SASTA OLIPHANT SCIENCE AWARDS

SOUTH AUSTRALIAN SCIENCE TEACHERS ASSOCIATION

Prize Winner

Models & Inventions

Year 3-4

Max Blairs

Grange Primary School

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Australian Government
Department of Defence

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Department for Education

SASTA South Australian Science Teachers Association

Hydraulic Bridge

By Max Blairs

Grange Primary School

_use me

The Science of Hydraulics

Hydraulics works on the principle that liquids can't be compressed so the pressure is the same. If you try to compress liquids the liquid just moves somewhere else.

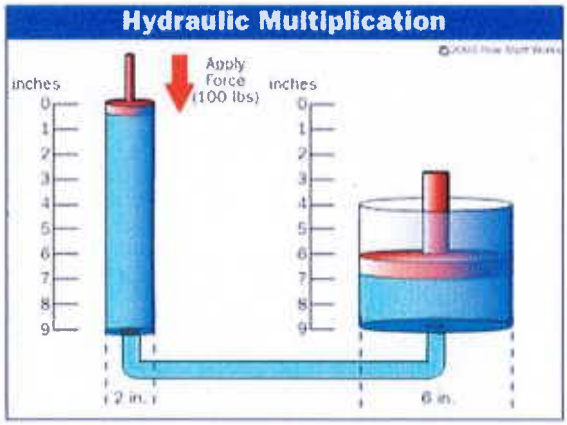
You can use two different size cylinders to change the force at each end of the cylinder. The pressure is the same at each end because of the liquid, but the force produced by the larger cylinder is greater than the force in the smaller cylinder.

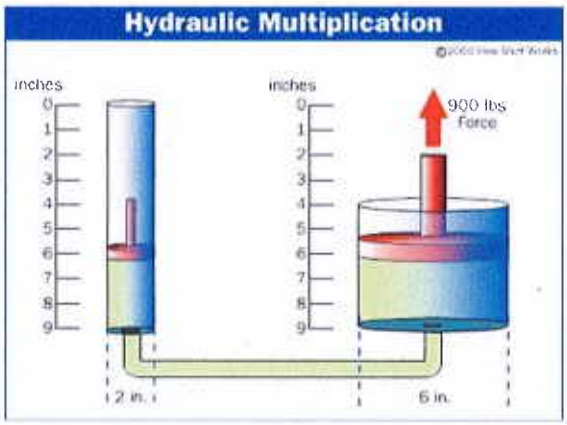
This can be used so that a small force from small cylinder can be used to create a large force in the large cylinder.

An example of this is a hydraulic drawbridge.

I decided to make a model hydraulic drawbridge to test this out.

I used different size syringes to test this out.





hydraulic_multiplication_2_IMG3.jpg (884×309) (lubescience.com)

Construction of the Drawbridge

First I did a rough sketch of the drawbridge.

Then I (with the help of my dad) worked out the different measurements for the pieces.

Then we went to Bunnings and bought a big plank of wood and asked them to cut it.

Then I measured the tunnel for cars to go through and we cut it out. I did the drilling. My dad cut the straight lines with a jigsaw.

I then glued all the pieces together.

Then we connected the hinges to the tower and connected the bridge pieces to the hinges.

Last we screwed the towers onto the base. I did the drilling with the help of my dad.

After we added the hydraulics I decorated the towers and the base.

Addition of the Hydraulics

Next I had to attach the hydraulics to the outside of the towers to make the bridge go up and down.

I measured that I wanted the syringes to lift the bridge about 5mm-10mm.

