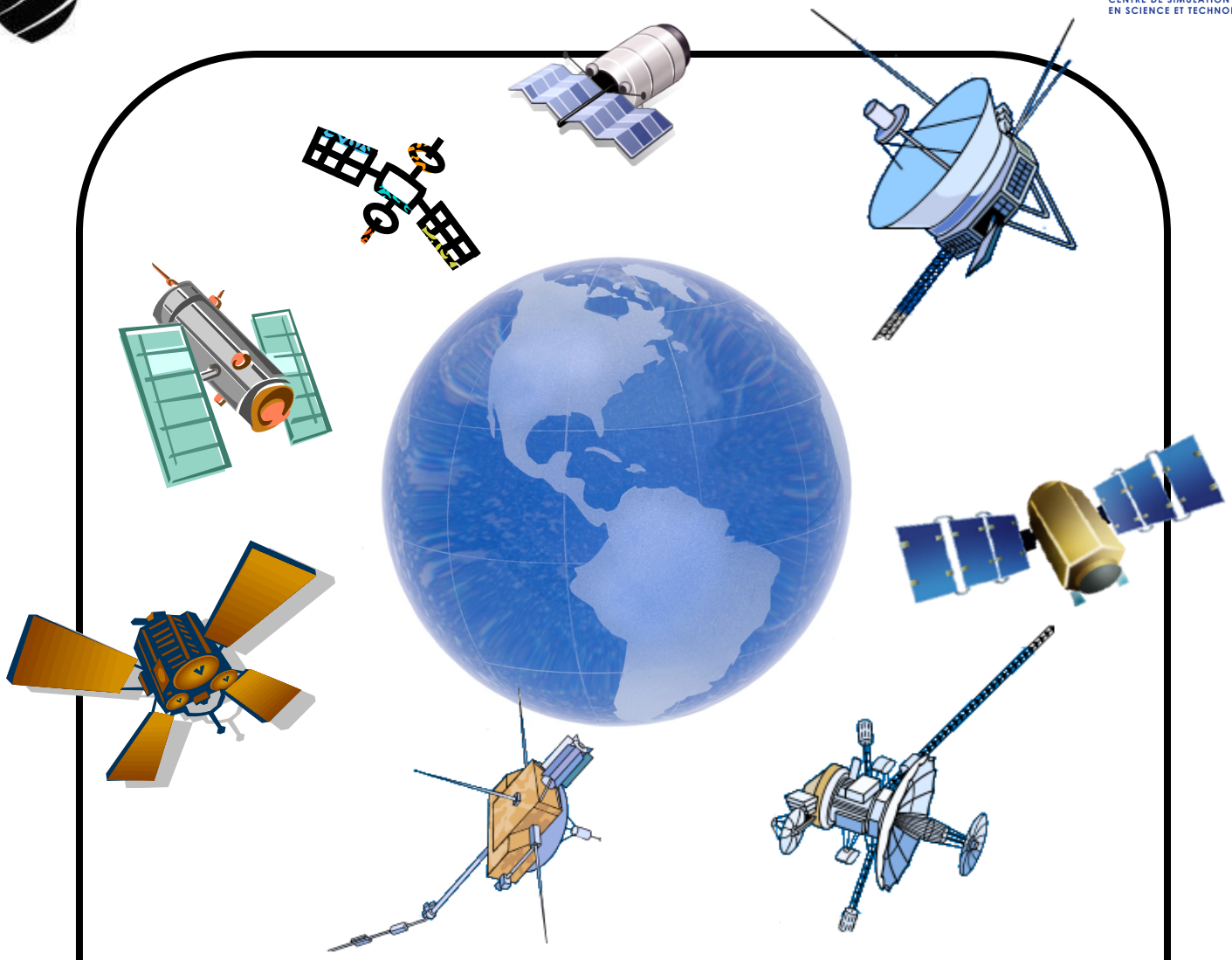
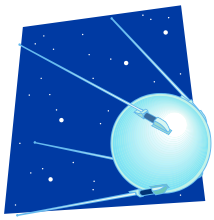


Orbital Cleanup Space Mission!

Mission Workbook

Name: _____

Trash in Space?



Earth has only one natural satellite: the Moon. Other planets have many more. For instance, Saturn has no less tham 62 satellites !

However, Earth is the only known planet with a great number of artificial satellites. In 1957, USSR sent in orbit the first satellite ever built by humans. Since then, there has been more and more satellite launches. There is now even a space station orbiting around our planet.

