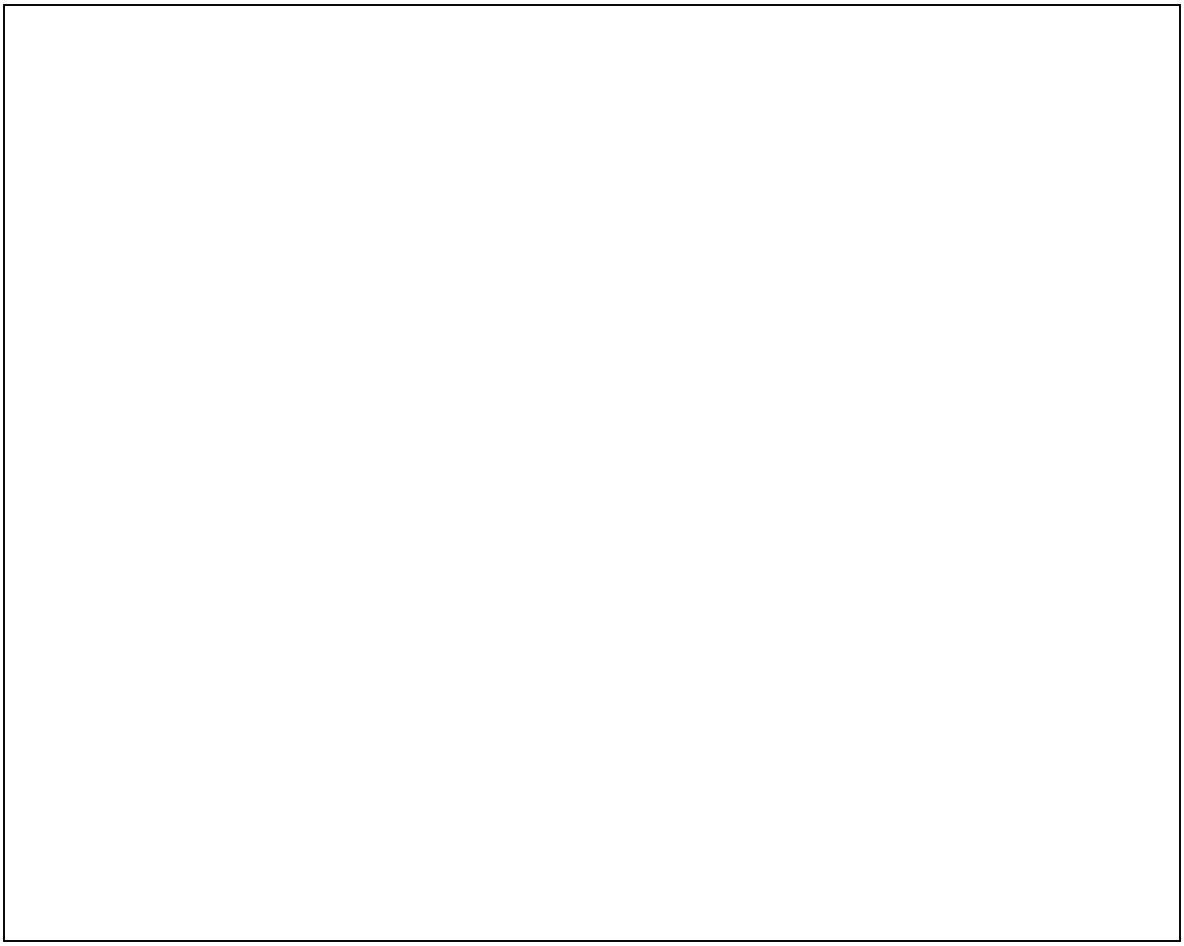
Grade 8 Lab Notebook

Science in Action 8

Index of Investigations, Challenges and Activities

Mechanical Systems

Give it a **TRY** **EMERGENCY!** (p.256)



Emergency **R**obotic **E**nvironmental **R**esponse **U**nit

Inst4uctions:

_____

_____

_____

_____

_____

_____

_____

_____

Activity D-1 ***Inquiry*** **The Right Machine For The Right Job**

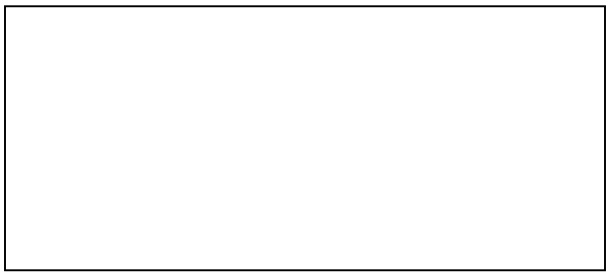
Problem: Which simple machine requires the least amount of force to lift a 1 kg mass?