We did some experiments to see how much fluid we needed in the syringes and what was the best combination to make the bridge move 5mm-10mm

Parts and Equipment

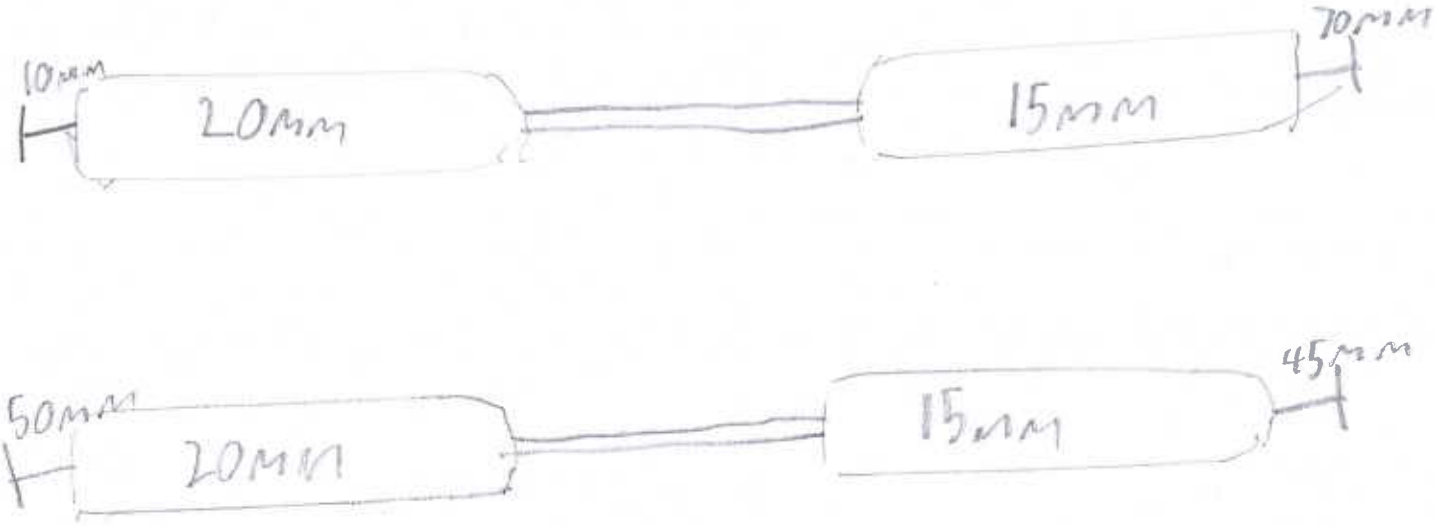
- 8 x sides of plywood [260x120mm]
- 8 x support beams of wood [20x20mm] x 260mm long
- 2 x base supports of wood [20x40mm] x 700mm long
- 2 x hinges
- Glue
- Syringes
- 3mm pipe
- 1 x t-connector
- Paint [green, brown and black]
- 8 x printed brick pictures
- 2 x cars [mini]

Experiment 1
1 Fat Master And 1 Skinny Slave

Equipment

1 x master syringe 20mm diameter
1 x slave syringe 15mm diameter
1 x tube 3mm

Experiment



40mm = 25mm

Observation

1. 25mm movement on master = 40mm movement on slave.
2. Easier to push slave than master Less force required.