Some satellites are equipped with disposable shields or rockets that break away from the satellite once it has reached its orbit. Old satellites also sometimes lose parts as they wear out. What happens to all these debris? And what happens to satellites that out of order? They stay in orbit. We have been sending objects in space for more than 50 years without ever recovering them... Just imagine the clutter that surrounds our planet!

This image represents objects in orbit around Earth. 95% of those objects are debris! There are several hundreds of thousands of them.
Imagine having to send a probe worth millions of dollars and which took years to build through this cloud...

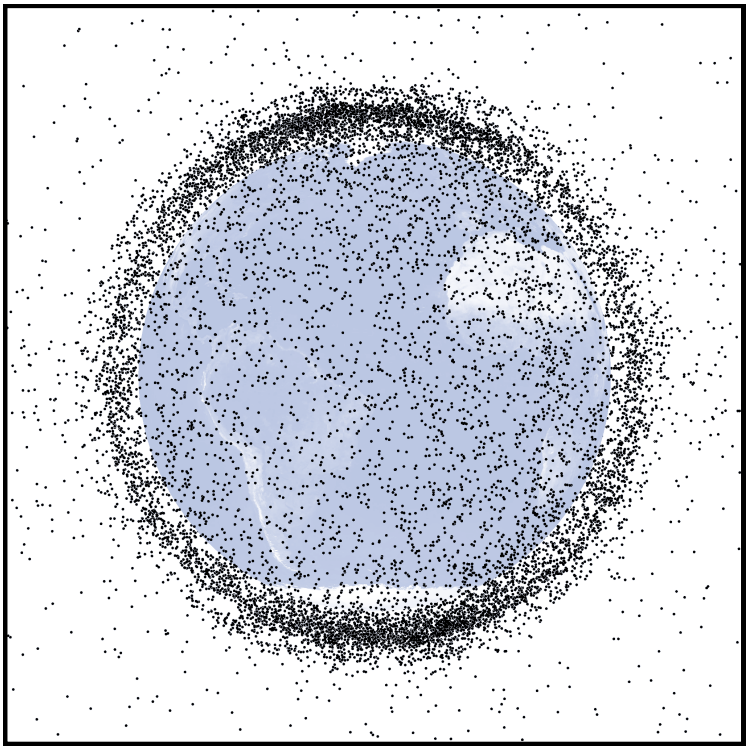


Image: NASA, Wikipédia

In 2007, space shuttle Endeavour was hit by a space debris. It left a one-centimetre wide hole in the hull of the shuttle.

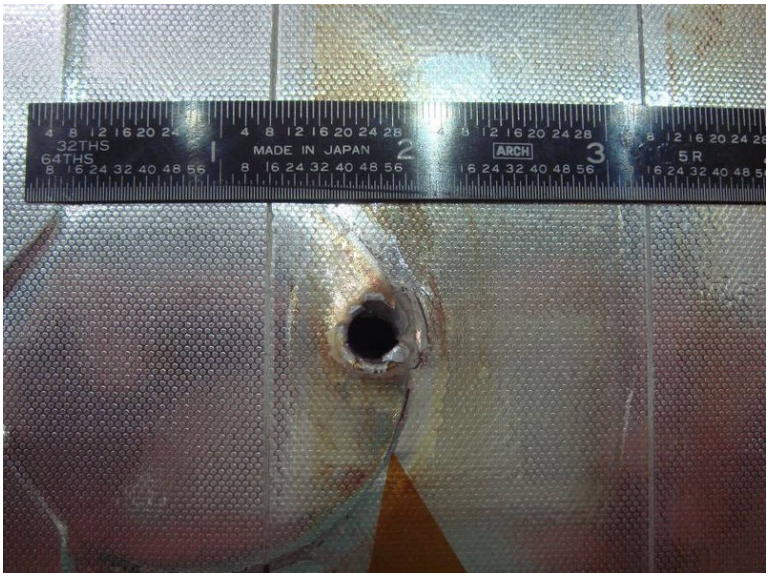


Image: NASA, Wikipédia

Space debris make space exploration more complicated. Some have already collided with a space shuttle, as seen on the picture above. In 2009 and again in 2011, the crew aboard the International Space Station even had to take refuge in escape pods because debris threatened to hit the station. Fortunately, the collisions were narrowly avoided.

That's enough! Space agencies know we'll soon have to pick up space debris. Teams of engineers all round the world are currently trying to find a solution to this problem.

