Simple Machines

Student’s worksheets

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IES Rocagrossa – Lloret de Mar

CLIL Course
Norwich Institute for Language Education
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## Unit 2: Inclined planes

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<th>Page</th>
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</thead>
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## Unit 3: Levers

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<tr>
<th>Lesson</th>
<th>Topic</th>
<th>Page</th>
</tr>
</thead>
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<td>Lesson 1</td>
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<tr>
<td>Lesson 4</td>
<td>Pulleys</td>
<td>99</td>
</tr>
<tr>
<td>Lesson 5</td>
<td>Assessment</td>
<td>104</td>
</tr>
</tbody>
</table>
Unit 1

Force, work and machines
Lesson 1: Force
Worksheet 1: Introduction

Name: 

Group: 

Date: 

Activity 1: Look at the picture and try to answer the following questions.

a) What is the man trying to move? ______________________________________________________________________

b) Who was he? ______________________________________________________________________

c) Where was he from? ______________________________________________________________________

d) When did he live? ______________________________________________________________________

e) Why was he famous? ______________________________________________________________________

f) What kind of object is he using? ______________________________________________________________________

g) Why is he using that object? ______________________________________________________________________

“Give me a place to stand and I will move the Earth”
**Activity 2:** The pictures show different simple machines. Match the pictures with the names.

- inclined plane
- wheel
- lever
- pulley
- screw
- wedge
Activity 3: Put the letters in order to find the words and write the correct word below the drawings.

<table>
<thead>
<tr>
<th>Letters</th>
<th>Word</th>
</tr>
</thead>
<tbody>
<tr>
<td>shup</td>
<td></td>
</tr>
<tr>
<td>lulp</td>
<td></td>
</tr>
<tr>
<td>crefo</td>
<td></td>
</tr>
</tbody>
</table>

When we

we make a

When we

we make a
**Activity 4:** Rewrite the following sentences using the synonyms in the box.

<table>
<thead>
<tr>
<th>Activity 4:</th>
<th>Rename the following sentences using the synonyms in the box.</th>
</tr>
</thead>
</table>
| A force is any cause that can... | (1) ...increase the speed of an object.  
(2) ...decrease the speed of an object.  
(3) ...change the trajectory of an object.  
(4) ...change the shape of an object. |

| synonyms | divert  
decelerate  
deform  
accelerate |

<table>
<thead>
<tr>
<th>Activity 5:</th>
<th>Using the cards, construct the puzzle with your classmates and then fill in the table.</th>
</tr>
</thead>
<tbody>
<tr>
<td>QUANTITY</td>
<td>QUANTITY SYMBOL</td>
</tr>
<tr>
<td>length</td>
<td></td>
</tr>
<tr>
<td>time</td>
<td></td>
</tr>
<tr>
<td>mass</td>
<td></td>
</tr>
<tr>
<td>force</td>
<td></td>
</tr>
</tbody>
</table>
**Given to students cut up**

<table>
<thead>
<tr>
<th>QUANTITY</th>
<th>QUANTITY SYMBOL</th>
<th>UNIT OF MEASUREMENT</th>
<th>UNIT SYMBOL</th>
</tr>
</thead>
<tbody>
<tr>
<td>length</td>
<td>l</td>
<td>metre</td>
<td>m</td>
</tr>
<tr>
<td>time</td>
<td>t</td>
<td>second</td>
<td>s</td>
</tr>
<tr>
<td>mass</td>
<td>m</td>
<td>kilogram</td>
<td>kg</td>
</tr>
<tr>
<td>force</td>
<td>F</td>
<td>Newton</td>
<td>N</td>
</tr>
</tbody>
</table>
Lesson 2: Work and energy
Activity 6: Let’s review the concept of work in physics. Follow the instructions.

Student A

“Take one book and move it one metre”

Student B

“Take one book and move it two metres”

Student C

“Take two books and move them one metre”

Student D

“Take two books and move them two metres”
Think about the work you have done.

Use the table below as in the example to write sentences comparing the work each of you has done.

<table>
<thead>
<tr>
<th>Student</th>
<th>B</th>
<th>C</th>
<th>did</th>
<th>the same work as the work of</th>
<th>student</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>D</td>
<td></td>
<td></td>
<td>double</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>half</td>
<td>B</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>four times</td>
<td>D</td>
</tr>
</tbody>
</table>

**Student A did half the work of student B**
**Activity 7:** Machines use energy to do work. Fill in the boxes with the words given.

wind, run, electricity, phone, petrol, food, transport, generate electricity

Now order the following words to find the definition of energy:

ability is Energy the work do to

Energy...
**Activity 8:** Using the cards, construct the puzzle with your classmates and then fill in the table.

<table>
<thead>
<tr>
<th>QUANTITY</th>
<th>QUANTITY SYMBOL</th>
<th>UNIT OF MEASUREMENT</th>
<th>UNIT SYMBOL</th>
</tr>
</thead>
<tbody>
<tr>
<td>length</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>time</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mass</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>force</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>work</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>energy</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Given to students cut up

<table>
<thead>
<tr>
<th>QUANTITY</th>
<th>QUANTITY SYMBOL</th>
<th>UNIT OF MEASUREMENT</th>
<th>UNIT SYMBOL</th>
</tr>
</thead>
<tbody>
<tr>
<td>length</td>
<td>l</td>
<td>metre</td>
<td>m</td>
</tr>
<tr>
<td>time</td>
<td>t</td>
<td>second</td>
<td>s</td>
</tr>
<tr>
<td>mass</td>
<td>m</td>
<td>kilogram</td>
<td>kg</td>
</tr>
<tr>
<td>force</td>
<td>F</td>
<td>Newton</td>
<td>N</td>
</tr>
<tr>
<td>work</td>
<td>W</td>
<td>Joule</td>
<td>J</td>
</tr>
<tr>
<td>energy</td>
<td>E</td>
<td>Joule</td>
<td>J</td>
</tr>
</tbody>
</table>
Activity 9:  Listen and fill the gaps.

Problem A
A man ______ a box for ____. To ____ the box, the man _____ a _____ ______. Find the ____ done in the ______.

Problem B
A person _____ a ____ to ____ an object from the floor. The _____ reached is ____ and the _____ done is ______. Determine the ______ necessary to ____ the object.

Problem C
A ______ _____ is ______ to move a _________ doing ________ of ____ in the _______. Find the _________ the _________ has been moved.

Answer the following questions choosing the appropriate option. Find the answers in the text above.

