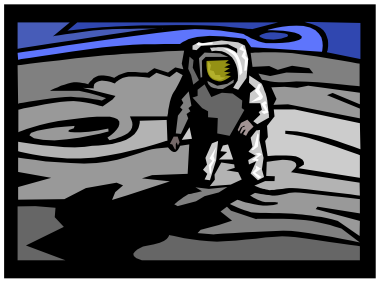
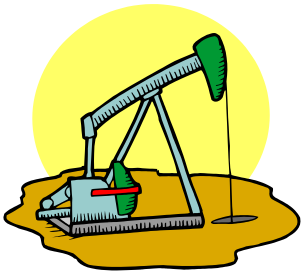
Mission Workbook

Name(s): _____

Mission: Lunar Base of the 21st Century

Code: LB21





Mission:

1. AM : Chooose the energy source that is the most appropriate for the lunar base.
2. PM : Install a prototype that will use the chosen source and generate energy on the Moon.

Energy sources to evaluate:

1. Petroleum (p.4)
2. Sunlight (p.8)
3. Wind (p.12)
4. Batteries (p.16)

Aspects to study for each resource:

1. How can we produce electricity with this resource?
2. What equipment will we have to take to the Moon?
3. What will be the total mass of that equipment?

Characteristics sought for the energy source

1. Must fonction on the Moon
2. The mass of material to be brought to the Moon must be as small as possible

Base characteristics

The future base will include living quarters and working quarters connected together. The astronauts will also have access to two lunar vehicles.

All indoor and outdoor equipment will run on electricity.

Sketch of the lunar base and an exploration vehicle

Total energy needs for the lunar base:

500000 watt hours (Wh) per day

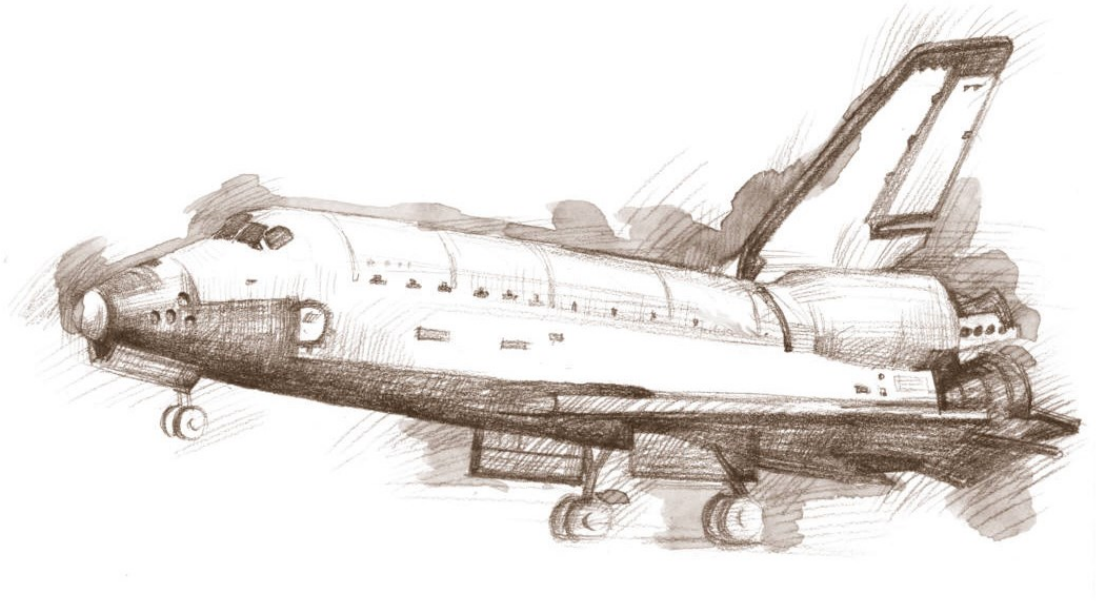
500 kilowatt hours (kWh) per day

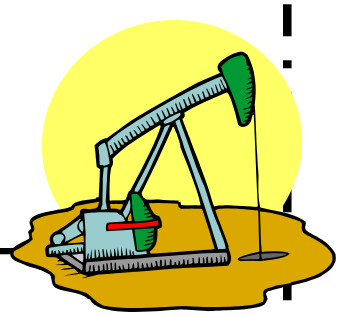
Prototype to be installed on the Moon:

To work properly, the prototype to be placed on the Moon must include a light-emitting diode (LED) to send a signal to Earth, a motor to move the LED, and a source of electricity to be determined.