Some debris are made of iron or steel, so it's possible to catch them with a magnet. However, others are made of copper or plastic, and must be gathered mechanically… The challenge for your class will be to build magnetic and mechanical arms that will be used to gather debris in a simulated space mission. Good luck!

The mission for your class

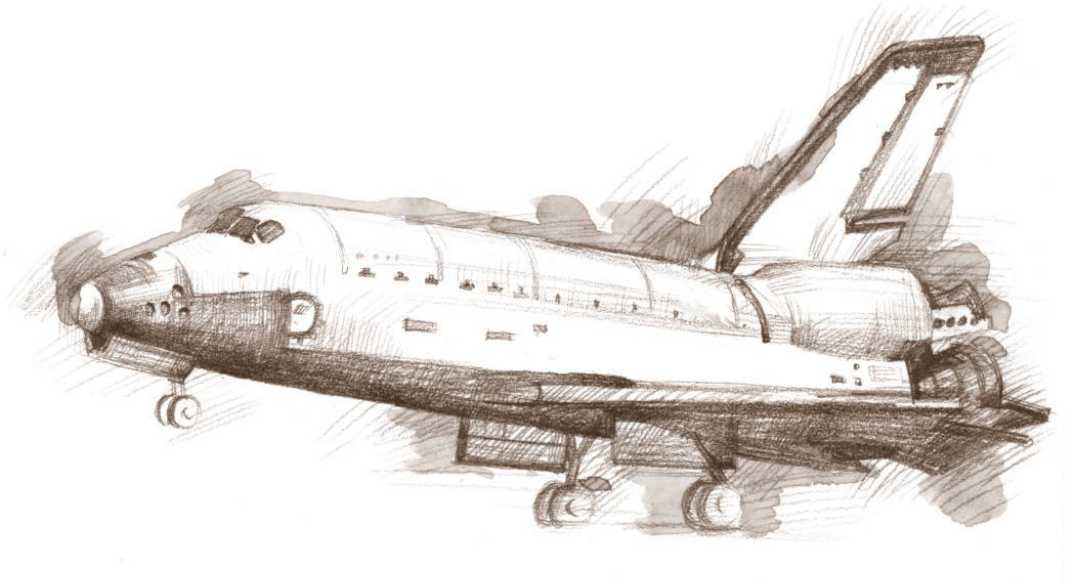
For your mission, you'll first prepare in class. Afterwards. You will go to the Science and Technology Simulation Center, the CENST. You will complete your mission using the space shuttle and the control room at the CENST.

Your mission will be a simulation. To simulate is to recreate a situation as faithfully as possible to allow someone to learn and make discoveries.

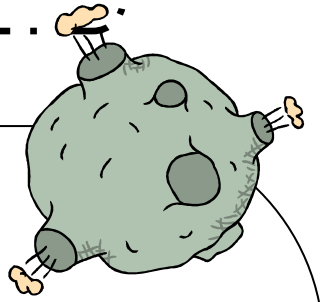
Before the mission, you will have to **build** two debris-gathering arms: a magnetic arm and a mechanical arm. You will also have to test them to make sure they will work properly once in orbit.

During the mission, each student will be give a **role**. Everyone must therefore prepare himself to play his part properly on the day of the mission.

This workbook will help you prepare your arms and your role. You will also bring it with you during the space mission. A good workbook is a scientist's best friend, so take good care of yours!



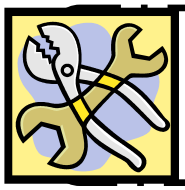
Let's get prepared!
The destination and the objective



What is the destination of your mission?

What is the goal of your mission?

What do you know about your destination?



Let's get prepared!
The mechanical arm

Your teacher will show you several devices that can be used to pick up objects. Among those, chose two that could inspire you to build a mechanical arm.

Object #1

Description: _____

_____

When I use the object, the following parts move: _____

_____

What I will try to reproduce when I will build my mechanical arm:

_____

_____

Object #2

Description: _____

_____

When I use the object, the following parts move: _____

_____

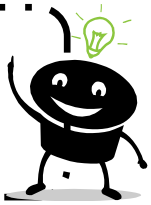
What I will try to reproduce when I will build my mechanical arm:

_____

_____

There you go! You are ready to begin construction of the mechanical arm! Consult the scope statement and start making plans!