1. A road vehicle with two wheels is a...
   a) car
   b) motorbike
   c) trolley
   d) lorry

2. What’s the name of the distance between the ground and something above it?
   a) height
   b) weight
   c) tall
   d) high
3. If you .......... something, you elevate it.
   a) gift 
   b) mist 
   c) lift 
   d) shift 

4. It is a thick cord or wire.
   a) root 
   b) rote 
   c) cuerda 
   d) rope 

5. A ............... is a series of actions which are executed in order to achieve a result.
   a) promise 
   b) success 
   c) process 
   d) goodness 

6. A ............... is any cause that can change the movement or the shape of an object.
   a) force 
   b) power 
   c) energy 
   d) work 

7. When you move something making a force, you are doing...
   a) job 
   b) work 
   c) wok 
   d) walk 

8. To use force in order to move something towards you.
   a) To rule 
   b) To brush 
   c) To push 
   d) To pull 

9. To use force to make something move away from you.
   a) To rule 
   b) To brush 
   c) To push 
   d) To pull
Activity 10: Solve the problems.

Problem A
A man pushes a box for 10 m. To move the box, the man makes a 200 N force. Find the work done in the process.

Problem B
A person pulls a rope to lift an object from the floor. The height reached is 15 m and the work done is 4500 J. Determine the force necessary to lift the object.

Problem C
A 400 N force is applied to move a motorbike doing 20000 J of work in the process. Find the distance the motorbike has been moved.
Lesson 3: Machines
**Worksheet 6:  **Machines

Name:

Group:

Date:

**Activity 11:** Write the names of the following machines and copy the letters in the numbered cells to find out the definition of a machine.

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th></th>
<th>B</th>
<th></th>
<th>C</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>10 26 34</td>
<td>1</td>
<td>24 37</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>36 2 21 19 22 32</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>D</th>
<th></th>
<th>E</th>
<th></th>
<th>F</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>16 38 12</td>
<td>8</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>G</th>
<th></th>
<th>H</th>
<th></th>
<th>I</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>13 14</td>
<td></td>
<td>17 4</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>20 25 18</td>
<td>30 5</td>
<td>29 7 23</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
What’s a machine?

[Diagram of a machine with labeled parts]

1 2 3 4 5 6 7 8
9
10 11 12
13 14 15 16 17 18
19 5 3 20
21 22
23 24 25 26 27 12
28 29
30 31 32 33 34 35 2
36 2 37
1 38 39 40
15 40 20 12
Worksheet 7: Simple machines

Name: 
Group: 
Date: 

Activity 12: Listen to the teacher and write the number of the correct sentence below each picture.

A: sentence ____  B: sentence ____  C: sentence ____

D: sentence ____  E: sentence ____  F: sentence ____

Write down the name of the six simple machines:

A: ______________________  D: ______________________
B: ______________________  E: ______________________
C: ______________________  F: ______________________
**Activity 13:** Listen to your partners and write down the questions and the answers on the appropriate order. Complete the tree diagram using the last three answers.

1. __________________________________________________________
2. __________________________________________________________
3. __________________________________________________________
4. __________________________________________________________
5. __________________________________________________________
6. __________________________________________________________
7. __________________________________________
   __________________________________________
   __________________________________________

8. __________________________________________
   __________________________________________
   __________________________________________

9. __________________________________________
   __________________________________________
   __________________________________________
**Given to students cut up**

| A | The wheel and axle and the pulley are variants on the lever. |
| B | A simple machine has got few or no moving parts. |
| C | Simple machines can be thought of as building blocks for more complicated machines. |
| D | Simple machines are useful because they make work easier. |
| E | The two basic simple machines are the inclined plane and the lever. |
| F | A simple machine is a device that changes the direction or the magnitude of a force. |
| G | The screw and the wedge are variants on the inclined plane. |
| H | Learning the basics of simple machines is fundamental to understanding more intricate mechanisms. |
| I | A simple machine works by using a single applied force to do work against a load. |
Lesson 4: Mechanical advantage
Activity 14: Read the following text and circle T or F to state if the sentences on next page are true or false.

In practical or everyday applications, we give to weight the same meaning as we gave to mass in physics. In modern scientific usage, however, weight and mass are fundamentally different quantities: mass is an intrinsic property of matter, whereas weight is a force that results from the action of gravity on matter: it measures how strongly gravity pulls on that matter.

However, the recognition of this difference is historically a relatively recent development and in many everyday situations the word "weight" continues to be used when, strictly, "mass" is meant. For example, most people would say that an object "weighs one kilogram", even though the kilogram is a unit of mass.

The distinction between mass and weight is unimportant for many practical purposes because the strength of gravity is very similar everywhere on the surface of the Earth. In such a constant gravitational field, the gravitational force exerted on an object (its weight) is directly proportional to its mass. For example, object “A” weighs 10 times as much as object “B”, so therefore the mass of object “A” is 10 times greater than that of object “B”.

The difference between mass and weight is apparent when, for example objects are compared in different gravitational fields. For example, on the surface of the Moon, gravity is only about one-sixth as strong as on the surface of the Earth. A one-kilogram mass is still a one-kilogram mass (as mass is an intrinsic property of the object) but the downward force due to gravity is only one-sixth of what the object would experience on Earth. So the weight of the object on the moon will be one-sixth of what it would have on Earth.

To convert between weight (force) and mass, Newton's second law of “force = mass × acceleration" (F = m·a) is used. Here, “F” is the force (weight) due to gravity, “m” is the mass of the object in question, and “a” is the acceleration due to gravity, on Earth approximately 9,81 m/s\(^2\). For example, a mass of 2 kg experiences a weight force of 2 kg \(\times 9,81 \, \text{m/s}^2 = 19,62 \, \text{N}\).

Adapted from Wikipedia
<table>
<thead>
<tr>
<th></th>
<th>True</th>
<th>False</th>
</tr>
</thead>
<tbody>
<tr>
<td>1)</td>
<td>T</td>
<td>F</td>
</tr>
<tr>
<td>2)</td>
<td>T</td>
<td>F</td>
</tr>
<tr>
<td>3)</td>
<td>T</td>
<td>F</td>
</tr>
<tr>
<td>4)</td>
<td>T</td>
<td>F</td>
</tr>
<tr>
<td>5)</td>
<td>T</td>
<td>F</td>
</tr>
<tr>
<td>6)</td>
<td>T</td>
<td>F</td>
</tr>
<tr>
<td>7)</td>
<td>T</td>
<td>F</td>
</tr>
<tr>
<td>8)</td>
<td>T</td>
<td>F</td>
</tr>
<tr>
<td>9)</td>
<td>T</td>
<td>F</td>
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<td>10)</td>
<td>T</td>
<td>F</td>
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<td>11)</td>
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<td>F</td>
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<td>12)</td>
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<td>13)</td>
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<td>F</td>
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<tr>
<td>14)</td>
<td>T</td>
<td>F</td>
</tr>
<tr>
<td>15)</td>
<td>T</td>
<td>F</td>
</tr>
</tbody>
</table>

In science weight means the same as mass.