Chosen site to install the prototype:

The space shuttle has been programmed to land on the Moon at a precise location. The LED of the the prototype must be placed 1,75 metre away from the landing site.





Petroleum
Evaluation sheet

Resource : petroleum
Electricity production method:
combustion

Initial ideas

Do you think petroleum is a good source of energy for the lunar base?

_____

Why?

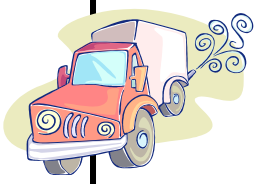
_____

_____

Execution

You will not handle this resource directly because of the risk of explosion. However, since petroleum is a type of oil, some measurements can be done by replacing the petroleum with vegetable oil. You must first find information regarding the availability of the resource and the mass of the required equipment..

Use of the resource



The chemical energy of petroleum is released through combustion. What is done to petroleum in a combustion?

Is petroleum a renewable energy source? Why?

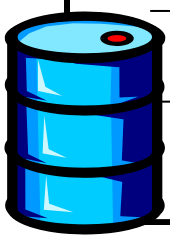
Availability of the resource

Where do we find the petroleum that we use?

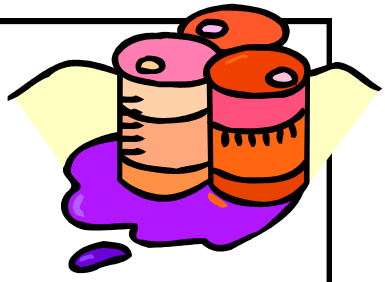
How is petroleum created?

Do you think we can find petroleum on the Moon? Why?

Will we need to bring this equipment only once or repeatedly?



Mass of the equipment



To supply the daily 500 kWh of energy, the space agency evaluates that we will need 100 barrels of petroleum per year. If one barrel contains 160 litres, how many litres will it take for a whole year?

_____

We have to know how much all this will weigh. Petroleum being a type of oil, its weight is almost the same as that of vegetable oil.

The objects on the table will not allow you to measure the mass of a litre of oil directely. Look for a way around the problem. You will also need to make a few calculations.

_____

_____

One litre of petroleum weighs about: _____ grams

According to your estimate, what will be the total mass for everything we will need to bring to the Moon? Give your answer in grams then convert it to kilograms.

_____

_____

_____

Results

Is this resource available on the Moon?

_____

If it is not available, can we bring it to the Moon?

_____

What mass of equipment will we need to bring to the Moon to produce all the electricity with this resource?

_____

How often will it be necessary to bring this mass to the Moon?

_____

Petroleum
Decision

Do you recommend this method of energy production for the lunar base?

Yes ☐ **No** ☐

Solar power
Evaluation sheet

Resource : Sunlight
Electricity production method:
Photoelectric effect

Initial ideas

Do you think sunlight is a good source of energy for the lunar base?

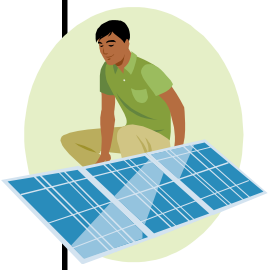
Why?

Execution

You will see how a solar panel works and what kinds of limitations this technology has. You will then have to find information regarding the availability of the resource and the mass of the required equipment.

Use of the resource

Build a circuit in which the electricity generated by a solar panel allows the LED to light up. Use the Sun-in-a-box instead of the real Sun. Draw a plan of your circuit using the symbols from the appendix.



What would happen if there were clouds. To simulate clouds, hide part of the solar panel with a piece of cardboard. Look at the LED and note your observations in the table below.

	The LED…
¼ of the panel is hidden	
½ of the panel is hidden	
¾ of the panel is hidden	

According to your test, will solar panels function in the presence of clouds?