Let's get prepared!
Mr. Ørsted's discovery



Hans Christian Ørsted was born in 1777, in Denmark. He would sometimes work in his father's pharmacy. He was interested by what he learned by working with drugs and he chose to go to university to study sciences. He eventually became a researcher in physics.

Image: Wikipédia

A young Hans Christian.

Image: Wikipédia

At this time, scientists were fascinated by electricity. It had only been a few years since an Italian, Alessandro Volta, had invented the electric battery. Ørsted's work consister in trying to learn more about electricity. He would also teach to university students what scientists had discovered so far.

Alessandro Volta

One day, Ørsted was in class with his students to give them a lecture about electricity. He had prepared an electric circuit with a battery and a long wire. He also wanted to talk about magnetism, so he had brought his compass. When Ørsted connected the battery, the compass' needle changed direction. What a surprise! Only magnets were known to have that effect on a compass!

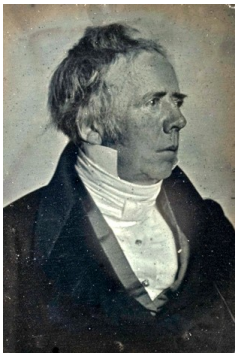


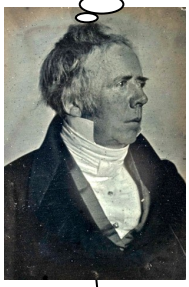
Image: Wikipédia

Hans Christian Ørsted

Ørsted repeated the experiment many times to better understand the phenomenon. He then talked about his with all his physicist colleagues and news of his discovery spread throughout the scientific community.

Let's get prepared!
The magnetic arm's magnet

Mr. Ørsted has discovered that an electric current in a wire affects a compass just like a magnet. You can easily verify his discovery. Build the following electric circuit:



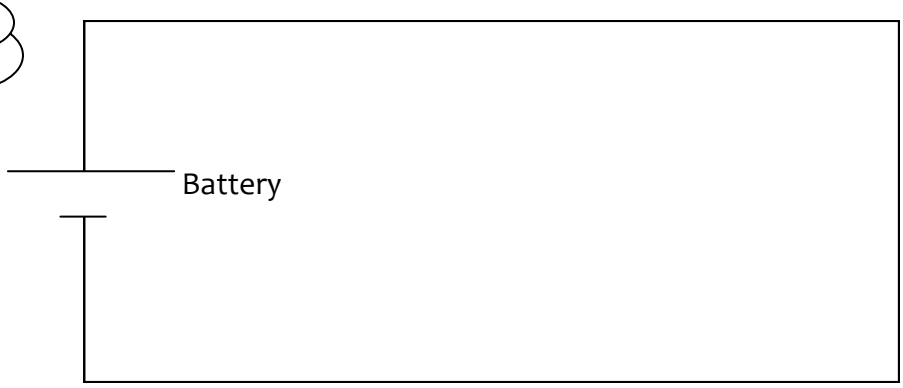
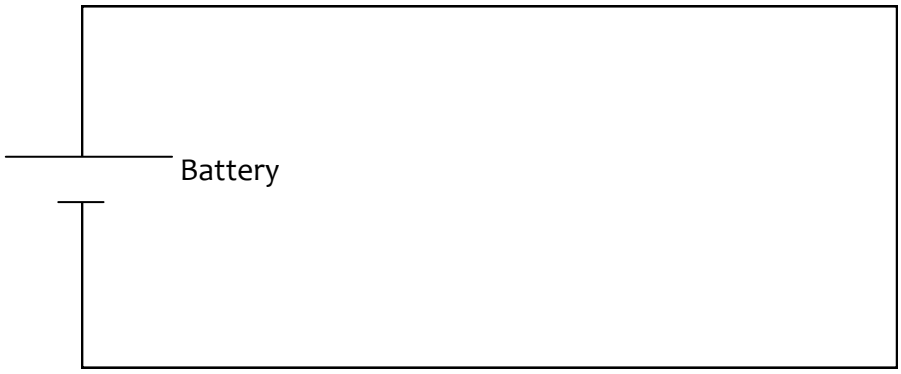
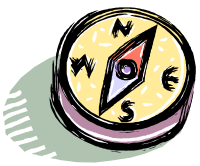


Diagram for the electrical circuit to be built.

