Grade 8

Science Focus

Lab Workbook

Unit 4
Mechanical Systems

Developed by Dave Durrant

Edquest Resources 2001

Levers in Action

Investigation 4-A
Page 272 - 273

Problem: How does changing the position of the fulcrum affect the effort force in different levers?

Hypothesis: _____

_____ .

Investigative Procedure: Follow the directions outlined on pages 272 - 273

Data Collection:

Position of Load	Type of Lever	Effort Force Required … (Description)
P_1	Class 1	
P_2	Class 1	
P_3	Class 1	
P_1	Class 2	
P_2	Class 2	
P_3	Class 2	
P_1	Class 3	
P_2	Class 3	
P_3	Class 3	

Analysis of Data:

1. **(a)** _____

   (b) _____

2. _____

   _____

3. manipulated variable(s) _____

   responding variable(s) _____

4. _____

   _____

   _____

Lab Investigation 4-A submitted by _____ _____

Date _____

Gearing Up For Speed

Investigation 4-B
Pages 290 - 291

Problem: How does the speed ratio change as you switch between different gears on a bicycle, and how does this affect the force you need to pedal the bicycle?

Hypothesis: _____

_____

_____ .

Investigative Procedure: Follow the directions outlined on pages 290 - 291

Data Collection:

Title: _____

Number of Teeth	Front Sprockets		
	1	2	3
1			
2			
3			
4			
5			
6			

Analysis of Data:

1. _____

_____

2. high gear is _____

_____

low gear is _____

_____

3. _____

_____

Conclude and Apply:

4. _____

_____

_____

5. _____

_____

_____

6. _____

_____

_____

Bicycle Gears

Derailer

Lab Investigation 4-B submitted by _____ _____

Date _____

Pick It Up !

Investigation 4-C
Page 294

Problem: What is the best design of a prototype for a **crane**, to lift a **load of 12 N** with an **effort force of 4 N**?

Hypothesis: _____

_____ .

Plan and Construct: **(Directions given on page 294 – Science Focus Textbook)**

Step 1 – Discuss various designs that can accomplish the task
Step 2 – Select the materials to use for your prototype from the materials provided
Step 3 – Get permission to build your prototype (Teacher's approval)
Step 4 – Draw a Blueprint, identifying component parts and their functions
Step 5 – Construct your prototype
Step 6 – Test your prototype

Blueprint:

Evaluate:

1. _____

_____

_____

_____

_____

2.

Problem Encountered	Modification Made	Result

Recommendations:

_____

_____

_____

_____

_____

_____

_____

Lab Investigation 4-C submitted by _____ _____

Date _____

Easy Lifting

Investigation 4-D
Pages 300 - 301

Problem 1: How can you calculate the mechanical advantage of a compound pulley?

Hypothesis: _____

_____ .

Problem 2: How can you test the efficiency of a pulley system?

Hypothesis: _____

_____ .

Investigative Procedure: Follow the directions outlined on pages 300-301

Data Collection: (Table Title) _____

Trial	Load	Effort	Number of Ropes
A			
B			
C			
D			
E			

Analysis:

1. **Analysis Table Title** _____
2. **(Calculate the Mechanical Advantage and complete the column in the table)**
3. **(Record # of Ropes column in the Analysis table below)**

Trial	Number of Ropes	Mechanical Advantage
A		
B		
C		
D		
E		

4. manipulated variable_____

responding variable_____

controlled variables were _____

_____

<u>Conclude and Apply</u>:

5. _____

_____

_____

6. Efficiency for the Compound pulley in Trial E is _____

Calculation of Efficiency

Lab Investigation 4-D submitted by _____ _____

Date _____

Egg Drop

Investigation 4-E
Page 306

Problem: How can you design and build a structure that will protect (prevent it from cracking) a raw egg that is dropped from a height of 2 m?

Hypothesis: _____

_____ .

Design Specifications:

- no more than 50 straws and 1 m of masking tape
- egg must be dropped from a height of at least 2m
- cracks or complete breakage will result in failure of the structure

Plan and Construct: **(Directions given on page 306 – Science Focus Textbook)**

Step 1 – Discuss various designs that can accomplish the task
Step 2 – Select the materials to use for your prototype from the materials provided
Step 3 – Get permission to build your prototype (Teacher's approval)
Step 4 – Draw a Blueprint, identifying component parts and their functions
Step 5 – Construct your prototype
Step 6 – Test

Blueprint:

Evaluate:

1. _____

   _____

   _____

   _____

   _____

2.

