EPro8 Challenge

Practice Challenges

These challenge cards are provided so that teams can practice and prepare for the Vector Vector EPro8 Challenge.

During the Vector EPro8 Challenge teams will be based at a workstation containing gears, motors, pulleys, aluminium extrusion, weights, wheels, electronics blocks, cable, wing nuts, bolts and much more.

The scope of these practice challenges is limited to equipment readily available to schools.

You can complete all parts of a challenge, or select which parts you wish to complete. They can be done in any order.

Each challenge has a "Criteria" and a "Hint".
<u>Criteria</u> is what you will be judged on.
<u>Hints</u> are some ideas. You won't be judged on the hints and don't need to follow them.

Engineer   Problem Solve   Innovate

Each team should consist of four students. Each team should be supplied with the equipment shown below.

Teams have 2 ½ hours to finish as many challenges as they can. There is no "correct" answer for each challenge. Provided they achieve the criteria any solution is fine. It's great to think outside the square.
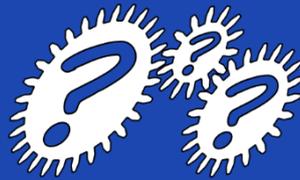
Start by explaining the rules and demonstrating the equipment.

Equipment

During the actual Vector EPro8 Challenge teams will be based at a workstation containing gears, motors, pulleys, aluminium extrusion, weights, wheels, electronics blocks, cable, wing nuts, bolts and much more.

It is not practical to supply all schools with this equipment. Instead these practice challenges are designed around equipment that can be purchased locally. Purchase enough equipment so that each team has access to one set.

Item	Price	Supplier
30 bamboo garden stakes, 600mm long	$10	Mitre 10 Mega
4 rolls insulation tape	$8	Mitre 10 Mega
15m rope (3mm diameter)	$5	Mitre 10 Mega
1 tape measure	$6	Mitre 10 Mega
100 rubber bands (size 18)	$2	Warehouse Stationery
10 balloons	$1	The Warehouse
16 L storage container, **label removed**	$15	The Warehouse
2 L Systema container, label still on it	$5	The Warehouse
5m hose	$10	The Warehouse
Thermometer, 0-50° (e.g. swimming pool thermometer)	$14	The Warehouse
1 L measuring jug	$5	The Warehouse
10 sheets A3 paper		
Stopwatch		
Scissors		
Electric Jug		
Water supply		

Rock Band

Your dad is a fan of 80's rock music... AC/DC, Bon Jovi and Def Leppard.

You want to entertain him with your best performance. The only problem is you hate the sound of rock music and prefer Taylor Swift.

So you need to build instruments that will make their sounds while you are in a different room from the instruments.

Percussion (Drums)		
Criteria	An impact (hitting motion) produces a sound. The "musician" must be at least 5m away from the sound. The "tune" must be at least five sounds at a regular beat.	40 Points
Hint	Sounds are produced by vibrations. Hitting an object produces vibrations. These travel through the air. We hear these vibrations as sound. Machines are used to transmit movement over distances and to turn one form of movement into another. You could use string and a lever to convert a pulling motion into a drumming motion	

String Instrument

Criteria	Construct an instrument that produces a sound by vibrating string, a rubber band or a similar object. The "musician" must be at least 5m away from the sound. The "tune" must be at least five sounds at a regular beat.	60 Points
Hint	A tight string held at both ends will vibrate when it is plucked. A pluck is a motion that lets go of the string once it is finished. You don't keep your finger on a guitars strings. If you did then your fingers would stop the vibration. You will need something stiff yet flexible to pluck the string.	

Wind Instrument

Criteria	Construct an instrument that makes a sound using only air. The "musician" must be at least 5m away from the sound. The "tune" must be at least five sounds at a regular beat.	40 Points
Hint	Fast moving air can produce vibrations. This happens in your voice box, where two flaps vibrate as air passes over them. By changing the shape of the flaps your voice produces different sounds. You can replicate this by making air pass over a tight flap of paper. You will need to find a way of making the air travel a distance.	

