

EPro8 Challenge

Practice Challenges

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

During the 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”.

Criteria is what you will be judged on.

Hints are some ideas. You won't be judged on the hints and don't need to follow them.

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Engineer Problem Solve Innovate

Format

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

Teams have two hours to finish the most challenges that 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 – in particular the cable ties which can be used to tie the timber together.

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 x bamboo garden stakes, 600mm long	\$7	Mitre 10 Mega
1 packet of 100 cable ties (100mm long)	\$5	Mitre 10 Mega
1 x 2m and 1 x 5m length of hose	\$7	Mitre 10 Mega
2 x pulleys	\$6 x 2	Mitre 10 Mega
15m rope (3mm diameter)	\$4	Mitre 10 Mega
1 bucket	\$2	Mitre 10 Mega
1 tape measure	\$6	Mitre 10 Mega
1 litre measuring jug	\$4	The Warehouse
1 packet table tennis balls	\$4	The Warehouse
100 rubber bands (size 18)	\$2	Warehouse Stationery
3 sheets A4 card		
Cellotape		
Scissors		
Empty 1.5 litre coke bottle		
1 x rock (weight between 300 & 700 g) <small>Optionally spray painted gold</small>		
Water		

Castle Siege

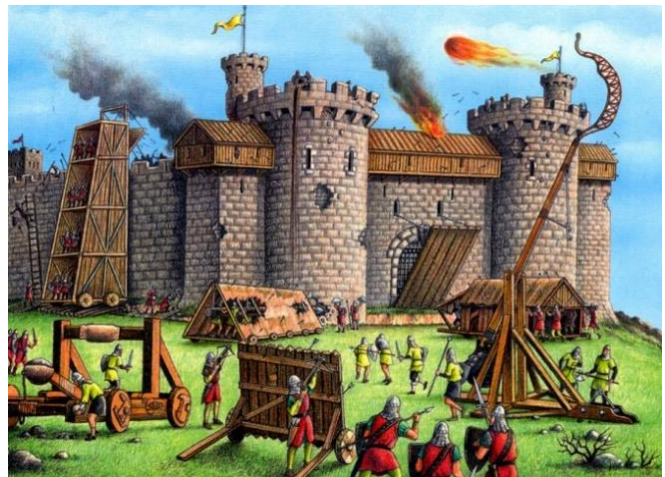
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You are the chief engineer for the great medieval king – King Richard III.

It is a troubled time, and your castle is under constant threat of attack.

King Richard III has charged you with developing a defence system for the castle. You are to construct a device that can shoot boulders at least five meters.



But be warned – King Richard III does not take kindly to failure.

Catapult

Criteria	Build a device that can launch a ping pong ball. The ping pong ball must travel through the air at least three metres before hitting the ground.	50 Points
Hint	You need some way of storing energy ready so that when you trigger the device, it has energy ready to transfer to the ping pong ball. Using the rubber bands is the obvious solution. But you could also lift a weight up that could drop. Stretching a rubber band and lifting a weight are different ways of storing energy.	

Easy Trigger

Criteria	After loading, no team member can touch the device. The judge must be able to trigger the device using only one little finger. The ping pong ball must travel through the air at least three metres before hitting the ground.	70 Points
Hint	If you have set up your device to have all the energy stored, it shouldn't take a lot of effort to actually trigger the device. All the work has already been done.	

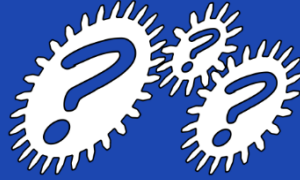
Hit The Target

Criteria	The ping pong ball must be able to hit an A3 sheet of paper at least three metres from the device. Teams can choose the location for the A3 sheet of paper, but once it is set it cannot be moved again.	90 Points
Hint	An advantage of a machine is that, assuming everything is the same, it should perform the same every time. The key here is to make sure every part of your device is exactly the same every time you load it to fire.	

Booby Trap

Criteria	A trip wire is placed on the ground. When the enemy triggers the trip wire, the device automatically fires the ping pong ball.	60 Points
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www.vectorepro8challenge.co.nz



Gold Rush

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While tramping in the Southern Alps, you see a strange glistening rock. You pick it up and realise that it is a nugget of pure gold.

At the next hut a fellow trumper offers you \$25,000 for the gold nugget. You know that a gram of gold is worth about \$50 – but you have no idea what this nugget of gold weighs.

There certainly aren't any scales in your tramping pack. You do have a water jug though. You have the idea of finding how much water weighs the same as the rock.



Scales

Criteria	Build a device that can compare the weight of two similar objects, and show which is the heaviest.	60 Points
Hint	You could build a balance scale, or you could use the rubber bands – mark how far one weight stretches the rubber bands, then swap to the weight. The heaviest weight will stretch the rubber band the longest.	