Weight and mass are forces.

Weight is a force.

An object with one kilogram mass weighs one kilogram.

The kilogram is a unit of mass.

Sometimes the distinction between mass and weight is unimportant.

Gravity on the Earth is different depending on the country.

The weight of an object is directly proportional to its mass.

The weight is 10 times greater than the mass.

It’s easy to understand the difference between mass and weight comparing the same object on different planets.

On the Moon gravity is stronger than on Earth.

The mass of an object is the same on the Moon as on Earth.

The weight of an object is the same on the Moon as on Earth.

We can know the weight of a mass using Newton’s second law.

On Earth the weight of a 5 kg mass is 37 N.
Worksheet 9: Conservation of energy principle

Name:

Group: Date:

Activity 15: Find the card with the concept related to your definition. Dictate it to the members of your group and write all of them on your worksheet.

a) Conservation of energy principle: __________________________________________

b) Friction: _____________________________________________________________

c) Frictionless system: ___________________________________________________

d) Ideal machine: _______________________________________________________

e) Actual machine: ______________________________________________________

f) Efficiency: ___________________________________________________________
**Given to students cut up** (one card to each member of the group except to the runner).

<table>
<thead>
<tr>
<th>Conservation of energy principle</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Friction</strong></td>
</tr>
<tr>
<td><strong>Frictionless system</strong></td>
</tr>
<tr>
<td><strong>Ideal machine</strong></td>
</tr>
<tr>
<td><strong>Actual machine</strong></td>
</tr>
<tr>
<td><strong>Efficiency</strong></td>
</tr>
</tbody>
</table>
**Cards cut up on a table**

<table>
<thead>
<tr>
<th>Definition</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy can neither be created nor destroyed; it can only be transformed from one state to another.</td>
<td></td>
</tr>
<tr>
<td>Force that makes the relative motion between two objects more difficult.</td>
<td></td>
</tr>
<tr>
<td>Ideal system with no friction forces within it.</td>
<td></td>
</tr>
<tr>
<td>Theoretical machine in which there is no loss of energy (e.g., because of the friction).</td>
<td></td>
</tr>
<tr>
<td>Machine in which there is loss of energy (i.e., real machine)</td>
<td></td>
</tr>
<tr>
<td>Is the ratio of energy used by a machine to the useful work the machine has done.</td>
<td></td>
</tr>
</tbody>
</table>
**Activity 16:** Listen to the teacher and take notes about mechanical advantage.

![Diagram of a seesaw with forces labeled.](image-url)
Worksheet 11: Mechanical advantage 2

Name: 
Group: 
Date: 

Activity 17: Answer the following questions. Use the answers from activities 15 and 16.

1. Do simple machines multiply energy?
   _____________________________________________________________
   _____________________________________________________________
   _____________________________________________________________
   _____________________________________________________________

2. What’s the relationship between the input energy and the output work in an actual machine? Why?
   _____________________________________________________________
   _____________________________________________________________
   _____________________________________________________________
   _____________________________________________________________

3. What’s the relationship between the input energy and the output work in an ideal machine? Why?
   _____________________________________________________________
   _____________________________________________________________
   _____________________________________________________________
   _____________________________________________________________

4. What principle related to energy do simple machines violate?
   _____________________________________________________________
   _____________________________________________________________
   _____________________________________________________________
5. What’s the cost of making less force with a simple machine to get the same energy?

6. How can we get the mechanical advantage formula?
Activity 18: Solve the following problems.

**Problem A**
A man is lifting a cupboard with a simple machine. The mass of the cupboard is \( m_c = 50 \) kg. To move cupboard, the man makes a 250 N force. Find the mechanical advantage of the machine.

**Problem B**
A person weighing 800 N moves an object with a simple machine using all his weight. The mechanical advantage of the machine is \( MA = 5 \). Determine the mass of the object.

**Problem C**
A car has a 1000 kg mass. We want to move it with a machine able to multiply the force applied 8 times. Calculate the effort we have to do to move the car.
Lesson 5: Assessment

\[ \sqrt{7} - 1 = x \]
Activity 19

1. The pictures show different simple machines. Match the pictures with the names.

   - inclined plane
   - wheel
   - lever
   - pulley
   - screw
   - wedge

2. Fill in the table.

<table>
<thead>
<tr>
<th>QUANTITY</th>
<th>QUANTITY SYMBOL</th>
<th>UNIT OF MEASUREMENT</th>
<th>UNIT SYMBOL</th>
</tr>
</thead>
<tbody>
<tr>
<td>length</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>time</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mass</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>force</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>work</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>energy</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
3. **Match each of the following six concepts with its definition.**

<table>
<thead>
<tr>
<th>Machine Energy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Work Force</td>
</tr>
<tr>
<td>Mechanical advantage Simple machine</td>
</tr>
</tbody>
</table>

a) ___________________: any cause that can accelerate, decelerate, divert or deform an object.

b) ___________________: machine that changes the direction or the magnitude of a force.

c) ___________________: factor by which a machine multiplies the force applied to it.

d) ___________________: result of making a force over a distance.

e) ___________________: any device that uses energy to perform an activity.

f) ___________________: the ability to do work.

4. **Circle T or F to state if the sentences are true or false.**

a) T F In science weight means the same as mass.

b) T F Weight and mass are forces.

d) T F An object with one kilogram mass weighs one kilogram.

e) T F The weight of an object is directly proportional to its mass.

f) T F The mass of an object is the same on the Moon as on Earth.

g) T F On Earth the weight of a 5 kg mass is 37 N.
5. **Answer the following questions choosing the appropriate option.**

- The bigger the distance,…
  a) the bigger the force.
  b) the bigger the work.
  c) the bigger the speed.
  d) the bigger the acceleration.

- How many moving parts has a simple machine got?
  a) 10
  b) 15
  c) 20
  d) A simple machine has got few or no moving parts.

- Which are the two basic simple machines?
  a) The wheel and the wedge.
  b) The inclined plane and the screw.
  c) The inclined plane and the lever.
  d) The pulley and the wheel.

- What devices are variants on the inclined plane?
  a) The pulley and the wheel.
  b) The wedge and the hydraulic press.
  c) The wheel and the lever.
  d) The screw and the wedge.

- What devices are variants on the lever?
  a) The pulley and the wheel.
  b) The wedge and the hydraulic press.
  c) The wheel and the inclined plane.
  d) The screw and the wedge.

- When we say “energy can neither be created nor destroyed” we are stating…
  a) the simple machines’ principle.
  b) the conservation of energy principle.
  c) Newton’s second law.
  d) the simple machines’ law

- We can know the weight of a mass using…
  a) the simple machines’ principle.
  b) the conservation of energy principle.
  c) Newton’s second law.
  d) the simple machines’ law
6. Using the words in the box, explain the difference between an ideal machine and an actual machine.