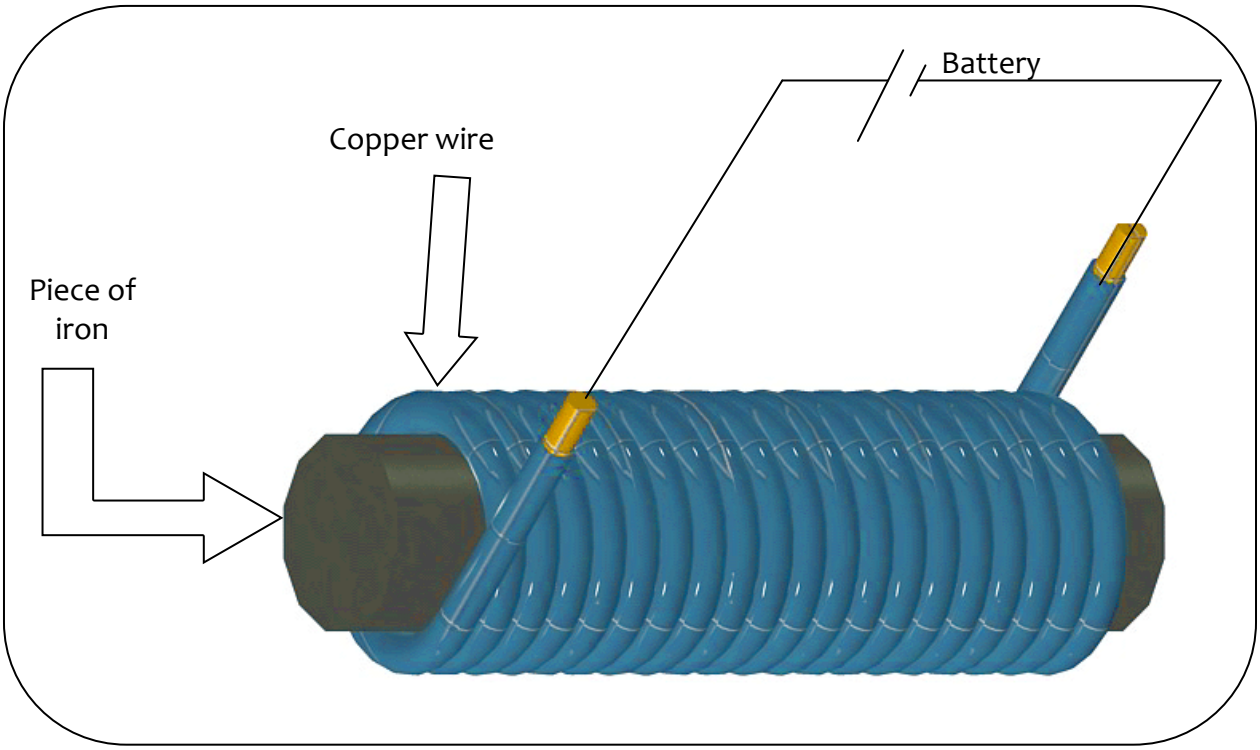
Place a compass next to the electric wire. What happens? What if you disconnect the battery?





What can you observe here?

If you had a great number of electric wires passing near the compass in the same direction, the needle would divert a lot. It would act like a stronger magnet: you could even attract small iron objects. To obtain this effect, wind a length of copper wire around a piece of iron, like a corkscrew. Then, connect the two extremities of the wire to a battery.

