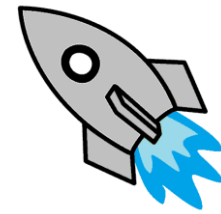


Water Rockets



Self-Led Session Instructions









Use these instructions with the Scout Adventures water rocket kit to run a 90 minute water rockets session for a group of 12 people. It is recommended that you run parts 1 to 5, then choose between parts 6 and 7. However you can create your own missions if you prefer!

Scan the QR code for a 5 minute video introducing the session before you run it. The video shows you what's in the box, explains how the session is structured, and explains key safety points.



Basic Session Structure

This guide has a page for each of the sections below which you can use when running the session.

Session section	Approx. Timing
 Part 1 – Introduction An introduction to the session and how it works	5 Minutes
 Part 2 – Research and Development Plan and design your rocket	10 Minutes
 Part 3 – Build Your rocket Use the materials to put your rocket together	10 Minutes
 Part 4 – Test Flights See how well they fly	15 Minutes
 Tinker Time Fix and adapt anything that needs tweaking	10 Minutes
 Part 5 – Landing Zones Try to aim your rocket so it lands on the target!	15 Minutes
 Part 6 – Eject! (Option 1) Can you save your astronaut?	25 Minutes
 Part 6 – Precious Cargo (Option 2) Can you safely parachute the rocket back to earth?	25 Minutes

What's in the Box?



4 x Rocket Tail Units



1 x Pressure Tube



1 x Water Jug



4 x 2 Litre Bottles



1 x Stirrup Pump



4 x Parachuting Astronaut



1 x Target Mat



4 x Lightweight material



Tape, Scissors and String & Elastic bands



Assorted Paper & Card



Felt Tips

Note: You can supplement the paper card with other clean items from your recycling if you want to add more items for teams to build rockets with.

Part 1 – Introduction

Time: Approximately 5 minutes.

Equipment: None

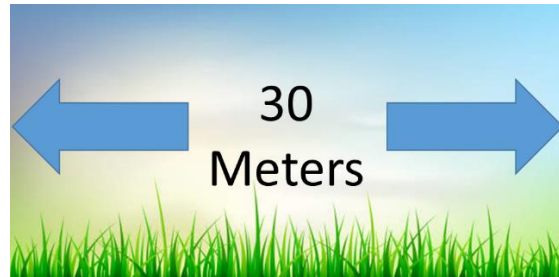
Use this page to help introduce the Water Rocket session to your group. You will demonstrate a rocket being launched or show the group a video.

Before you start

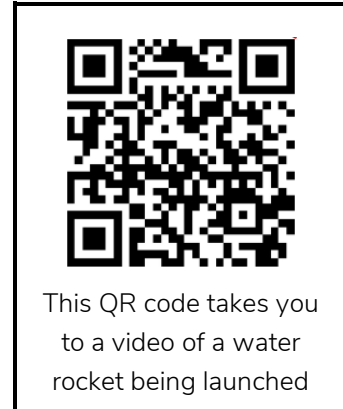
- Collect the Water Rocket box ready for you session.
- Check the contents of the kit against the list at the start of this document
- Choose where to run the activity. Ideally you need 2 spaces:



An indoor or covered space for groups to build their rockets



A wide outdoor space for groups to launch their rockets. Check this areas for overhead obstructions or hazards.



Introduce the Session

The suggested introduction for the session is:

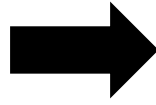
- We're going to spend the next 90 minutes being Rocket Scientists
- Working in teams we're going to design and launch a rocket, once we've tested our rockets we're going to add an astronaut and see if we can get them to return safely to earth after their flight.
- Now demonstrate a rocket launch – either using one of the rockets or on the video.