<table>
<thead>
<tr>
<th>friction</th>
<th>frictionless system</th>
</tr>
</thead>
<tbody>
<tr>
<td>theoretical</td>
<td>loss of energy</td>
</tr>
<tr>
<td>real</td>
<td>efficiency</td>
</tr>
</tbody>
</table>

7. A person drives a car over 50 m. The engine of the car makes a 1200 N force. Find the work done in the process.

8. A cupboard has a 60 kg mass. We want to move it with a machine able to multiply the force applied 3 times. Calculate the effort we have to do to move the cupboard.
Unit 2
Inclined planes
Lesson 1: **The inclined plane**
Worksheet 14: The inclined plane 1

Activity 20: Each paragraph is an application of the inclined plane. Read the text and draw the different devices.

1. It is a pipe with a wide mouth. It is used to channel liquid into bottles.

2. It is a truck used to move furniture from one place to another. Portable ramps allow easy loading and unloading of this kind of trucks.

3. It is a construction designed to bridge a large vertical distance by dividing it into smaller vertical distances, called steps.

4. It is a truck used for transporting loose material (such as sand) for construction. It has an open-box which can be lifted up to allow the contents to be unloaded easily.

5. It is a sport in which skiers go down a take-off ramp, jump, and attempt to land the furthest down on the hill below.

6. It can be found in parks and schools. The user climbs to the top of it via a ladder or stairs, sits down on the top of it and slides down.
Activity 21: Fill in the gaps with the appropriate letter (e, n or t). Then read the text and label the drawing.

A_ i_cli__d pla__ is a fla_ surfac_ whos__ dpoi__s ar_ a_ diff_r__ h_igh_s. By movi__g a_ obj_c__ up a_ i_cli__d pla__ ra_h_r_ ha_ compl__ly v_ri_cally, h_ amou__ of forc_ r_quir_d is r_duc_d, a_ h_ xp__s of i_cr_asi__g_ h_ dis_a_c__ h_obj_c__ mus__ rav_l. W_ call_ h_ w_igh_ of_ h_obj_c__ h_ load a_d i__ ca_b_ id__i_ifi_d wi_h_ h_ l__ r L. h_ffor_w_ hav_ o apply_ o mov__ h_obj_c__ is h_ forc_ F. h_ h_igh_ of_ h_ i_cli__d pla__ is h_ v_ri_cal dis_a_c__ b_w__ h_ low_s_ a_d h_ high_s_ poi__s_ h_ ramp. W_ r_pr_s__ h_is dis_a_c__ wi_h_ a_ h_ h_p_a_h__ h_obj_c__ mus__ follow if w_ wa__ o us__ _h_ simp__ machi__ is _h_ l__g_h (l) of_ h_ i_cli__d pla__.
**Activity 22:** Listen to the teacher and take notes about inclined plane.
**Worksheet 16: Constructing an inclined plane**

**Name:**

**Group:**

**Date:**

**Activity 23:** Follow the instructions to construct an inclined plane and check how it works.

**a)** Using the material provided prepare an inclined plane like in the figure.

**b)** Measure the length \( l \) and the height \( h \) of the plane with a measuring tape.

\[
\begin{array}{|c|c|}
\hline
l \text{ (m)} & h \text{ (m)} \\
\hline
\end{array}
\]

**c)** Weigh the toy car with a dynamometer and calculate the work \( W_h \) to move it from B to C.

\[
W_h =
\]

This is the force we have to make to lift the car vertically from B to C.
d) Considering an ideal system, the work to move the car from B to C ($W_h$) and the work to move it from A to C ($W_l$) are the same ($W_l = W_h$). Determine the theoretical force ($F_t$) needed to pull the car from A to C.

$$W_l = \quad \rightarrow \quad F_t =$$

<table>
<thead>
<tr>
<th>$F_t$ (N)</th>
<th>This is the theoretical force we should make to move the car from A to C.</th>
</tr>
</thead>
</table>

e) Work out the theoretical mechanical advantage of the inclined plane ($MA_t$).

$$MA_t =$$

f) Put the car on the inclined plane and pull it from A to C. Read the actual force ($F_a$) you are making on the dynamometer’s scale.

<table>
<thead>
<tr>
<th>$F_a$ (N)</th>
<th>This is the actual force we have to make to move the car from A to C.</th>
</tr>
</thead>
</table>
g) Why is the actual force bigger than the theoretical force ($F_a > F_t$)?

h) Determine the actual mechanical advantage ($MA_a$).

$$MA_a =$$

i) Find out the actual work ($W_a$) we have to do to move the car from A to C.

$$W_a =$$
**Worksheet 17: Inclined plane problems**

**Name:**

**Group:**

**Date:**

**Activity 24:** Solve one of the following problems with your group and explain it to the rest of the class. Listen to the other groups and write down all the problems.

**You may need this vocabulary:**

First we calculate… Then we… After that…
The answer is… The unknown is… We isolate…
equals / is equal to times / multiplied by over / divided by
If we want to work out X… If we want to find out Y…

**Problem A**

- Mass of the object: 2 kg
- Length of the ramp: 3 m
- Force we have to make: 15 N
- Load we want to move: 2 kg
- Mechanical advantage: 
- Height of the inclined plane:
### Problem B

<table>
<thead>
<tr>
<th>Mass of the object:</th>
<th>5 kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height of the inclined plane:</td>
<td>2 m</td>
</tr>
<tr>
<td>Mechanical advantage:</td>
<td>MA = 3</td>
</tr>
<tr>
<td>Load we want to move:</td>
<td></td>
</tr>
<tr>
<td>Force we have to make:</td>
<td></td>
</tr>
<tr>
<td>Length of the ramp:</td>
<td></td>
</tr>
</tbody>
</table>

### Problem C

<table>
<thead>
<tr>
<th>Mass of the object:</th>
<th>30 kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height of the inclined plane:</td>
<td>4 m</td>
</tr>
<tr>
<td>Force we have to make:</td>
<td>180 N</td>
</tr>
<tr>
<td>Load we want to move:</td>
<td></td>
</tr>
<tr>
<td>Mechanical advantage:</td>
<td></td>
</tr>
<tr>
<td>Length of the ramp:</td>
<td></td>
</tr>
</tbody>
</table>
### Problem D

<table>
<thead>
<tr>
<th>Mass of the object:</th>
<th>Length of the ramp:</th>
</tr>
</thead>
<tbody>
<tr>
<td>80 kg</td>
<td>10 m</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Mechanical advantage:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MA = 4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Load we want to move:</th>
</tr>
</thead>
<tbody>
<tr>
<td>4800 N</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Force we have to make:</th>
</tr>
</thead>
<tbody>
<tr>
<td>50 m</td>
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</table>