Hypothesis:

_____

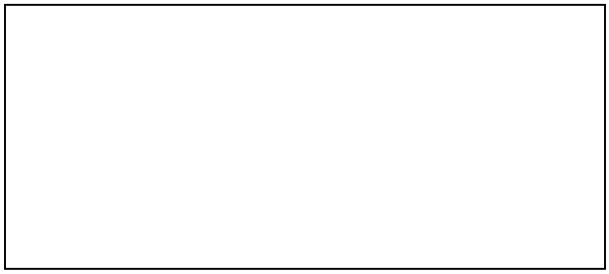
_____

Station 1



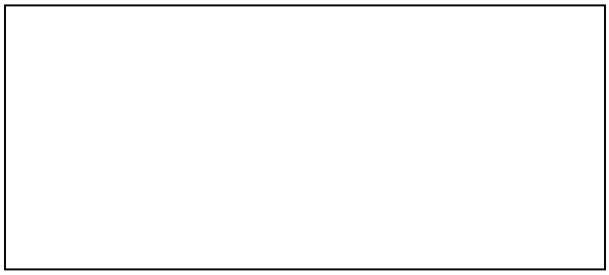
Force needed ____ N

Station 2



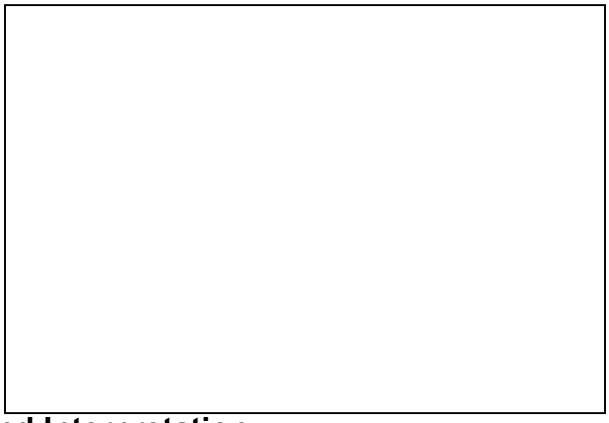
Force needed ____ N

Station 3



Force needed ____ N

Station 4



1st Class **Force needed ____ N**

2nd Class **Force needed ____ N**

3rd Class **Force needed ____ N**

Analysis and Interpretation

12.

_____

_____

_____

13. **a)**

_____

_____

b)

_____

_____

14.

_____

_____

_____

15.

_____

_____

_____

Conclusion:

16.

_____

_____

_____

_____

_____

_____

Give it a **TRY ANALYZING A MECHANICAL DEVICE!** (p.271)

The function of the pencil sharpener is _____

_____

_____

Subsystems of the Pencil Sharpener | Simple Machine within each subsystem

_____ _____

_____ _____

_____ _____

_____ _____

How do the subsystems work together to make the device perform its function?

_____

_____

_____

Activity D-2 *Inquiry* Bicycle Gears

Problem: What are the differences among three different gears on a bicycle?

Hypothesis:

_____

_____

____

Data Collection:

Gear	Front Sprocket: No. of Teeth	Rear Sprocket: No. of Teeth	Radius of rear wheel	Radius of pedal	No. of back wheel turns
Lowest Gear					
Middle Gear					
Highest Gear					

9. Gear Ratios:

Gear	Front Sprocket: No. of Teeth	Rear Sprocket: No. of Teeth	Gear Ratio
Lowest Gear			
Middle Gear			

Highest Gear			

10. Linear Distance:

Radius of pedal	**Circumference (radius x 2π)**	**Linear Distance**
Lowest Gear		
Middle Gear		
Highest Gear		

11. Linear Distance:

Radius of rear wheel	**Circumference (radius x 2π)**	**Linear Distance**
Lowest Gear		
Middle Gear		
Highest Gear		

12.