Experiment 2
1 Skinny Master And 2 Fat Slaves

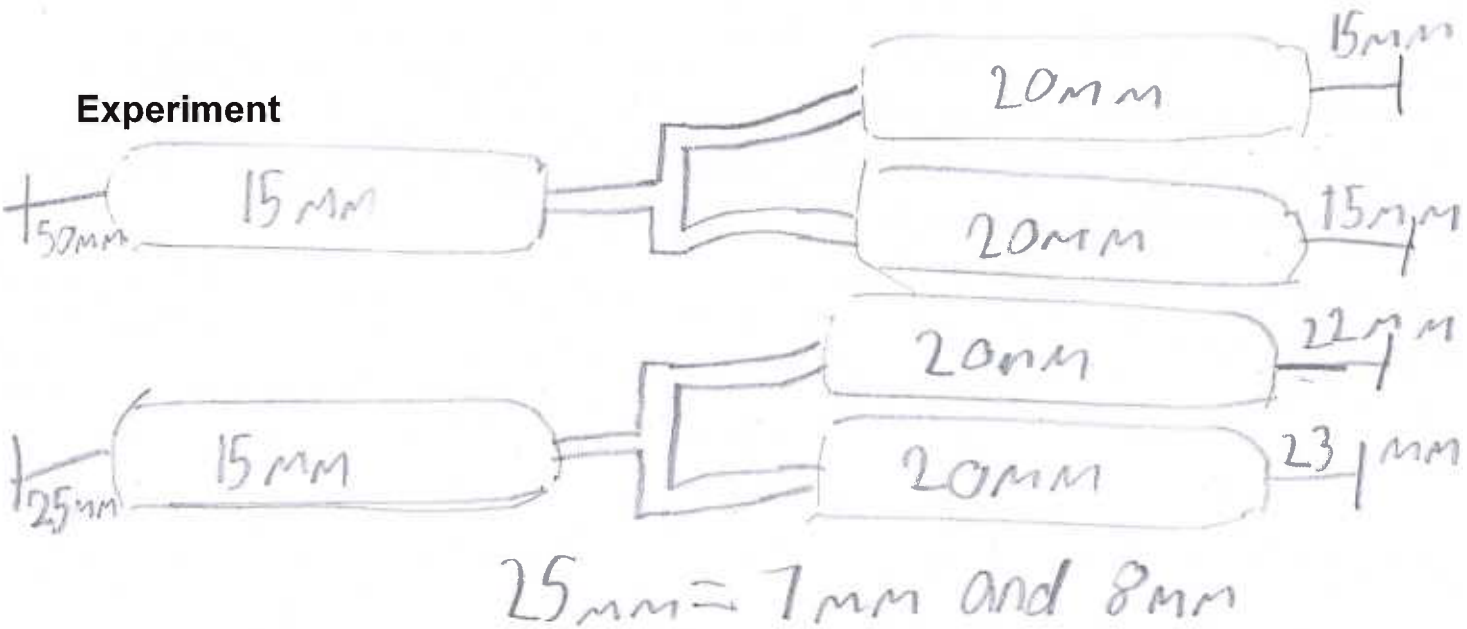
Equipment

1 x master syringe 15mm diameter
2 x slave syringe 20mm diameter
3 x tubes 3mm
1 x t-connector 3mm