<table>
<thead>
<tr>
<th>Height of the inclined plane:</th>
</tr>
</thead>
<tbody>
<tr>
<td>80 kg</td>
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</table>

### Problem E

<table>
<thead>
<tr>
<th>Length of the ramp:</th>
</tr>
</thead>
<tbody>
<tr>
<td>50 m</td>
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</table>

<table>
<thead>
<tr>
<th>Force we have to make:</th>
</tr>
</thead>
<tbody>
<tr>
<td>4800 N</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Mechanical advantage:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MA = 5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Load we want to move:</th>
</tr>
</thead>
<tbody>
<tr>
<td>50 m</td>
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</table>

<table>
<thead>
<tr>
<th>Mass of the object:</th>
</tr>
</thead>
<tbody>
<tr>
<td>80 kg</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Height of the inclined plane:</th>
</tr>
</thead>
<tbody>
<tr>
<td>50 m</td>
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</tbody>
</table>
### Problem F

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length of the ramp</td>
<td>25 m</td>
</tr>
<tr>
<td>Height of the inclined plane</td>
<td>8 m</td>
</tr>
<tr>
<td>Force we have to make</td>
<td>3700 N</td>
</tr>
<tr>
<td>Mechanical advantage</td>
<td></td>
</tr>
<tr>
<td>Load we want to move</td>
<td></td>
</tr>
<tr>
<td>Mass of the object</td>
<td></td>
</tr>
</tbody>
</table>

### Problem G

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mass of the object</td>
<td>500 kg</td>
</tr>
<tr>
<td>Length of the ramp</td>
<td>150 m</td>
</tr>
<tr>
<td>Height of the inclined plane</td>
<td>12 m</td>
</tr>
<tr>
<td>Mechanical advantage</td>
<td></td>
</tr>
<tr>
<td>Load we want to move</td>
<td></td>
</tr>
<tr>
<td>Force we have to make</td>
<td></td>
</tr>
</tbody>
</table>
**Problem H**

- Height of the inclined plane: 
- Force we have to make:  
- Mechanical advantage: MA = 8  
- Load we want to move: 
- Mass of the object: 
- Length of the ramp: 

![Diagram of an inclined plane with a height of 18 m and a force of 590000 N applied]
Worksheet 18: Screws and wedges

Name: 
Group: 
Date: 

Activity 25: Write the name of the following objects below their pictures and classify them between wedges and screws using the table in next page. If you think a device can be both simple machines, consider just the screw.

1: __________________  
2: __________________  
3: __________________  

4: __________________  
5: __________________  
6: __________________  

7: __________________  
8: __________________  
9: __________________  

10: __________________  
11: __________________  
12: __________________  

13: __________________  
14: __________________  
15: __________________
<table>
<thead>
<tr>
<th>WEDGE</th>
<th>SCREW</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td></td>
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</tbody>
</table>
Activity 26: Complete the crossword. All the words are items based on the wedge or the screw. Pictures from activity 25 can help you.

Across
4. With this device we can make a hole in the ground.
5. Thanks to this item we can see in the dark.
7. We use it to eat what we cut with number 2.
8. If you turn it properly you can join two objects.
10. In the middle ages it used to be a weapon.
13. With its teeth we can cut wood.
14. It can be full of honey, for example.

Down
1. It is a tool for opening wine bottles.
2. We use it to cut food.
3. It is very useful when you have to change a wheel.
5. It is the front of a ship.
6. With this machine you can push water up (two words).
9. If you hit it with a hammer you can join two objects.
11. It can be used to fasten a poster to the wall.
Lesson 2: The wedge
Worksheet 19: The wedge 1

Activity 27: Order the following words in each sentence and put the sentences into the correct sequence to obtain an explanation about the wedge and its shape.

Student A
the of nail. Round tip a like

Student B
also a can wedge round. be But

Student C
meet sharp planes a and edge. These form

Student D
of The inclined is adaptation an plane. wedge the

Student E
adaptation back back. to consists This inclined planes of two joined

Student F
In that case, wedges can be seen as many inclined planes beside each other around an axis.

Correct sentences

Student A: 

Student B: 

Student C: 

Student D: 

Student E: 

Student F: In that case, wedges can be seen as many inclined planes beside each other around an axis.
**Correct sequence**

<table>
<thead>
<tr>
<th>Sentence 1:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Sentence 2:</td>
<td></td>
</tr>
<tr>
<td>Sentence 3:</td>
<td></td>
</tr>
<tr>
<td>Sentence 4:</td>
<td></td>
</tr>
<tr>
<td>Sentence 5:</td>
<td></td>
</tr>
<tr>
<td><strong>Sentence 6:</strong> In that case, wedges can be seen as many inclined planes beside each other around an axis.</td>
<td></td>
</tr>
</tbody>
</table>
**Activity 28:** The following statements are similarities and differences between wedges and single inclined planes. Listen to the teacher and choose the appropriate underlined word to complete each sentence.

A. The input force is applied thickness/parallel/perpendicular to the ramp of an inclined plane, while the input force is applied thickness/parallel/perpendicular to the thickness/parallel/perpendicular of the wedge.

B. **Inclined/split/Instead** of helping you to move things to a higher level as inclined/split/instead planes do, normally wedges help you to **inclined/split/instead** things apart.

C. Although the **wedge/both/machines** is an adaptation of the inclined plane **wedge/both/machines** of them are simple **wedge/both/machines**.

D. The mechanical advantage of inclined planes and wedges is the **output/input/ratio** of the **output/input/ratio** force to the **output/input/ratio** force.

E. In both machines the **bigger/angle/smaller** the **bigger/angle/smaller**, the **bigger/angle/smaller** the mechanical advantage.

F. In use/remains/moves, an inclined plane **use/remains/moves** stationary while the wedge **use/remains/moves**.

G. Inclined force/energy/planes and wedges multiply force/energy/planes but they don’t multiply force/energy/planes.
Use the information above to fill in the Venn diagram with similarities and differences about the inclined plane and the wedge.
**Activity 29:** The mechanical advantage of a wedge can be calculated by dividing the length of the slope by its thickness \((MA = \frac{l}{t})\). Use a ruler to measure the dimensions of the wedges, find the mechanical advantage in both cases and answer the questions.
1. With which of the two wedges will be easier to split the rectangle apart? Why?

_________________________________________________________
_________________________________________________________
_________________________________________________________
_________________________________________________________
_________________________________________________________

2. What output force (L) will we get with the first wedge if we hit its thick side (t) with a 500 N force (F)? And with the second one?