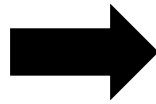
Launching the Rocket

- Check the bottle for damage before you fill it.
- Only fill the bottle with 1/3 water – heavier than this and it might tip over.
- Follow this instructions on the back of this sheet to add the tail unit.
- Spectators must stand back at least 10 meters.
- Kneel down the full length of the hose from the rocket when pumping.
- Keep pumping until the rocket launches! (You might get wet!)
- When taking the tail until off again be careful not to lose the "O"ring

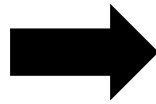
Assembling the basic rocket



1. Place the rubber "O" ring inside the white plastic cap.



2. Push rubber bung through white cap so the groove seals both sides



3. Push all 3 fins onto the white cap



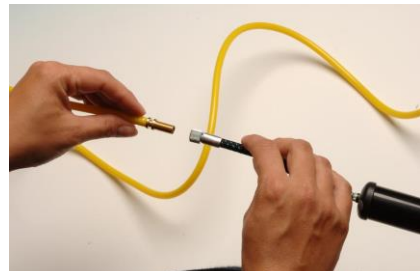
4. Fill the bottle 1/3 with water



5. Screw the tail unit on.



6. Push the brass nozzle into the rubber bung

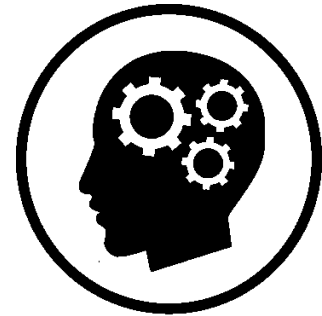


7. Connect the other end to the pump

8. Stand as far away as the hose will allow, then start pumping to launch! The rocket will launch when the pressure in the bottle is about 25psi.

Important! Be careful with the rubber "O" ring it can sometimes drop out when you put the tail on the bottle, and without it the rocket will leak!

Part 2 – Research and Development



Time: 10 Minutes.

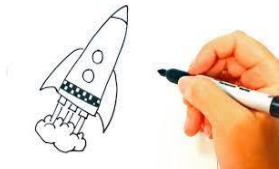
Equipment: Paper and Pens

In this section teams must design their rockets based on the objectives you set.

Explaining the task

- Split your group into teams of 3
- They have 10 minutes to design their rocket.
- They will then have 10 minutes to build their rocket before the first test flight.
- The rocket must be designed to meet the mission objectives

Teams must produce:



A labelled drawing of your rocket



A list of materials you need to build it

Mission Objectives

Your rocket must:

1. Be able to be launched at least 3 times
2. Look like a rocket. It must have:
 - a. A nose cone
 - b. At least 2 wings
3. You can only use materials you can afford to buy using your budget
4. You must NOT damage the rocket shell (bottle) or it won't be able to launch.

The Budget

- Each team has 1 Million pounds to spend on developing their rocket
- There is a list of high tech items they can buy. If you like you can add extra items to this standards materials (clean rubbish from your camp – e.g. cardboard boxes etc)
- If you like you can give teams the chance to earn more budget by completing silly tasks.










Limit the supply!

This activity works best if participants have to THINK and PLAN what they use to make their rockets. Use the budget sheet to limit what they can use – don't just give them access to all the materials!

Available Engineering Materials

You have £1 Million Pounds to spend on building your rocket. You can buy:

 <p>Xenon Rocket Shell (Plastic Bottle and Tail Unit) £400,000 Each.</p>	 <p>Lightweight Space Alloy (A4 Paper) £50,000 Each</p>
 <p>Heavy Weight Space Alloy (A4 Card) £100,000 Each</p>	 <p>Astro Space adhesive (Masking Tape) £20,000 per 5cm</p>
 <p>Nano-Elastic Lanyard (Elastic Band) £20,000 Each</p>	 <p>Polymer Fibre Cable (String) £30,000 per 30cm</p>
 <p>Lunar Tool Kit (Scissors and 2 Felt Pens) Free to all Teams</p>	<p>Important: DON'T CUT THE BOTTLE! If your bottle is damaged it won't be able to fly!</p>

Part 3 – Build your Rockets!



Time: 10 Minutes.

Equipment: Build materials

In this section teams must build a rocket that matches their design.

Explaining the task

- o Each team should now have a drawing of their rocket and a list of materials they need.
- o Teams can now come up to you (maybe set up a shop counter) and buy the materials they need (keep track of how much they have spent)
- o They now have 10 minutes to build their rockets!
- o If they run out of materials you can set them silly tasks to earn more money and buy more materials, OR they can trade with other teams.