Hypothesis

25mm movement on master = 12.5mm movement on each slave

Experiment



Observation

1. 25mm movement on skinny master = 7mm and 8mm movement on each fat slave

Experiment 3
1 Skinny Master And 2 Fat Slaves

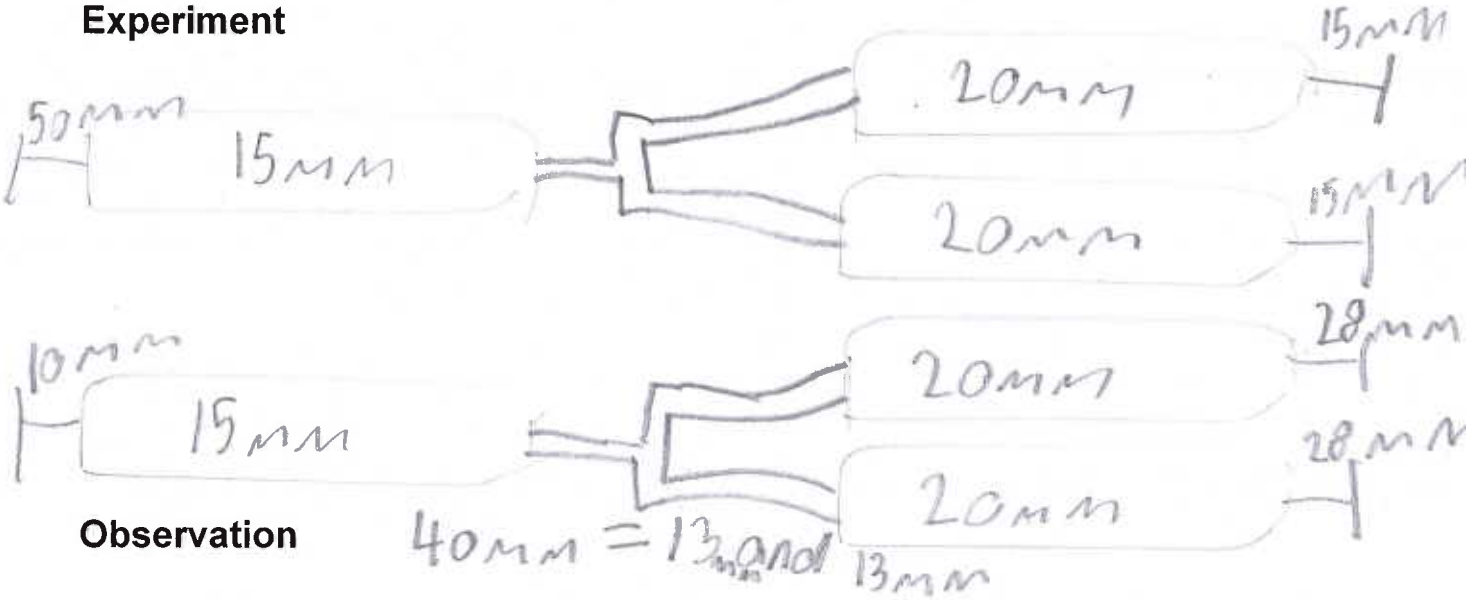
Equipment

1 x master syringe 15mm diameter
2 x slave syringe 20mm diameter
3 x tubes 3mm
1 x t-connector 3mm

Hypothesis

40mm movement on master = 20mm movement on each slave

Experiment



Observation

1. 40mm movement on skinny master = 13mm movement on each fat slave.