Gear	**Distance rear wheel travels with one complete turn of the pedal**		
Lowest Gear			
Middle Gear			
Highest Gear			

13.

	Circumference of pedal's circle / Distance traveled by the rear wheel	**Ratio**
Lowest Gear		
Middle Gear		
Highest Gear		

14. Ratio Comparisons (Question 9 and 13)

Lowest Gear _____

Middle Gear _____

Highest Gear _____

15. Low Middle High _____

_____

16. Conclusion _____

_____

_____

_____

Try This At Home How Many Machines Are In Your Home? (p. 276)

Machine	Function (Task it performs)	Source of Energy

The most common source of energy is _____

Label (▲) the machines included in your story about …

A Typical School Day Without Machines

_____

Activity D-3 P***roblem Solving*** **Building A Mechanical System** (p.283)

Problem: Using 2 simple machines can you create a mechanical system to lift a 1.5 kg mass 30 cm with the greatest possible mechanical advantage?

Hypothesis:

Specifications:

- Consists of two easily identified simple machines
- Raises the 1.5 kg mass 30 cm
- Spring scale measures force needed

Blueprint:

Materials List:

Action:

Communicate:

5. _____

_____

6. _____

_____

7. _____

_____

_____

_____

Give it a **TRY** **Work Input and Work Output** (p.291)

You do **9.8J** of work when you lift a 1 kg mass, 1 metre.

[Use the pulley described, a 1 kg mass, a spring scale and a metre-stick]

Calculate the **work input and work output** when you use **a single pulley**

Calculate the **work input and work output** when you use **a double pulley**.

Are Work Inputs and Outputs different in the pulley systems you tested? YES NO

_____

_____

_____

Activity D-4 ***Inquiry*** **Mechanical Advantage in a Hydraulic Jack** (p.296-297)

Problem: How does pressure create mechanical advantage in a hydraulic jack?

Hypothesis:

_____

_____

10. Data Collection Table:

Area of the plunger		***Force Needed***
Plunger pushed on	**Plunger supporting 1 kg mass**	
Plunger in 50 ml syringe	Plunger in 50 ml syringe	control
Plunger in 50 ml syringe	Plunger in 10 ml syringe	
Plunger in 10 ml syringe	Plunger in 50 ml syringe	

Analyzing and Interpreting:

11. _____

_____

12. _____

_____

13. a)

b) _____

c) _____

Conclusion:

14. _____

_____

Activity D-5 ***Experiment On Your Own*** **Build A Water Driven Device** (p.301)

Problem: How can you construct a mechanical device driven by water that can lift a mass a vertical distance of 10 cm?

Hypothesis:

_____

_____

_____

Specifications:

- Must be driven by water power
- Must utilize the spool and string assembly provided by the teacher
- Must combine simple machines to attach to the lifting mechanism

Plan / Blueprint:

Troubleshooting:

1	
2	
3	
4	

Largest mass _____ Estimated Mechanical Advantage _____

Activity D-6 ***Decision Making Activity*** **Evaluating A Mechanical Device** (p.313)

Issue: How can you determine if mechanical devices you use are worth the cost?

Criteria: ___Cost___ ___Energy Efficiency___

___Environmental Impact___ ___Appearance___

___Ease of use___ ___Comfort___

Specifications: A **Snowmobile** is a new device that has just been invented and introduced into the marketplace. You are a product tester. Will you recommend people buy it?

Develop your testing Criteria:

_____
_____

_____

_____

Test The Snowmobile, using Your Criteria:

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Support Your Evaluation:

_____

_____

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_____

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_____

Try This At Home **Choosing A New Set Of Wheels** (p. 314)

Scooters – Skateboards – Roller Blades

Which is the best one?

How Can You Determine Which Device Is The Best Transportation Device to Buy?