IMPORTANT – Emphasise that they should not cut or damage the plastic bottle!

Part 4 – Test Flights



Time: 15 Minutes.

Equipment: Rockets, Pump, Water, Jug

In this section teams test if their rockets work!

Step by Step - How to run the test flights

Launch preparation

1. Each team will get one test flight to start with.
2. Decide on the order for rocket launch (which team goes first)
3. Explain the safety rules (back of this card)
4. Get the first team to fill their rocket 1/3 with water then screw on the tail unit
5. Connect the Yellow pressure hose and position the rocket at your chosen launch location,
6. Tell groups to watch how the rockets perform as they will get a chance to modify them after the test flight to improve how they fly.

Lift Off!

7. Choose one participant from the team to be the “Launch Controller”
8. The Launch Controller kneels down as far from the rocket as the hose will reach.
9. Everyone else moves at least 10m back from the Launch Zone.
10. They start pumping and keep going until the rocket launches!

Recovery and Reset

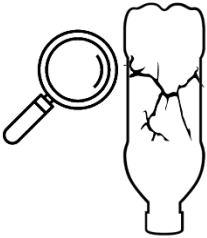

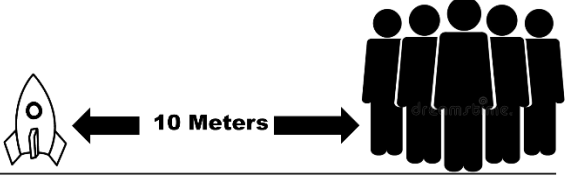
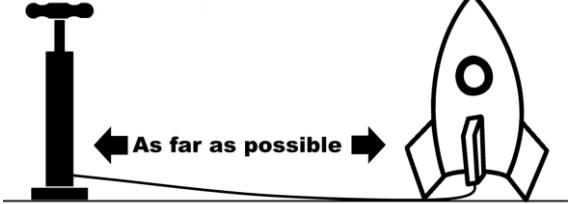


11. Recover the first rocket from where it landed
12. Repeat for the remaining rockets



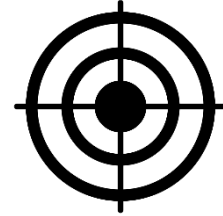
Water, water everywhere!

Before launching make sure anything which should stay dry (like these instructions and the box of paper/card) are out of the way!

Rocket Launch Rules

1	<p>Before launching check your rocket for leaks or damage.</p>	
2	<p>Choose one person to be the launch controller</p>	
3	<p>Everyone else should be 10 Meters away.</p>	
4	<p>The Launch controller should be as far away from the rocket as possible.</p>	
5	<p>When you start pumping keep going until the rocket launches unless there is a problem. This might take 2 or 3 minutes.</p>	
6	<p>If there is a problem STOP and get an adult to help.</p> <p>(If a rocket falls over, carefully release the pressure as if you were opening a fizzy drinks bottle that has been shaken up!)</p>	

Part 5 – Landing Zones



Time: 10 Minutes + 15 Minutes.

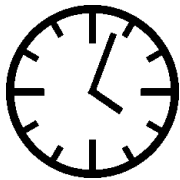
Equipment: Rockets and Build materials

In this section teams must improve their rockets.

Explaining the task

Now that we have successfully tested our rockets we will improve them and then have a competition

Tinker Time



- You can now repair, improve and adapt your rockets – think about how it performed in the test flight.
- Think about how to can aim your rocket.
- You have 10 minutes to make improvements.
- You can spend up to £250,000 more on engineering materials