Experiment 4
1 Fat Master And 2 Skinny Slaves

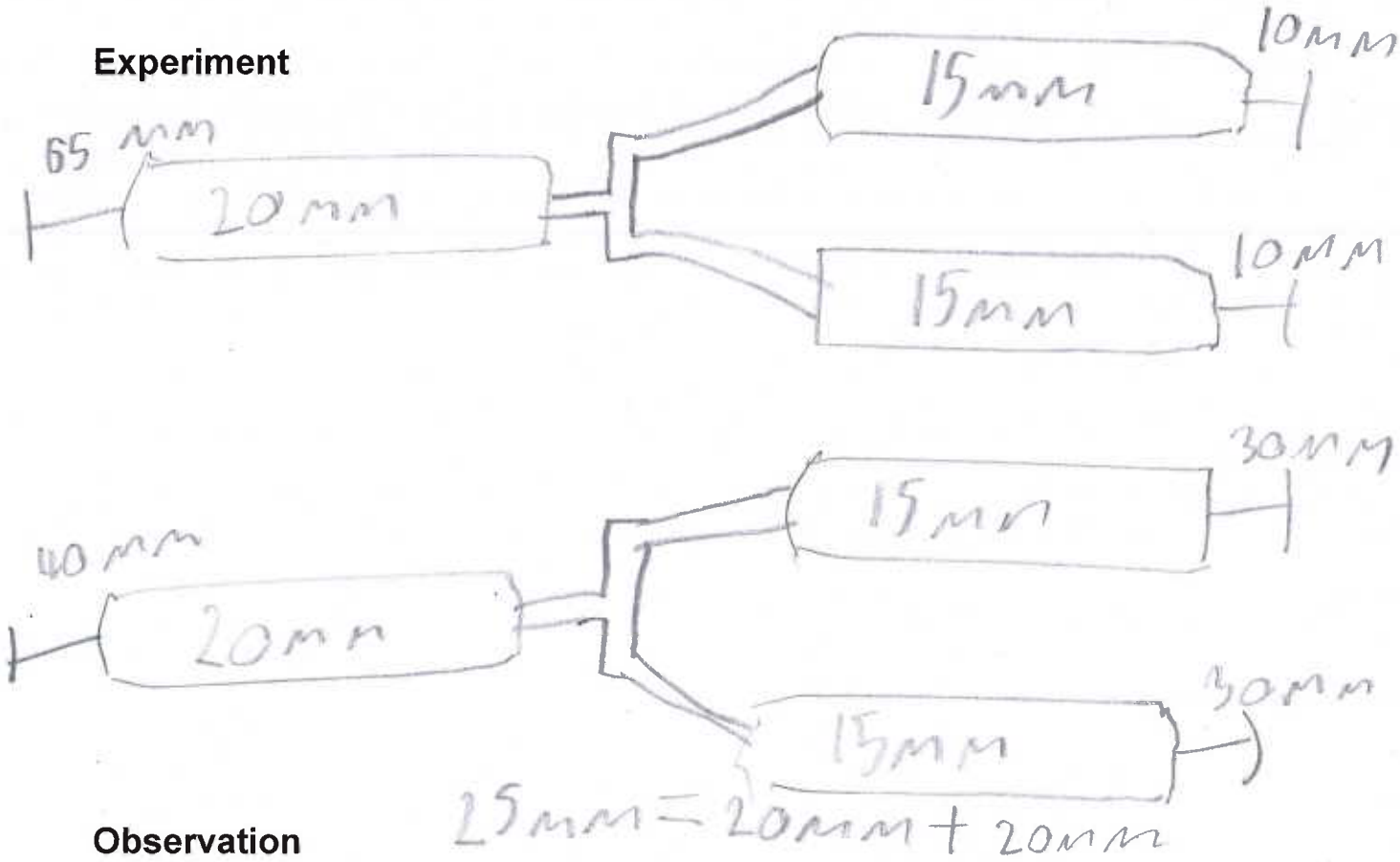
Equipment

1 x master syringe 20mm diameter
2 x slave syringe 15mm diameter
3 x tubes 3mm
1 x t-connector 3mm

Hypothesis

25mm movement on master = 12.5mm movement on each slave

Experiment



Observation

1. 25mm movement on master = 20mm movement on each slave
2. Similar force.