Weigh the Nugget

Criteria	Using the scales, find how much water weighs the same as the gold nugget.	70 Points
Hint	Reuse the scales built previously, but this time using a water jug. How much water weighs the same as the heavier rock?	

Calculate the Weight

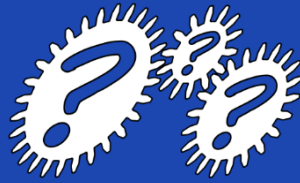
Criteria	Determine the weight of the water – this is the weight of the gold nugget.	70 Points
Hint	A fun bit of trivia for you: One litre of water weighs one kilogram. This means 1ml of water weighs 1 gram, and 100ml of water weighs 100 grams.	

Should you Sell It?

Criteria	One gram of gold is worth \$50. Calculate the value of the gold nugget. Should you sell it to the fellow tramper for \$25,000?	50 Points
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Water Tower

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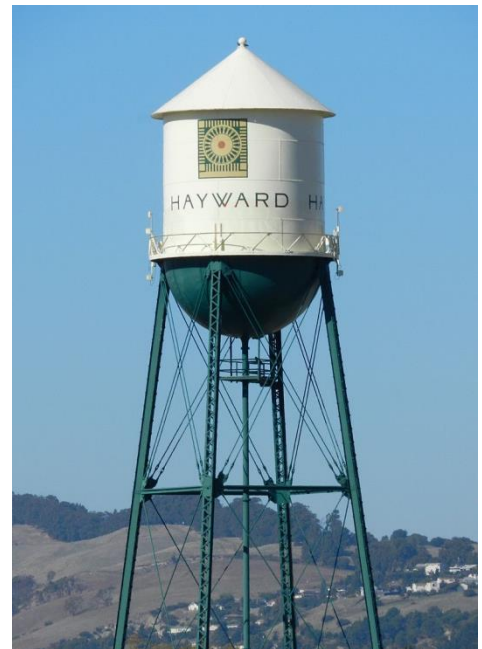
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You work for the local council. Your job is to get fresh water to the city's homes and businesses.

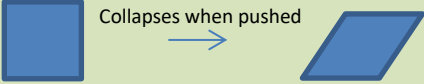
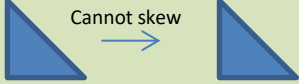
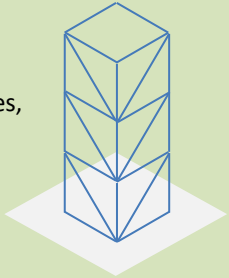
There is a small dam in a nearby river. The water is cleaned and then pumped to massive water tanks – usually on the top of a nearby hill.

When people turn their taps on the water flows down pipes from this water tank. If the tank wasn't up high, then the water wouldn't flow.

But there are no hills in your town. You have to build a tower, and place the water tank on top.



Tower Construction

Criteria	Build a free standing structure with an empty bucket on top. The lowest point of the bucket must be at least one metre above the ground.		60 Points
Hint	<p>Squares or cubes can skew, so they are weak:</p>  <p>Triangles cannot skew, so they are strong and rigid:</p> 		<p>A diagonal brace will turn a square into two strong rigid triangles.</p> <p>Many cranes and towers are built with lots of strong triangles, like in this diagram:</p> 

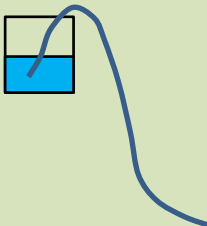
Water Tank

Criteria	The tank on top of the tower must be able to hold at least two litres of water.	70 Points
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Pump It Up

Criteria	<p>You need to pump the water from the water treatment plant to the water tank.</p> <p>Build a pump that can get water from ground level up to the bucket at the top of the tower.</p>	80 Points
Hint	<p>You will need a way of pushing the water up hill.</p> <p>Fill a coke bottle with water. Seal the lid of the bottle by putting your thumb on it. Now have a team mate squeeze the bottle as hard as they can. What happens?</p> <p>Squeezing the bottle increases the water pressure inside the bottle. Water moves when there is a difference in water pressure.</p> <p>You will need to work out a way of directing this pressurised water into the water tank.</p>	

Plumbing

Criteria	Water from the tower must be able to run to a location three metres away.	60 Points
Hint	<p>If you suck on a straw you reduce the water pressure at your mouth, so the water flows to your mouth. If you have a hose full of water and lift up one end, the weight of the water at the top pushes on the water below. This pressure causes the water to flow.</p> <p>Combining these two actions is called a syphon.</p> <p>Gravity pulls the water out of the hose. This creates suction at the top of the hose. This suction pulls the water up the side of the bucket.</p> <p>The trick to make this work is the hose must always be full of water. You can get it started by sucking on the end of the hose – like a giant straw.</p> <div style="text-align: right; margin-top: 20px;">  </div>	

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