Competition Time

Set up

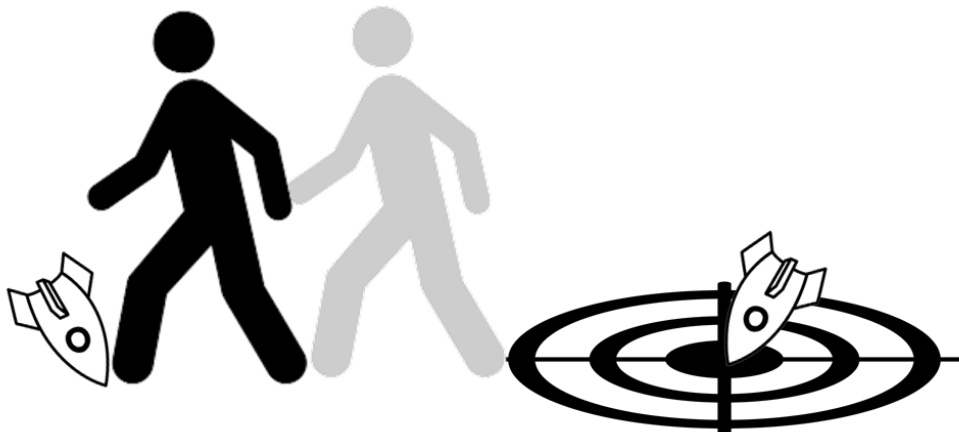
- Place the large target on the ground roughly where the test flights landed.

Challenge

- Each team will have 2 attempts to launch their rocket and try to get it to land as close as possible to the target.
- Your score will be based on how close you are to the target with each rocket. Your combined score for both rockets | your total.

Scoring

- Each team starts with 100 points
- If they land ON the target they score the points on the target in **addition** to their 100.
- If they land OFF the target they **lose 5 points** for every full step away from the target.
- Later on the points will be converted to money for the final challenge.
- The maximum score for 2 rockets is 400 points.



2 Steps = -10 points
(Total = 100 - 10 = 90)

Bullseye = +100 points
(Total = 100 + 100 = 200)

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Part 6 – Eject! (Option 1)



Time: 25 Minutes.

Equipment: Rockets and Build materials, Parachuting Astronaut

Teams must build an ejection system so that their Astronaut launches with the rocket, then release and parachutes safely to earth.

Explaining the task

Our next mission is to launch an astronaut, who must then parachute safely back to earth.

Tinker Time



- Give each team an astronaut
- They can now repair, improve and adapt your rockets – think about how the astronaut will release from the rocket.
- You have 10 minutes to make improvements.
- For every 1 point you score in the last competition you have an additional £1000 to spend!

Competition Time

Set up

- Place the large target on the ground roughly where the test flights landed.

Challenge

- Each team will have 1 attempt (2 if you have time) to launch their rocket and try to get their astronaut to land on the target.
 - Your score will be based on how close you are to the target with each astronaut.

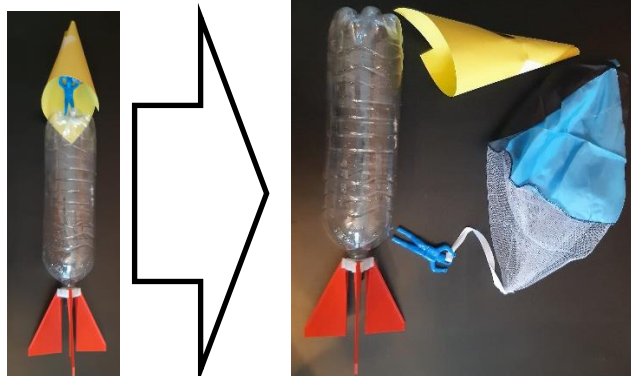
Scoring

- If the astronaut lands ON the target they score the points on the target.
- If they land OFF the target they **lose 5 points** for every full step away from the target.
- In this competition teams can score minus points!