Experiment 5
1 Fat Master And 2 Skinny Slaves

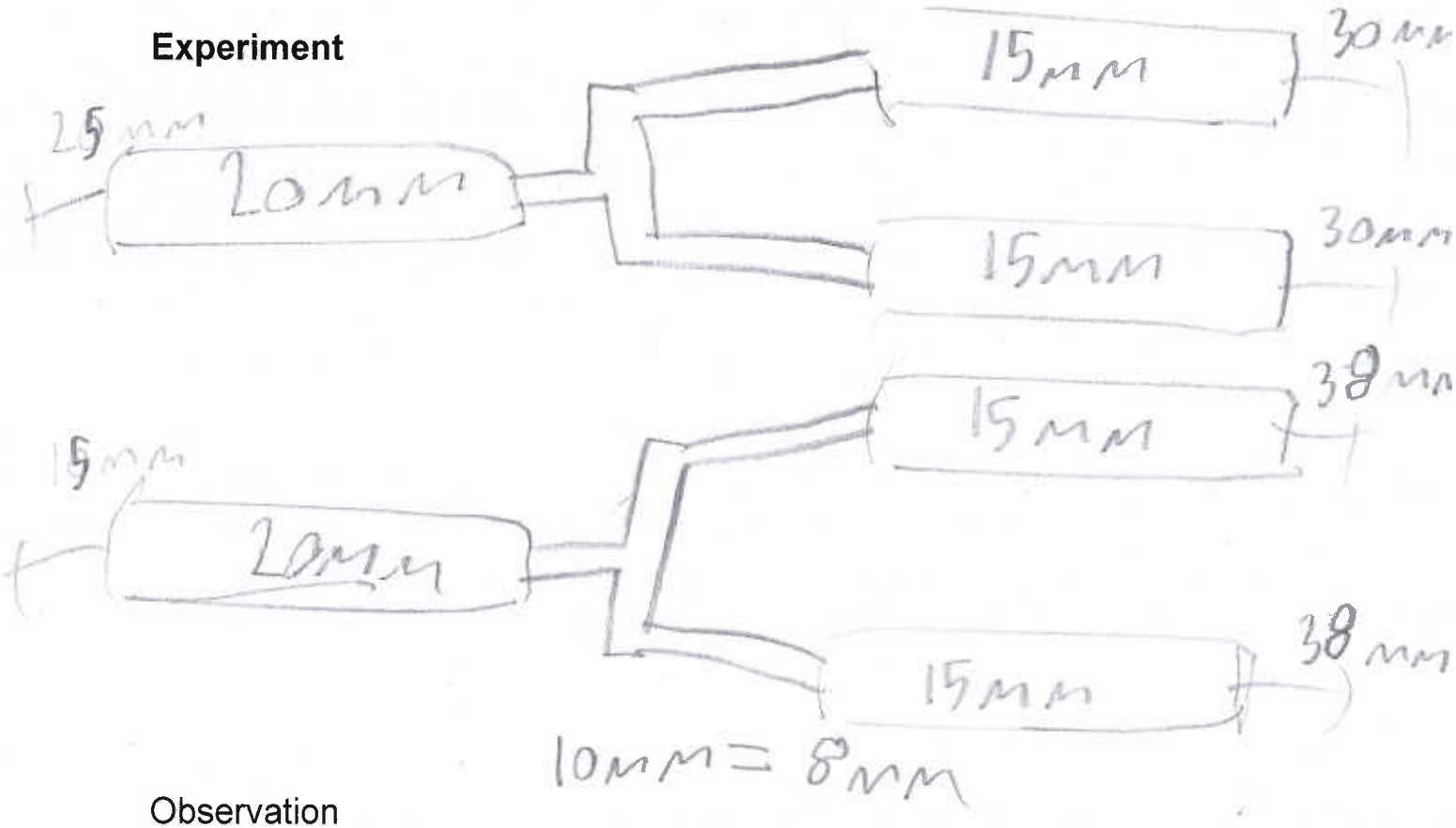
Equipment

1 x master syringe 20mm diameter
2 x slave syringe 15mm diameter
3 x tubes 3mm
1 x t-connector 3mm

Hypothesis

10mm movement on master = 8mm movement on each slave

Experiment



Observation

1. 10mm movement on master = 8mm movement on each slave
2. Similar force.

Conclusion

Experiments 2 and 5 resulted in movement of about 8mm.

I decided to go with experiment 5 because it required less movement and fit better.

Problems

The two sides don't always go up and down at the same time. I don't know why and I really want to fix it.

Assistance

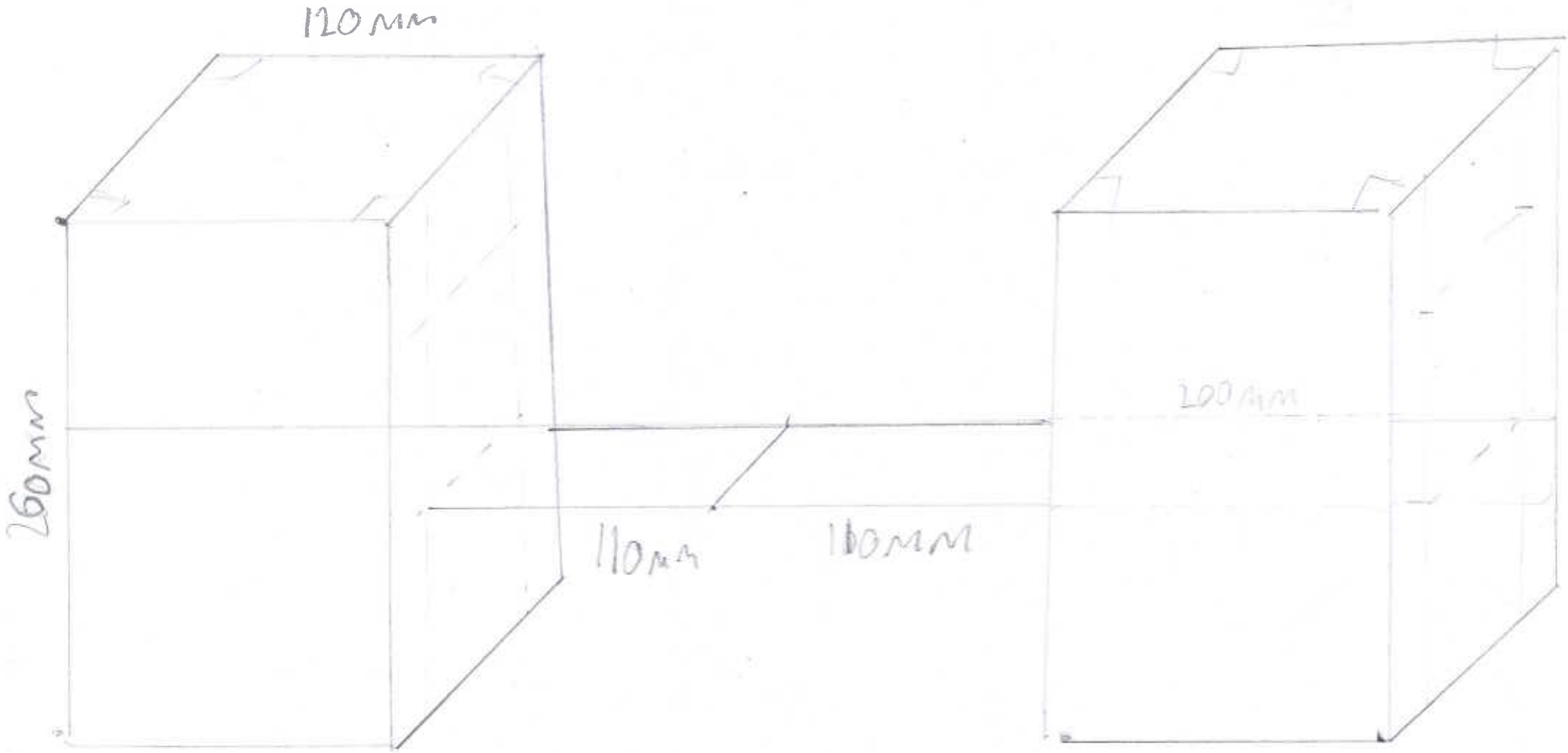
My dad helped me with the measurements for the towers.