_____

_____

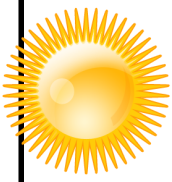
Masse du matériel

To supply the 500 kWh of energy needed for a day, the space agency has estimated that 12 500 solar panels will be necessary.

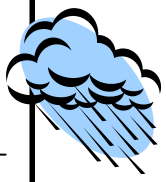
How much does one solar panel weigh? Give your answers in grams.

What will be the total mass of the solar panels? Give your answer in grams then convert it to kilograms.

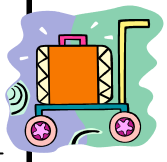
Availability of the resource (explain your answers)



Is there sunlight on the Moon?



Are there clouds on the Moon?



What must we bring to the Moon in order to use that resource?

Will we need to bring this equipment only once or repeatedly?

Results

Is this resource available on the Moon?

If it is not available, can we bring it to the Moon?

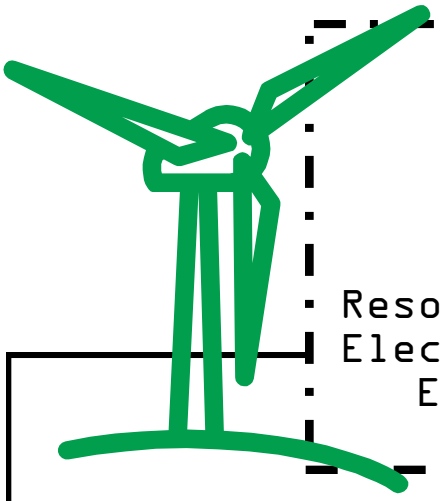
What mass of equipment will we need to bring to the Moon to produce all the electricity with this resource?

How often will it be necessary to bring this mass to the Moon?

Solar power
Decision

Do you recommend this method of energy production for the lunar base?

Yes ☐ **No** ☐



Wind power
Evaluation sheet

Resource : wind
Electricity production method:
Electromagnetic induction

Initial ideas

Do you think wind is a good source of energy for the lunar base?

_____

Why?

_____

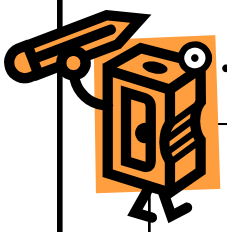
_____

Execution

You will see how you can use a turbine to transform motion into electricity as well as how you can connect the elements of a circuit. You will then have to find information regarding the availability of the resource and the mass of the required equipment.

Use of the resource

The dynamo provided to you is a bladeless turbine. You will be the one turning the crank instead of the wind! Build a circuit in which you can light up one lightbulb using the dynamo.



Draw a plan of your circuit using the symbols from the appendix.

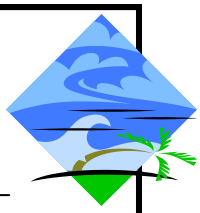
The way the elements of a circuit are connected can have a huge impact on how it operates. Using the parts and the diagrams on the table, answer the following questions.

Do you need to turn the crank harder if you build a circuit with two light bulbs in a **series circuit**?

Do you need to turn the crank harder if you build a circuit with two light bulbs in a **parallel circuit**?

If you have a wind turbine and ttwo light bulbs, will you get more light by connecting the bulbs in series or in parallel?

Availability of the resource



In your words, explain what wind is.

Explain what an atmosphere is.

Does the Moon have an atmosphere?

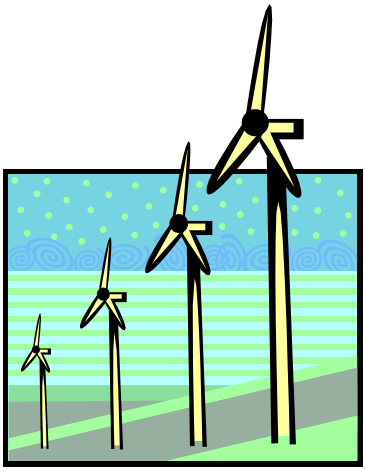
Is there wind on the Moon?

Can wind turbines function on the Moon?

Masse of the equipment

Is there any equipment we could bring to the Moon that would allow us to use wind power?

If you think so, write down what kind of equipment and estimate its mass. If not, explain why.