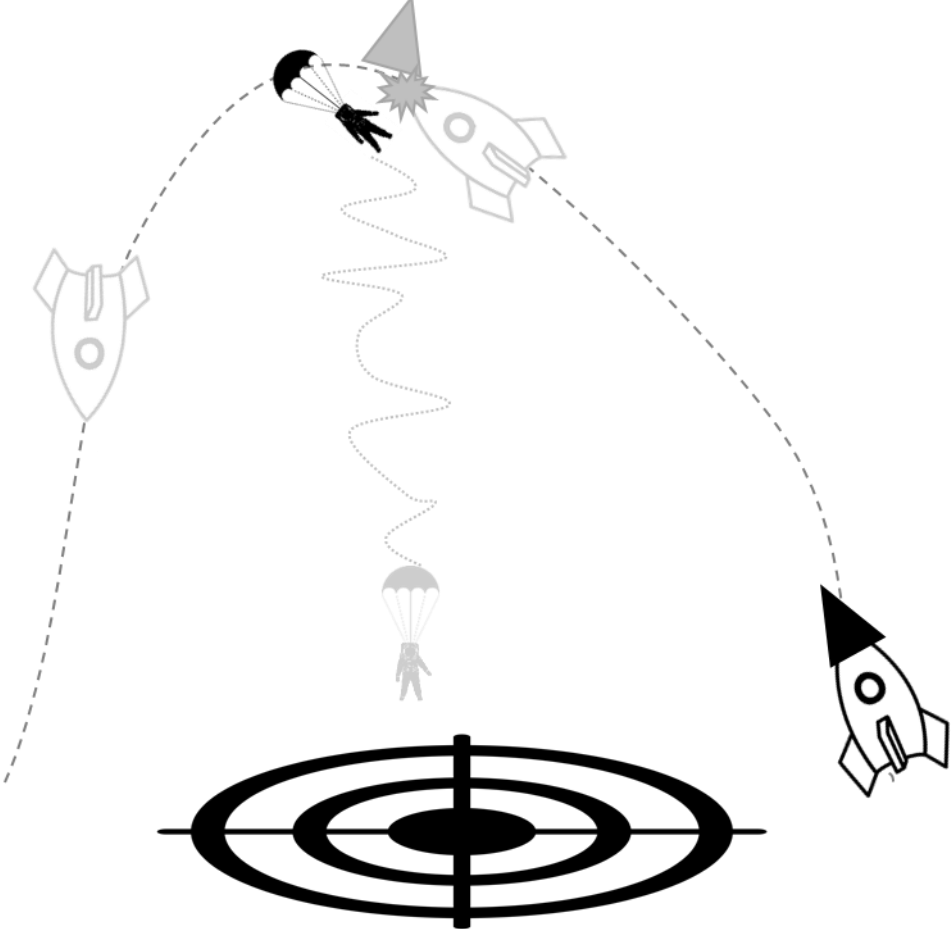


Simple solution

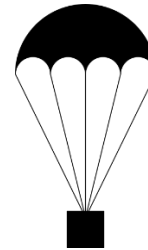
One of the simplest solutions is to add a nose cone which falls off when the rocket stops accelerating – but you can use elastic band and more complicated methods to try and fire the astronaut away off as well!



Eject!

Mission	Example Flight Plan
<ul style="list-style-type: none">○ Adapt your rocket so that it can launch an astronaut○ The astronaut must release from the rocket and parachute safely to earth○ You score points for how close the astronaut lands to the target	 A diagram illustrating the flight plan. It shows a rocket on the left launching upwards. A dashed line shows the rocket's path as it ascends and then curves back down to the right. At the peak of the curve, an astronaut is shown being ejected from the rocket, with a parachute deployed. A dotted line shows the astronaut's path as they descend towards a target on the ground. The target is a bullseye with a central dot and concentric circles. The astronaut is shown landing near the center of the target.
Time	
<ul style="list-style-type: none">○ You have 10 minutes to adapt your rocket	
Engineering Materials	
<ul style="list-style-type: none">○ You can buy more engineering materials○ You have £1000 for every 1 point you scored in the last competition (e.g. if you score 100 points you have £100,000 to spend)	
Important! You must not damage the astronaut or parachute in any way!	

Part 7 – Precious Cargo (Option 2)



Time: 25 Minutes.

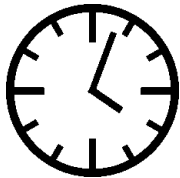
Equipment: Rockets and Build materials, Parachute Fabric

Teams must build a parachute system that will safely return their rocket to the earth.

Explaining the task

Our next mission is to build a parachute that will safely return our rocket to the earth without damage.

Tinker Time



- They can now repair, improve and adapt your rockets – think about how the astronaut will release from the rocket.
- You have 10 minutes to make improvements.
- For every 1 point you score in the last competition you have an additional £1000 to spend!