One Man Band

Criteria	All three instruments, as described above, can all be played simultaneously by one "musician".	40 Points

Single Action

Criteria	All three instruments, as described above, can all be played simultaneously by one "musician" and one action.	50 Points
Hint	The string and percussion are both triggered by a movement, while the air instrument is triggered by air. You will need to either use a physical movement to move the air, or air to make a physical movement. Could a balloon be used here?	

For details of your nearest Vector EPro8 Challenge event visit

www.epro8challenge.co.nz

Bath Time

After a hard day's rugby and mud fights your mum says that you have to have a bath before going to bed.

But it is so boring waiting for the bath to fill… when that time could be spent watching cat videos.

Calculate how much water your bath can hold, and therefore how long it will take the bath to fill.

Work out how much hot water to add and even find a way of automatically knowing when the bath is full.

| How Much Water?		
Criteria	Without using any water, calculate how many litres of water the bath (the large container) can hold. Your answer must be accurate to within 20%.	40 Points
Hint	The small container holds two litres of water. Work out how many of the small containers is the same volume as the big container. Be very accurate with your measurements. Pretend that both containers are rectangular blocks (ignore the angles on the side). Find how many times longer, wider and deeper the big container is than the small container. **IF** the big container was 1.5 times as wide and twice as long and three times as deep, then the big container could hold 1.5 x 2 x 3 = 9 times as much water.	

Fill Time

Criteria	By filling only the small container, calculate how long it will take to fill the bath (the large container).	50 Points
	While standing at the tap and not looking at (or touching) the bath, use this time to turn the tap off when the bath is at least 80% full.	
	The bath must not overflow.	

Water Level Sensor

Criteria	While standing at the tap and not looking at (or touching) the bath (the large container) you can determine when the bath is at least 80% full and turn the tap off.	60 Points
	The bath must not overflow.	
	You must not use the stopwatch or count seconds.	
Hint	A toilet cistern has a ball inside it that floats on the top of the water. As the cistern fills, the rising water level lifts the ball.	
	You will need something that can float, and to build a contraption so you can see this without looking at the bath, so you will know when to turn the tap off.	

Heating the Bath

Criteria	Record the temperature of the bath (the large container) full of cold water.	60 Points
	Determine how much boiling water is required to raise the baths temperature by 8°C.	
Hint	Tap water is normally around 20°C, depending on the time of the year. Boiling water is always 100°C.	
	If you replaced all the water with boiling water you would increase the temperature by 80°C. If you replaced half the water with boiling water you would increase the temperature by 40°C	
	Calculate how much water you need to replace to increase the temperature by 8°C.	

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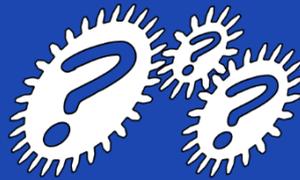
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Vector EPro8 Challenge

School Bags

Your teacher is getting grumpy – and no one likes a grumpy teacher.

Every day when the students arrive at school they dump all their school bags in a huge pile. It makes a terrible mess.

You need to design and build a system for storing the bags, including the contents of the bags.

And while you are at it – if you get hungry in class it would be great if you could get food from your lunch box without leaving your desk.

Single Bag Storage		
Criteria	Without removing any contents, determine which of your team's school bags is the heaviest. Build a structure so that the school bag and its contents are at least 500mm off the ground.	50 Points
Hint	Squares or cubes can skew, so they are weak. Collapses when pushed → Triangles cannot skew. They are strong and rigid.	A diagonal brace will turn a square into two strong rigid triangles. Structures use diagonal bracing to make them strong and rigid.

Multi Bag Storage

Criteria	Without removing any contents use all four of your team members' school bags. Build a structure so that all four of your school bags and their contents are at least 300mm off the ground. No part of any bag may be touching any other bag.	60 Points

Rain Jacket

Criteria	Along with holding all four bags as above, the structure can hold four rain jackets, with none of the bags or jackets touching each other.	30 Points

Lunchbox

Criteria	A lunch box must start in contact with the structure. While sitting at a desk at least four metres from the structure one item can be removed from the lunch box. After removing an item the lunch box must return to being in contact with the structure.	50 Points

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