Results

Is this resource available on the Moon?

_____

If it is not available, can we bring it to the Moon?

_____

What mass of equipment will we need to bring to the Moon to produce all the electricity with this resource?

_____

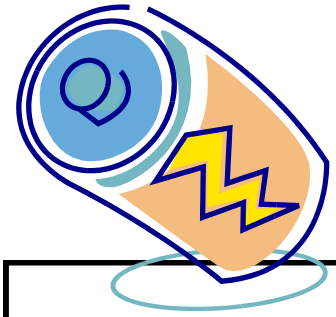
How often will it be necessary to bring this mass to the Moon?

_____

Wind power
Decision

Do you recommend this method of energy production for the lunar base?

Yes ☐ **No** ☐



Batteries
Evaluation sheet

Resource : chemical energy
Electricity production method:
Reduction-oxydation reaction

Initial ideas

Do you think the chemical reactions in batteries are a good source of energy for the lunar base?

_____

Why?

_____

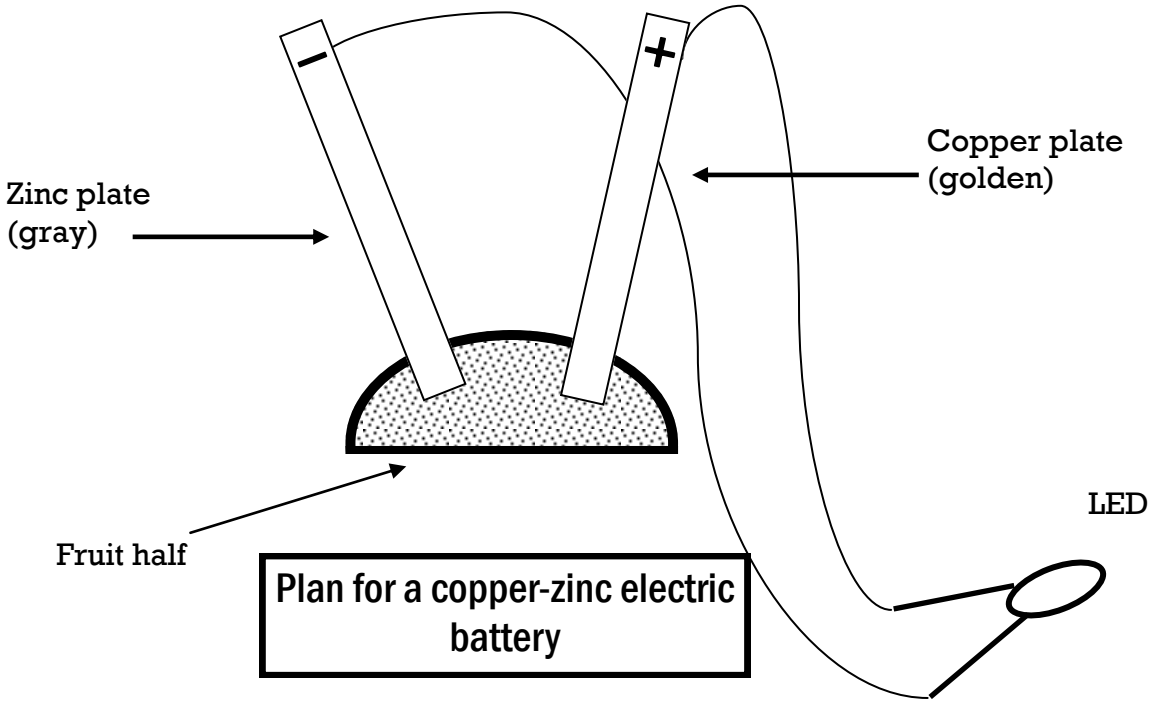
_____

Execution

A battery is made of two **different** types of material, one of which attracts electric current more than the other. The two materials are connected by a substance that acts like a "bridge" between the two. You will see how to put together a battery and how to use it in a circuit. You will then have to find information regarding the availability of the resource and the mass of the required equipment.

Use of the resource

Batteries transform chemical energy into electricity. The reaction you will observe takes place between zinc and copper plates connected through… fruit juice!