_________________________________________________________
_________________________________________________________
_________________________________________________________
_________________________________________________________
_________________________________________________________

3. How deep do we have to drive the first wedge in to open a 2,5 cm crack in the rectangle? And the second one?

_________________________________________________________
_________________________________________________________
_________________________________________________________
_________________________________________________________
_________________________________________________________

4. We have seen that usually inclined planes are used to move things to a higher level and wedges are used to split things apart. Think about another application of inclined planes and wedges and give some examples.

_________________________________________________________
_________________________________________________________
_________________________________________________________
_________________________________________________________
_________________________________________________________
Lesson 3: The screw
**Activity 30**: Look up in the dictionary the following words and write the meaning in the boxes.

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cathetus</td>
<td></td>
</tr>
<tr>
<td>Hypotenuse</td>
<td></td>
</tr>
<tr>
<td>Thread</td>
<td></td>
</tr>
<tr>
<td>Screw</td>
<td></td>
</tr>
<tr>
<td>Bolt</td>
<td></td>
</tr>
<tr>
<td>Nut</td>
<td></td>
</tr>
<tr>
<td>Pitch</td>
<td></td>
</tr>
</tbody>
</table>
Activity 31: Find in the following pictures the words you have learnt in activity 30. Each word must be written just once.
Worksheet 22: The screw 2

Name: 
Group: 
Date: 

Activity 32: If you put a metal screw beside a ramp it may be hard to see the similarities, but the screw is actually just another kind of inclined plane. Follow the instructions to get a screw from an inclined plane.

a) Cut a right-angled triangle from a sheet of paper. The dimensions of the minor cathetus should be 10 cm and the length of the major cathetus should be 15 cm.

b) Use a marker to colour the hypotenuse of the triangle.

c) Position the minor cathetus of the triangle along the side of a pen.

d) Fasten the minor cathetus to the pen with a piece of adhesive tape.

e) Wrap the paper around the pen by rolling the pen.

f) Fasten the end of the triangle with a piece of adhesive tape.
**Activity 33:** To study the mechanical advantage of the screws take a bench vice, a c-clamp or any similar device. Imagine you want to use this tool to raise something up the same way we use a jack to lift a car. Look at the pictures and follow the instructions.
a) Measure the length (r) of the handle (the distance from A to B) using a ruler, a measuring tape or a calliper.

\[
\begin{array}{|c|c|c|}
\hline
\text{Measuring tape} & \text{Calliper} & r \text{ (m)} \\
\hline
\end{array}
\]

b) If you turn the handle a complete round making a force (F), point A will describe a circumference. Work out the length of the circumference (remember: \( l_c = 2 \cdot \pi \cdot r \))

\[
l_c =
\]

c) Find out the work (\( W_1 \)) you will do if you turn the handle a complete round making a 100 N force (F).

\[
W_1 =
\]

d) Measure the pitch (p) of the screw using a ruler, a measuring tape or a calliper. The pitch is the distance you lift the box (L) each time you turn the handle a complete round.

\[
\begin{array}{|c|c|c|}
\hline
\text{Measuring tape} & \text{Calliper} & p \text{ (m)} \\
\hline
\end{array}
\]
e) Conservation of energy principle says that the input work of a machine \((W_1)\) must be equal to the output work of that machine \((W_2)\). Considering an ideal system (no loss of energy) \(W_2\) will be...

\[
W_2 = \]

f) "\(W_2\)" is the needed work to move the load \((L)\) a distance "p". Find out the maximum weight \((L)\) we could lift with the screw making a 100 N force. Calculate also the maximum mass \((m)\).

\[
W_2 = \rightarrow L = \]
\[
L = \rightarrow m = \]

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Lesson 4: Assessment

\[ \sqrt{7} - 1 = x \]
Activity 34

1. Fill in the boxes of the drawing with the appropriate names.

2. A person wants to build an inclined plane to move a box to a higher lever. The height he wants to reach is 3 m. The mass of the box is 85 kg and he is able to push with a 500 N force. Work out the needed length of the ramp and the mechanical advantage of the inclined plane.
3. Write down the name of the following devices and classify them between single inclined planes, wedges and screws.

1: ______________
2: ______________
3: ______________

4: ______________
5: ______________
6: ______________

7: ______________
8: ______________
9: ______________

<table>
<thead>
<tr>
<th>INCLINED PLANE</th>
<th>WEDGE</th>
<th>SCREW</th>
</tr>
</thead>
<tbody>
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</tr>
</tbody>
</table>
4. **Match each of the following six concepts with its definition.**

<table>
<thead>
<tr>
<th>Cathetus</th>
<th>Bolt</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pitch</td>
<td>Nut</td>
</tr>
<tr>
<td>Thread</td>
<td>Hypotenuse</td>
</tr>
</tbody>
</table>

a) ____________________: the longest side of a right-angled triangle, the side opposite the right angle.

b) ____________________: helical structure used to convert between rotational and linear movement or force.

c) ____________________: screw intended to be tightened or released by torquing a nut.

d) ____________________: in a right-angled triangle either of the sides that are adjacent to the right angle.

e) ____________________: a type of fastener with a threaded hole.

f) ____________________: the distance from the crest of one thread to the next.

5. **Circle T or F to state if the sentences are true or false.**

a) T F The input force is applied perpendicular to the ramp of an inclined plane.

b) T F In use, an inclined plane remains stationary while the wedge moves.

d) T F Inclined planes multiply force and wedges multiply energy.

e) T F Wedges can’t help you to split things apart.

f) T F The wedge is an adaptation of the inclined plane.

g) T F Wedges can be round.
6. A car weighs 12000 N. To change a wheel we have to lift half of the car with a jack. The pitch of the screw is 1 cm and the length of the handle is 20 cm. Find out the force needed to lift the car and determine the mechanical advantage of the jack.
Unit 3
Levers
Lesson 1: The lever
Activity 35: The following pictures show two seesaws. The seesaw is an application of the lever. Look at the pictures, discuss with your partner and answer the questions on the next page.

Seesaw 1

Seesaw 2
1. In the first picture, why is the man up and the girl down?

2. Think about three different ways the man and the girl could balance the seesaw?

3. In the second picture, why is the small man down and the big man up?

4. What would happen if the small man moved closer to the pivoting point of the seesaw?
**Activity 36:** Listen to the teacher and fill in the gaps with the words from the box. Then read the text and label the drawing.

| pivot | fulcrum | force | lever | arm | load |

A .......... is a simple machine that consists of a rigid bar that rotates about a fixed .......... point called the .......... If you apply a .......... to a .......... it will rotate about the ..........  

The effort .......... is exerted upon one .......... .........., called .......... .......... The .......... .......... is the perpendicular distance between the .......... and the ..........  

The resisting weight or .......... is exerted upon the other .......... .........., which we will call .......... .......... The .......... .......... is the perpendicular distance between the .......... and the ..........  

![Diagram of a lever system with labeled parts]
**Activity 37:** Follow the instructions to study the law of the lever. Take photos of all the process.