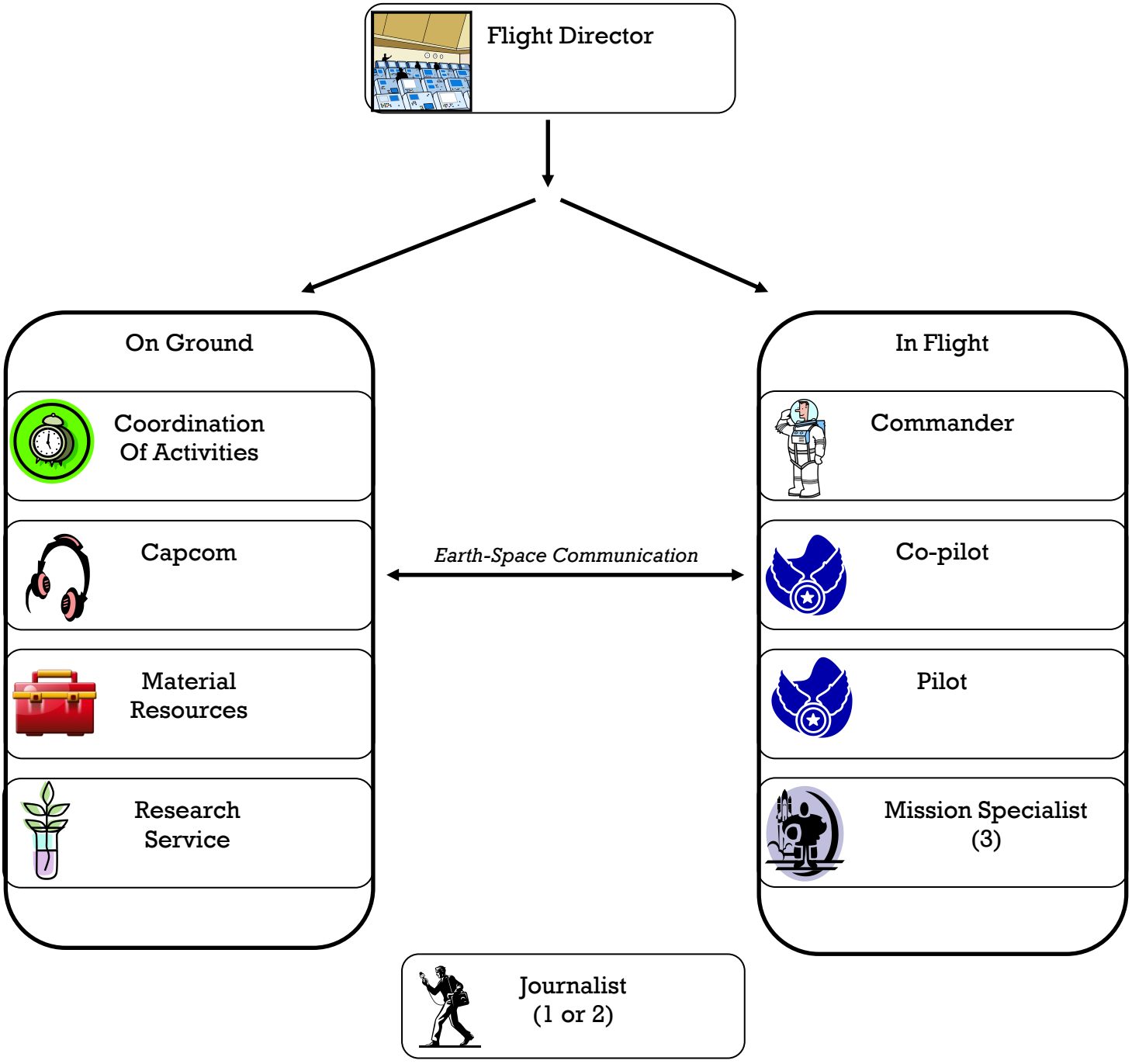


Connect and disconnect the battery to see how it affects a compass or a small trombone. If the current can pass, it's a magnet. If the current can not pass, it’s not a magnet. That’s what we call an electromagnet. You will have to build one for your magnetic arm!

There you go! You are ready to begin construction on the magnetic arm! Consult the scope statement and start making plans.

Let's get prepared!
The roles

The day of the mission, each person will have a role. The class will be divided in two groups: one half will complete its mission in the morning and the other will do so in the afternoon. The role organisation chart is as follows:



Let's get prepared!
The roles

To prepare your roles, you will work in the teams indicated here (journalists work as their own team):

Management Team

Flight Director

Commander

Coordination Of Activities

Navigation Team

Capcom

Co-pilot

Pilot

Scientific Team

Material Resources

Mission Specialists (3)

Research Service

Let's get prepared!
Each role's tasks

Navigation Team

Ground communicator (CAPCOM)

The day of the mission, takes place in the control room
Is the only one to maintain communications between the space team and the ground team. (Unless the flight director orders otherwise)
Always uses a proper and adequate language and avoids useless chatter.
Trains with the flight simulation software in order to be able to help the pilot.

Pilot

The day of the mission, takes place in the space shuttle
Trains with the flight simulation software
Works with the CAPCOM
Obeys the commander
Performs all the space manoeuvres (lift-off, landing, etc.)

Co-pilot

The day of the mission, takes place in the space shuttle
Trains with the flight simulation software just like the pilot
Assists the pilot in his manoeuvres
Is the only one to maintain communications between the space team and the ground team. (Unless the commander orders otherwise)
Always uses a proper and adequate language and avoids useless chatter.