Bunnings cut the tower pieces.

My dad cut the tunnels with a jigsaw and helped me to drill the holes.

I researched hydraulics on the internet. My dad gave me guidance and helped me with the experiments.

My mum read over the report and helped me with spelling and the set out.


120 мм
260мм
110мм
160мм
200мм

Operation

To raise the bridges push the plunger on the syringe at the bottom of the right tower slowly.

DO NOT push it too fast or the bridges will not open at the same time.

To make the bridges go down, pull the plunger back slowly.

You only need to move it about 10mm to make the bridges go up and down.

RISK ASSESSMENT FORM
Models & Inventions

This must be included with your report, log book or entry

NAME: Max Blairs ID: _____

SCHOOL: Grange Primary School

Activity: Give a brief outline of what you are planning to do.

I want to Make a model drawbridge, I Want to make it hydraulic.

Are there possible risks? Consider the following:

- Chemical Risks: are you using chemicals? If so, check with your teacher that any chemicals to be used are on the approved list for schools. Check the safety requirements for their use, such as eye protection and eyewash facilities, availability of running water, use of gloves, a well-ventilated area or fume cupboard.
- Thermal Risks: are you heating things? Could you be burnt?
- Biological Risks: are you working with micro-organisms such as mould and bacteria?
- Sharps Risks: are you cutting things, and is there a risk of injury from sharp objects?
- Electrical Risks: are you using mains (240 volt) electricity? How will you make sure that this is safe? Could you use a battery instead?
- Radiation Risks: does your entry use potentially harmful radiation such as UV or lasers?
- Other hazards.

Also, if you are using other people as subjects in an investigation you must get them to sign a note consenting to be part of your experiment.

Risks	How I will control / manage the risk
use of power tools	my dad supervised me and helped me.

(Attach another sheet if needed.)

Risk Assessment indicates that this activity can be safely carried out

RISK ASSESSMENT COMPLETED BY (student name(s)): Max Blairs

SIGNATURE(S): Max

☑ **by ticking this box, I / we state that my / our project adheres to the listed criteria for this Category.**

TEACHER'S NAME: _____ SIGNATURE: _____

DATE: _____