**a)** Student A will be the force \( F \) and students B and C together will be the load \( L \). Be sure that students B and C together are heavier than student A.

**b)** Weigh yourself using a bathroom scale.

<table>
<thead>
<tr>
<th>Mass (kg)</th>
<th>Weigh (N)</th>
<th>Force (A)</th>
<th>Load (B+C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student A</td>
<td>( m_A ) =</td>
<td>( mg_A = )</td>
<td>( F = )</td>
</tr>
<tr>
<td>Student B</td>
<td>( m_B ) =</td>
<td>( mg_B = )</td>
<td>( \frac{mg_B}{\text{Weigh}} )</td>
</tr>
<tr>
<td>Student C</td>
<td>( m_C ) =</td>
<td>( mg_C = )</td>
<td>( \frac{mg_C}{\text{Weigh}} )</td>
</tr>
</tbody>
</table>

**c)** Go to a playground where you can find a seesaw. Take a measuring tape with you.
d) *Using the measuring tape, measure the distance between both seats and the centre of the seesaw. These distances will be the force arm \((d_1)\) and the load arm \((d_2)\).*

<table>
<thead>
<tr>
<th>Force arm (m)</th>
<th>Load arm (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(d_1 = )</td>
<td>(d_2 = )</td>
</tr>
</tbody>
</table>

e) *Each student sits on their seat. Students B and C try to sit as close as possible to each other. What happens to the seesaw?*

f) *In the picture below, the force \(F\) tries to turn the seesaw anticlockwise and the load \(L\) tries to turn it clockwise. Remember that this tendency of a force to rotate an object around an axis is called the moment of force.*

\[
M_F = F \cdot d_1 \quad M_L = L \cdot d_2
\]

*Multiply force \(F\) by its arm \(d_1\) and you will get the moment of force \((M_F)\). Multiply load \(L\) by its arm \(d_2\) and you will get the moment of load \((M_L)\).*
Choose the correct sentence and write it under the table:

<table>
<thead>
<tr>
<th>Student A goes</th>
<th>up because $M_F$ is greater than ($&gt;$)</th>
<th>$M_L$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students B and C go</td>
<td>equal to ($=$)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>smaller than ($&lt;$)</td>
<td></td>
</tr>
</tbody>
</table>

Correct sentence: ________________________________________________________

**g)** To get the seesaw balanced, both moments should be equal:

\[ M_F = M_L \]

so:

\[ F \cdot d_1 = L \cdot d_2 \]

This equation is called the law of the lever.

Mathematically, it is the same to write:

\[ \frac{d_1}{d_2} = \frac{L}{F} \]

But the ratio of load to force is the mechanical advantage of a simple machine. So:

\[ MA = \frac{d_1}{d_2} = \frac{L}{F} \]

**h)** Isolate $d_2$ in the law of the lever and you will find out the distance you have to locate the load to balance the seesaw.

\[ d_2 = \]
i) Check the result changing the position of students B and C to the new distance $d_2$.

![Diagram of a seesaw with forces and moments]

$$MF = F \cdot d_1$$

$$ML = L \cdot d_2$$

j) Work out the mechanical advantage of the seesaw with the new distance $d_2$.

$$MA =$$

k) Fill in the gaps with the appropriate words and you will get some conclusions:

Thanks to the .......... we can move a big .......... (students B and C) making a small .......... (student A) because the force .......... ($d_1$) is much longer than the load .......... ($d_2$).

The shorter the load .......... ($d_2$), the smaller the .......... ($F$) needed to lift the ..........($L$). The longer the force .......... ($d_1$), the bigger the .......... ($L$) we can lift.

The .......... .......... (MA) of a .......... is the ratio of the .......... arm ($d_1$) to the load .......... ($d_2$).

l) Using the pictures you have taken and the results of the activity, prepare a 5 minute slideshow for the following day
Lesson 2: **Classes of levers**
Activity 38: Levers are divided into three classes, according to the relative situation of the fulcrum, the load and the force. Look at the pictures and answer the questions below.

1. Draw on the photo of the seesaw all the elements of the lever (fulcrum, force, load, force arm and load arm)

2. In a first class lever…
   a) the load is situated between the fulcrum and the force.
   b) the fulcrum is situated between the force and the load.
   c) the force is situated between the load and the fulcrum.

3. In a first class lever…
   a) the force arm is never smaller than the load arm.
   b) the force arm is never bigger than the load arm.
   c) the force arm can be bigger, equal to or smaller than the load arm

4. In a first class lever…
   a) the mechanical advantage could be bigger than 1, smaller than 1 or 1.
   b) the mechanical advantage is never bigger than 1.
   c) the mechanical advantage is never smaller than 1.

5. With a first class lever we can…
   a) multiply just distance and speed.
   b) multiply force or distance and speed.
   c) multiply just force.
1. Draw on the photo of the wheelbarrow all the elements of the lever (fulcrum, force, load, force arm and load arm).

2. In a second class lever…
   a) the load is situated between the fulcrum and the force.
   b) the fulcrum is situated between the force and the load.
   c) the force is situated between the load and the fulcrum.

3. In a second class lever…
   a) the force arm is never smaller than the load arm.
   b) the force arm is never bigger than the load arm.
   c) the force arm can be bigger, equal to or smaller than the load arm.

4. In a second class lever…
   a) the mechanical advantage could be bigger than 1, smaller than 1 or 1.
   b) the mechanical advantage is never bigger than 1.
   c) the mechanical advantage is never smaller than 1.

5. With a second class lever we can…
   a) multiply just distance and speed.
   b) multiply force or distance and speed.
   c) multiply just force.
1. Draw on the photo of the fishing rod all the elements of the lever (fulcrum, force, load, force arm and load arm).

2. In a third class lever...
   a) the load is situated between the fulcrum and the force.
   b) the fulcrum is situated between the force and the load.
   c) the force is situated between the load and the fulcrum.

3. In a third class lever...
   a) the force arm is never smaller than the load arm.
   b) the force arm is never bigger than the load arm.
   c) the force arm can be bigger, equal to or smaller than the load arm.

4. In a third class lever...
   a) the mechanical advantage could be bigger than 1, smaller than 1 or 1.
   b) the mechanical advantage is never bigger than 1.
   c) the mechanical advantage is never smaller than 1.

5. With a third class lever we can...
   a) multiply just distance and speed.
   b) multiply force or distance and speed.
   c) multiply just force.
### Activity 39: The following items are examples of levers. Use the dictionary to translate them into Catalan.