Scientific Team

Research Service

The day of the mission, takes place in the control room.
Before the lift-off, can enter in the space shuttle if necessary.
Prepares the experiments with the mission specialists.
Prepares the tools and materials with the mission specialists.
Makes sure the mission specialists' workbooks are ready before the mission.
Establishes the experiments schedule with the CA.
Is ready to assist the mission specialists during the experiments.

Mission specialists (MS)

The day of the mission, takes place in the space shuttle.
Prepares the experiments with the research service.
Is responsible for experiments and for performing spacewalks.
Obeys the commander.

Management Team

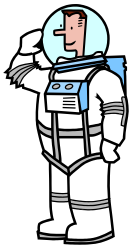
Flight Director (FD)

The day of the mission, takes place in the control room.
Has full authority over the mission and the personnel.
Always uses his authority in a responsible way.
Makes sure the mission takes place properly.
Must not leave his post in the in the control room.
Must take all the final decisions.
Makes sure all tasks are performed as they are planned for the mission.
Makes sure the members of the mission get along with each other.
Informs the adult in charge of any problem the team is unable to solve.

Coordination of Activities (CA)

The day of the mission, takes place in the control room.
Fills the schedule in the mission workbook, after consulting the other members of the mission.
Distributes the schedule to the other members at least one day before the mission.
Posts a copy of the schedule in view of everyone.
Makes sure the schedule is followed as loosely as possible.
Keeps the FD of the time and the schedule.
During the mission, corrects the schedule as needed and informs the rest of the personnel.
Assists the flight director.

Commander



The day of the mission, takes place in the space shuttle.
Obeys the flight director.
Has full authority over the space shuttle and its crew.
Always uses his authority in a responsible way.
Makes sure the crew is in good physical and mental shape.
Helps the MS as needed.
Informs the control room of any problem the crew cannot solve.
Works with the FD to prepare the mission.
Works with the CA to establish the mission schedule.