Plan for a copper-zinc electric battery

The plates must be inserted in the lemon, but they must not touch! The zinc and copper will react with the juice, which will produce an electric current.

A battery like this one is probably too weak light up a LED. **You will need to connect several batteries in a <u>series</u> circuit** to add their power. Use the plan on the table as a reference.

What is the minimal number of copper-zinc batteries you must use to light up the LED?

Availability of the resource

Since batteries are made by humans, there are of course none on the Moon. If we choose this resource, we would have to bring some with us.

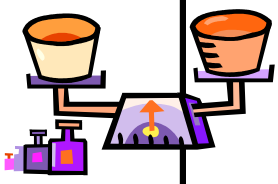
Will we need to bring this equipment only once or repeatedly?

_____

_____

_____

Mass of the equipment



The space agency estimates that its super batteries can provide **2 kWh each** before becoming completely discharged. They have the same weight as regular batteries. How much does a battery weigh?

_____ grams

How many batteries will be required to provide the 500 kWh of energy neeeded for the lunar base in one day?

_____

How many batteries will we need for one year?

_____

What will be the total mass of the batteries? Give your answer in grams then convert it to kilograms.

_____

_____

Results

Is this resource available on the Moon?

_____

If it is not available, can we bring it to the Moon?

_____

What mass of equipment will we need to bring to the Moon to produce all the electricity with this resource?

_____

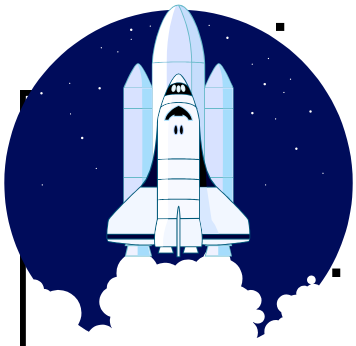
How often will it be necessary to bring this mass to the Moon?

_____

Batteries
Decision

Do you recommend this method of energy production for the lunar base?

Yes ☐ **No** ☐



Mission LB21:

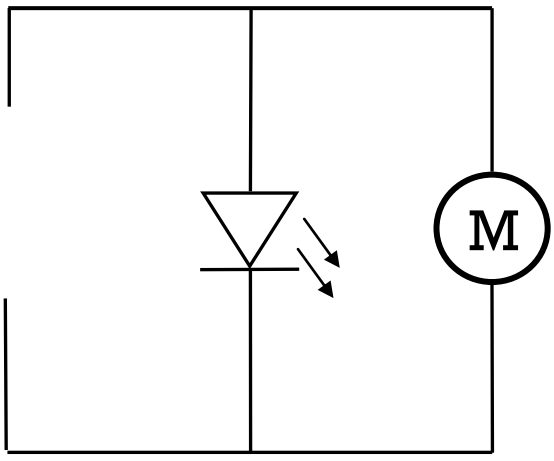
Final Report

What energy source does the class recommend we use to generate the electricity needed for the lunar base?

Why? Give a few reasons.

How will we generate electricity from this resource?

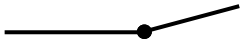
Complete the diagram of the prototype that will be placed on the Moon.



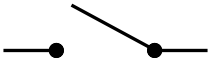
Appendix

Symbols for a few electric components

Electric wire

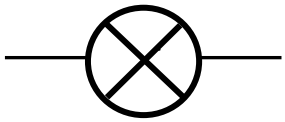


Connected wires

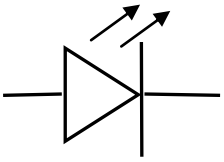


Open switch

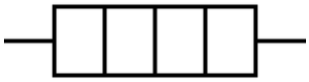
Closed switch



Light bulb

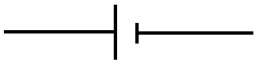


LED

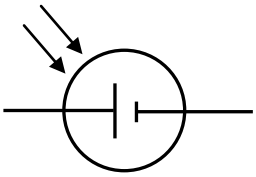


Heating element

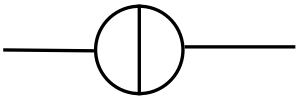
Motor



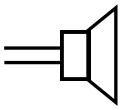
Battery



Solar panel



Dynamo



Speaker

Feel free to use the back of this sheet for your calculations.