<table>
<thead>
<tr>
<th>ENGLISH</th>
<th>CATALAN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scissors</td>
<td>Paper cutter</td>
</tr>
<tr>
<td>Hole punch</td>
<td>Tweezers</td>
</tr>
<tr>
<td>Broom</td>
<td>Crowbar</td>
</tr>
<tr>
<td>Pincers</td>
<td>Shovel</td>
</tr>
<tr>
<td>Scales</td>
<td>Can opener</td>
</tr>
<tr>
<td>Wheelbarrow</td>
<td>Stapler</td>
</tr>
<tr>
<td>Tongs</td>
<td>Bicycle brake</td>
</tr>
<tr>
<td>Nutcracker</td>
<td>Seesaw</td>
</tr>
<tr>
<td>Pliers</td>
<td>Oar</td>
</tr>
<tr>
<td>Fishing rod</td>
<td>Bottle opener</td>
</tr>
<tr>
<td>Fire extinguisher handle</td>
<td>Arm lifting a weight</td>
</tr>
</tbody>
</table>
**Activity 40:** Choose five devices which are levers or can be used as levers and that we can find at home, at school or somewhere else. Take a picture of them. Prepare a 5 minute slideshow presentation for the following day. You need to explain what class of lever your items are. You also have to show on the pictures all the elements of the levers (fulcrum, force, load, force arm and load arm).

**Activity 41:** Classify the levers from activity 39 according to the class of lever they are. Some of the examples can be different classes of lever depending on the way we use them.

<table>
<thead>
<tr>
<th>First class levers</th>
<th>Second class levers</th>
<th>Third class levers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tbody>
</table>
Worksheet 28: Lever problems

Activity 42: Solve the following problems.

You may need this vocabulary:

First we calculate… Then we… After that…
The answer is… The unknown is… We isolate…
equals / is equal to times / multiplied by over / divided by
If we want to work out X… If we want to find out Y…

Problem A
The force arm of a lever is 4 m long and the length of the load arm is 1 m. Calculate the force $F$ needed to lift a 1000 N load and find out the mechanical advantage of the lever.

Problem B
The force arm of a lever is 2 m long and the length of the load arm is 80 cm. Work out the weight we can lift making a 200 N force and calculate the mechanical advantage of the lever.
Problem C
The force arm of a lever is 1.5 m long. We want to lift a 2500 N weight applying a 1200 N force. Find out the length of the load arm needed and work out the mechanical advantage of the lever.

Problem D
The load arm of a lever is 0.5 m long. We want to lift a 4000 N weight applying a 500 N force. Find out the length of the force arm needed and work out the mechanical advantage of the lever.
Lesson 3: Wheel and axle
**Worksheet 29: Wheel and axle**

<table>
<thead>
<tr>
<th>Name:</th>
<th>Group:</th>
<th>Date:</th>
</tr>
</thead>
</table>

**Activity 43:** The pictures show different applications of the simple machine called wheel and axle. Match the pictures with the names.

- steering wheel
- bicycle
- windlass
- coffee grinder
- pepper mill
- water tap
- gears
- Ferris wheel
Activity 44: The bended bar can turn around the hole of the triangle. A force (F) is applied to lift a load (L). The distance between the force and the fulcrum is $d_1$. The distance between the load and the fulcrum is $d_2$.

a) What kind of simple machine is it?

b) How could you find out its mechanical advantage?

c) Follow the instructions to obtain the simple machine called wheel and axle. Draw it on next page.

- Draw two circumferences with a compass. The centre of the first circumference should be point B and its radius should be equal to $d_1$. The centre of the second circumference should be point A and its radius should be equal to $d_2$.

- Give some thickness to the big circumference (2 or 3 cm). This circumference will be the wheel.

- Enlarge the small circumference as a cylinder till it reaches the big one. The cylinder will be the axle.
**Activity 45:** Find and write down the end of the sentences by asking to your partners.

a) The wheel and axle is a…

b) The wheel and axle is a simple machine consisting…

c) When the wheel turns,…

d) If the wheel turns and the axle remains stationary, …

e) When the force is applied…

f) The mechanical advantage of a wheel and axle is…

g) Some examples of the wheel and axle are…
**Given to students cut up** (one card to each member of the group)

<table>
<thead>
<tr>
<th>…first class lever that can turn 360°.</th>
</tr>
</thead>
<tbody>
<tr>
<td>…of a big wheel rigidly attached to a smaller wheel called an axle.</td>
</tr>
<tr>
<td>…the axle also turns, and vice versa.</td>
</tr>
<tr>
<td>…it is not a wheel and axle machine.</td>
</tr>
<tr>
<td>…to the wheel in order to turn the axle, force is increased and distance and speed are decreased.</td>
</tr>
<tr>
<td>…the ratio of the radius of the wheel to the radius of the axle.</td>
</tr>
<tr>
<td>…a door knob, a screwdriver, and the steering wheel of an automobile.</td>
</tr>
</tbody>
</table>
Lesson 4: Pulleys
Worksheet 30:  The pulley

Name:

Group:  Date:

Activity 46: Listen to the teacher and take notes about the pulley.

What is a pulley?

Examples of pulleys

Different types of pulleys
<table>
<thead>
<tr>
<th>Pulley Type</th>
<th>Diagram</th>
<th>Equation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fixed pulley</td>
<td><img src="image1" alt="Fixed pulley diagram" /></td>
<td>MA = ( \frac{L}{F} ) = n</td>
</tr>
<tr>
<td>Movable pulley</td>
<td><img src="image2" alt="Movable pulley diagram" /></td>
<td></td>
</tr>
<tr>
<td>Compound pulley</td>
<td><img src="image3" alt="Compound pulley diagram" /></td>
<td></td>
</tr>
</tbody>
</table>
Activity 47: Solve the following problems.

You may need this vocabulary:

First we calculate… Then we… After that…
The answer is… The unknown is… We isolate…
equals / is equal to times / multiplied by over / divided by
If we want to work out X… If we want to find out Y…

Problem A

A block and tackle has two movable pulleys. Calculate the force needed to lift a 1600 N weight and find out the mechanical advantage of the machine.

Problem B

A block and tackle has three movable pulleys. Find out the load we can lift applying a 600 N force and work out the mechanical advantage of the machine.
**Problem C**

We want to lift a 8200 N weight applying a 820 N force. Find out the mechanical advantage needed. How many movable pulleys will we need?
Lesson 5: Assessment

\[ \sqrt{7} - 1 = x \]
Activity 48: Discuss with your partner, design a new corkscrew and write a report by answering the questions below.

1. To open a bottle of wine with this corkscrew we use more than one simple machine. Identify in the picture four different simple machines.

2. To open bottles more easily we could improve the mechanical advantage of the corkscrew. Explain what changes you would make to the simple machines involved in order to get a bigger mechanical advantage.

3. Draw your new corkscrew. Write down the size of all its parts.

4. Calculate the mechanical advantage of three simple machines of your corkscrew.

5. What problems could we have if we try to get a too big mechanical advantage?