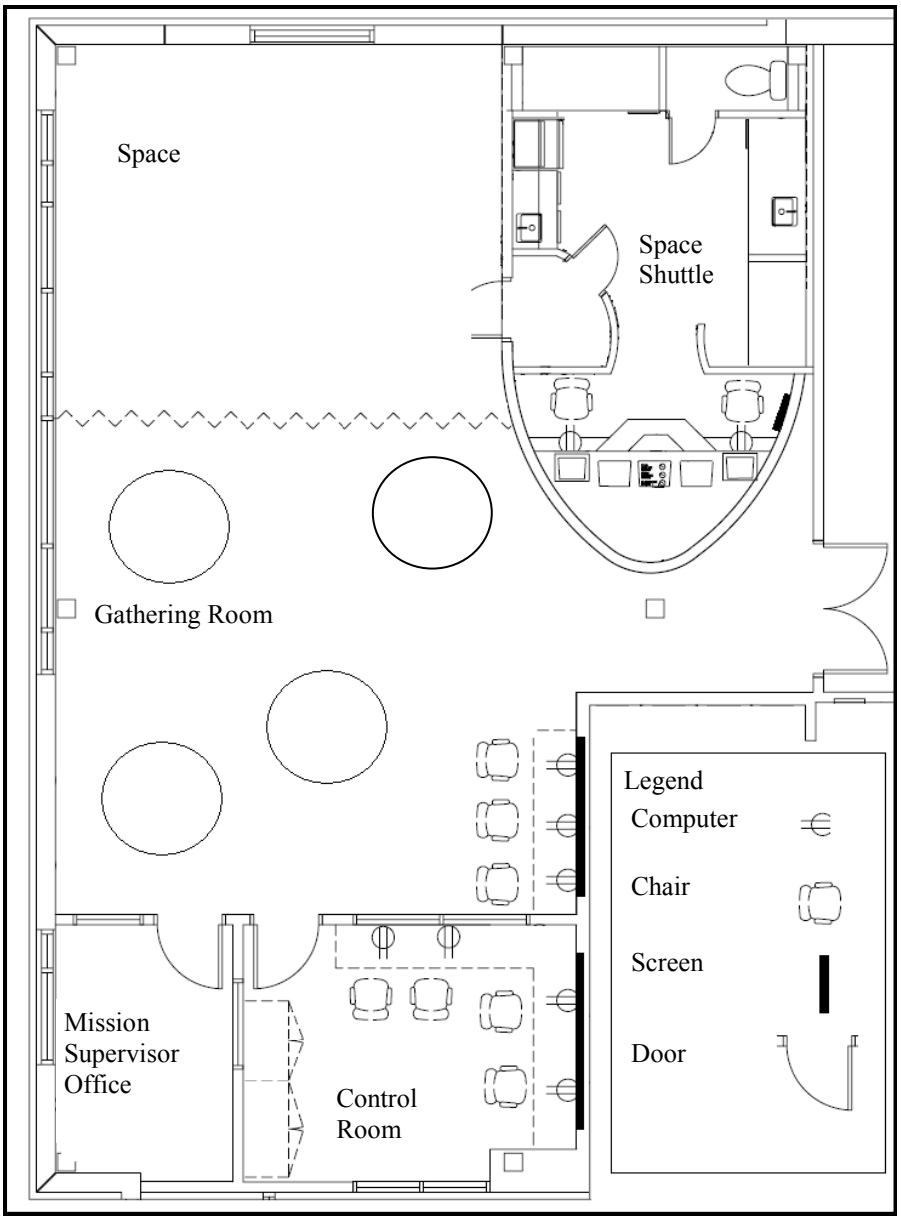
Journalist

The day of the mission, can go everywhere (but not in space!).
Has knowledge of all the aspects of the mission, including the experiments.
Gathers information (pictures, notes…) about all stages of the mission.
Makes interviews with members of the different teams *before* and *during* the mission, without hindering their work.
Write a short article about the mission.

Let's get prepared!
The locations

Your simulated space mission will take place at the CENST, the Science and Technology Simulation Centre of the Marguerite-Bourgeoys School Board.

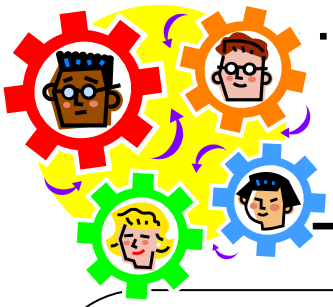
The staff members of the ground will be either in the control room or in the gathering room. The members of the flight crew will be in the space shuttle and some will go out in space.



Let's get prepared!
The proceedings

The important stages of the mission are listed below. The CA will determine the mission times by talking with the other members and will then give the hours to all members.

Stages	Mission time	Montréal time	My task will be...
Preparation	-00:10		
Lift-off	00:00		
Arrival at destination			
Spacewalk and cleanup			
MS reentry			
Departure from space			
Landing on Earth			
Return ceremony			
Mission end			



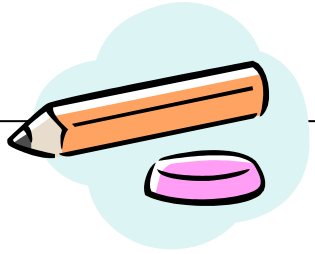
Let's get prepared!
The tasks

What is your role?

Where will you be on the day of the mission?

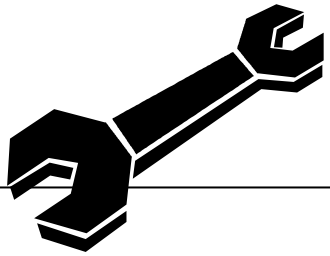
On the preceding pages, highlight your role, the team with which you'll prepare, and the location where you will be.

What will be your tasks on the day of the mission?



What must you do to prepare the mission**?**

Additional notes (don't forget anything!)



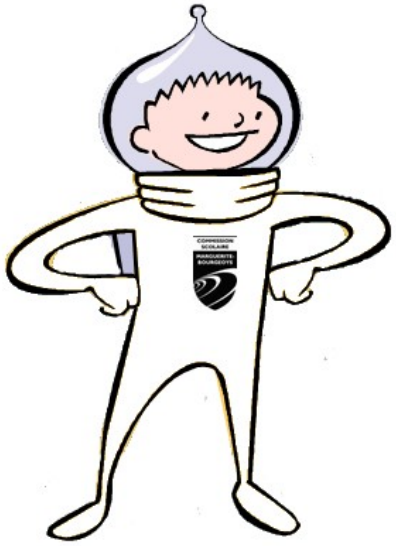
Return on the mission

What were the strong points and weak points of your mission?

Are you satisfied with your arm? Why?

Did your role correspond well with you? Why?

What advice would you give to another class about to go on a mission?



Mission sur mesure
3e cycle du primaire
CENST
Véronique Pagé
2011-2012