Problem Encountered	Modification Made	Effect

Extend Your Skills:

1. _____

   _____

   _____

2. _____

   _____

   _____

   _____

Lab Investigation 4-E submitted by _____ _____

Date _____

What a Lift !

Challenge: Can you calculate how much force, using a hydraulic lift, is needed to lift a minivan, without actually doing it?

Think About It (p. 310) (This will give you the background information you need)

What To Do:

Estimation and Reflection

Analysis:

Show your Estimated Calculations:

1. _____

_____

2. _____

_____

Lab Investigation 4-F submitted by _____ _____

Date _____

Build Your Own Hydraulic Lift

Investigation 4-G
Page 311

Challenge: Design and build a model of a hydraulic lift that will exert a large enough force on a load when you exert a small force on the lift. To make it more interesting, see if your design will incorporate

Design Specifications:

- your lift must exert a force in one place when you exert a force in a different place
- no air bubbles (in tubing or syringes)
- an observable mechanical advantage must be evident

Plan and Construct: **(Directions given on page 311 – Science Focus Textbook)**

Step 1 – Discuss various designs that can accomplish the task
(predict an arrangement that will allow you to balance the 250g and 1 kg masses on the two modified syringes)
Step 2 – Decide on a design that will attempt to raise the 1kg mass with the least force
(test your design)
Step 3 – Build your prototype
Step 4 – Draw a Blueprint, identifying component parts and their size specifications
Step 5 – Test your design

Blueprint:

Evaluate:

1. _____

_____

2. _____

_____

_____

Problem Encountered	Modification Made	Effect

Extend Your Skills:

3. _____

_____

_____

_____

4. _____

_____

_____

_____

Lab Investigation 4-G submitted by _____ _____

Date _____

Comparing Pressure Exerted on a Gas and on a Liquid

Investigation 4-H
Pages 314 - 315

Problem: What happens when you exert the same amount of pressure on a gas and on a liquid?

Hypothesis: _____

_____ .

Investigative Procedure: Follow the directions outlined on pages 314 - 315

Data Collection:

Trial	Syringe 1 (Water) Time (s)	Syringe 2 (Air) Time (s)
Prediction		
Closed 1		
Closed 2		
Closed 3		
Prediction		
Open 1		
Open 2		
Open 3		

Analyze:

1. _____

_____

2. _____

_____

3. _____

_____

4. manipulated variable_____

responding variable_____

controlled variables were _____

_____

Conclude and Apply:

5. _____

_____

_____

_____

6. _____

_____

_____

_____

_____

Lab Investigation 4-H submitted by _____ _____

Date _____

How Silly Can It Be?

Investigation 4-I
Page 328

Think About It: Are machines always practical? What about the one pictured on **p. 328**?

Thoughts: _____

_____

_____

What To Do: Follow the directions outlined on page 328:

My Rube Goldberg Device

Analyze:

1. _____

_____

_____

_____

_____

2. _____

_____

_____

_____

_____

_____

_____

_____

_____

3. Partner's comments:

_____

_____

_____

_____

_____

4. Optional Application

Lab Investigation 4- I submitted by _____ _____

Date _____

New, Improved Robots Required!

Challenge: Can you design a robot arm by applying what you have learned from Topics 1-6?

Design Specifications:

- your robot arm must be **powered**
- must be able to pick up a container and move it **10cm** and drop it
- this powered action must be done in **less than 1 min**.
- the robotic arm must be able to **move up and down** as well as from **side to side**
- it must have an **operational jaw mechanism**
- **three different mechanisms** must be combined in the working prototype (model)
- you are **not allowed to touch the device** during **pickup, transport or unloading**

Plan and Construct: **(Directions given on page 311 – Science Focus Textbook)**

Step 1 – Discuss various designs that can accomplish the task
(predict which design will allow you to meet all the specifications)
Step 2 – How will your arm manoeuvre and stop?
Step 3 – Build your prototype
Step 4 – Draw a Blueprint, identifying component parts and their size specifications
Step 5 – Test it (does it balance the load?)

Blueprint

Evaluate:

Problem Encountered	Modification Made	Effect

1. _____

_____

2. _____

_____

_____

3. _____

_____

_____

_____

4. _____

_____

_____

_____

Lab Investigation 4- J submitted by _____ _____

Date _____

The Real Costs (Alternative to Bicycles)

Think About It

(Choosing the most **AWESOME Skateboard**)

	Model / Type	Cost	Other Features
Deck			
Wheels			
Trucks			
Bearings			
Stickers			
Safety Equipment			
	Budget	**$200**	

Criteria used to make final selection of each component needed to make your Skateboard:

_____

_____

_____

What it looks like …

Lab Investigation 4- K submitted by _____ _____

Date _____