Criteria:

Choose one of the devices and provide **a detailed timeline** (using INSPIRATION) that helps to describe when, how and why they were developed. (**Attach on a separate page**)

Complete **a survey** of your class or school and identify their reasons for choosing a particular transportation device (set of criteria).

Scooters	Skateboards	Roller Blades

SCIENCE WORLD

Case Study

Living With A Machine

Determining the IMPACT of a Machine – The Automobile – on us.

What new technologies should be developed for the automobile?

What restrictions should be placed on the automobile?

What steps should be taken to determine the impacts of new technologies on people and on the environment, before the technology is made available to the consumer?

Six Simple Machines

1. **lever**: changes direction or amount of force
2. **pulley**: changes amount and/or direction of force
3. **wheel and axle**: changes amount of force
4. **inclined plane**: changes amount of force
5. **screw**: changes amount of force

6. **wedge**: changes amount of force

Machine is a device that makes work easier.

Simple Machine is a device that does work with only one movement.

- machines increase the force exerted by a person on an object
- machines cannot increase the amount of work done

All simple machines are variations of two types: **lever** and **inclined plane**

Two forces are involved when a machine is used to do work.

Effort Force (F_e): The force applied to the machine.

Resistance Force (F_r): The force applied by the machine to overcome resistance due to gravity or friction.

example: prying a lid off a paint can

force applied to handle of screwdriver = effort force

force applied to lid by the screwdriver = resistance force

Two kinds of work done when a machine is used

Recall: $W = F \times d$

Work input (W_{in}): Work done on the machine

Produced by the effort force **(F_e)** through a distance **(d_e)**

therefore: $\mathbf{W_{in} = F_e \times d_e}$

Work output (W_{out}): Work done by the machine

Produced by the resistance force **(F_r)** through a distance **(d_r)**

therefore: $\mathbf{W_{out} = F_r \times d_r}$

Energy is always conserved. $\mathbf{W_{in}}$ must equal or be less than $\mathbf{W_{out}}$.

Energy is lost due to friction.

Ideal Machine: A machine in which work input equals work output.

$$\mathbf{W_{in} = W_{out}}$$

$$\mathbf{F_e \times d_e = F_r \times d_r}$$

Most cases, a machine multiplies a force. So...

$\mathbf{F_r > F_e}$ and $\mathbf{W_{in}}$ must equal $\mathbf{W_{out}}$ therefore $\mathbf{d_e > d_r}$

example: Paint can lid

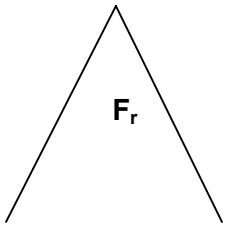
- force applied by you on screwdriver less than force applied to lid
- distance you moved the handle greater than distance moved by lid

Mechanical Advantage (MA):

-The number of times a machine multiplies the effort force

- To calculate, divide the resistance force by the effort force

$$\mathbf{MA = \frac{\text{resistance force } (F_r)}{\text{effort force } (F_e)}}$$



$$MA * F_e$$

Some machines don't multiply force. They change direction of F_e. **MA = 1**

example: flag pole, window blinds

Machines with **MA < 1** increase distance moved or speed

example: rowing a boat

Compound Machine: A combination of two or more simple machines.

example: a bicycle

Can you locate the effort force and resistance force on the bicycle?

Efficiency: A measure of how much of the work put into a machine is changed to useful work put out by a machine.

$$\textbf{Efficiency} = \frac{W_{out}}{W_{in}} \times 100\% = \frac{F_r \times d_r}{F_e \times d_e} \times 100\%$$

Only ideal machines are 100% efficient and they don't exist.

To increase the efficiency of a machine you need to decrease friction.

Power is a measure of the amount of work done in a certain amount of time. To calculate, divide the work done by the time required to do the work.

$$\text{power} = \frac{\text{work}}{\text{time}} = \frac{W}{t} = P$$

Power is measured in **watts (W)**, named for James Watt, inventor of the steam engine.

1 watt = 1 joule / s

(power used to raise a glass of water from knees to mouth in 1 sec.)

1 watt is very small, so another common measurement is used:

1000 watts = 1 kW (kilowatt)