the similarities between the three following elements:
the components of the heart and its circulatory system,
the parts of the water pistol,
the mechanical pumping system that you built,
mentioning their different parts and functions.

Collect the information with the help of documents supplied.
Organise your data in the form of tables, diagrams, organisational charts...

2. The mechanical system you built presents limitations in terms of the real function of the heart. Explain these limitations.



UNDERSTANDING THE WORKINGS OF THE HEART (CIRCULATORY SYSTEM AND TYPES OF BLOOD VESSELS)