Additional Engineering Materials

	<p>Lunar Helios Parachute Membrane (Lightweight fabric) £50,000 Per Square</p> <p>Restrictions on use: Squares can be taped, or have holes made to thread string through but CANNOT be cut up into smaller pieces</p>
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Competition Time

Set up

- Place the large target on the ground roughly where the test flights landed.

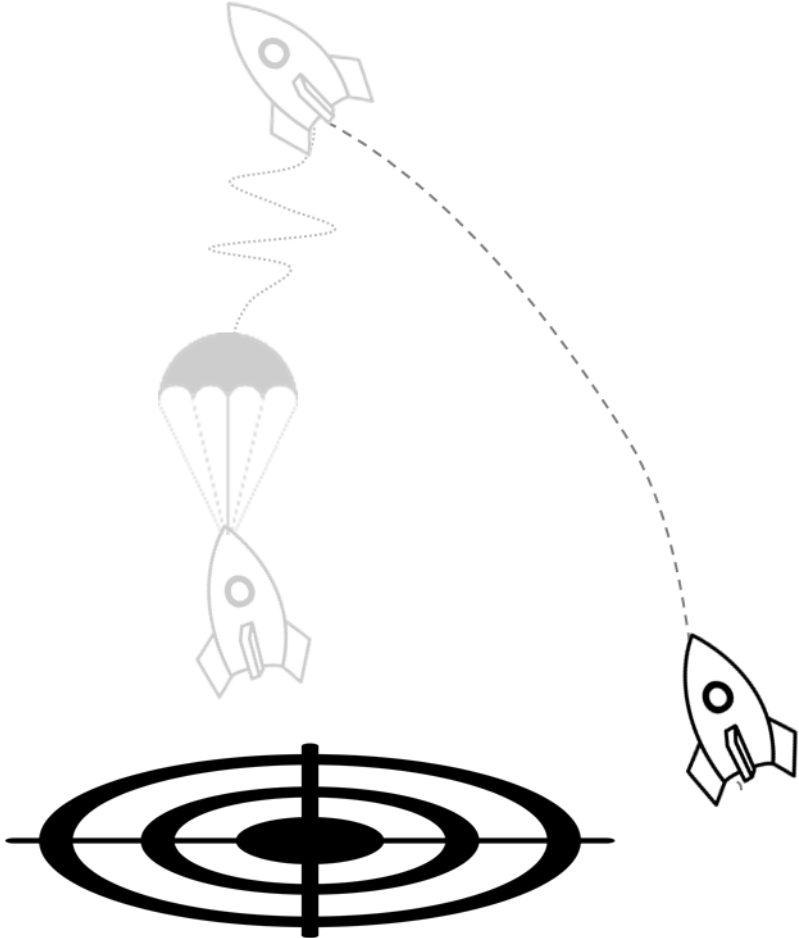
Challenge

- Each team will have 1 attempt (2 if you have time) to launch their rocket and try to get it to land safely on the target
- Your score will be based on how close you are to the target with each rocket.

Scoring

- If the rocket lands ON the target they score the points on the target.
- If it lands OFF the target they **lose 5 points** for every full step away from the target.
- In this competition teams can score minus points!

Precious Cargo!

Mission	Example Flight Plan
<ul style="list-style-type: none">○ Adapt your rocket so that it can parachute safely back to earth○ You score points for how close your rocket lands to the target	 <p>The diagram illustrates a flight plan for a water rocket. It shows a rocket launching from the bottom right, following a dashed parabolic path to a peak. From the peak, a dotted line indicates the descent, leading to a parachute that opens. The rocket then descends vertically towards a target on the ground, represented by a bullseye with a vertical line through its center. The target is located to the left of the rocket's landing point.</p>
Time <ul style="list-style-type: none">○ You have 10 minutes to adapt your rocket	
Engineering Materials <ul style="list-style-type: none">○ You can buy more engineering materials○ You have £1000 for every 1 point you scored in the last competition (e.g. if you score 100 points you have £100,000 to spend)	
Important! You must not cut up the parachute material, but you can use tape or string to adapt it.	

Self-Led Water Rockets – Risk Assessment

This risk assessment covers the significant hazards associated with instructing and supervising a water rockets session. As the supervising adult you may need to supplement this with specific knowledge of individuals in your group – for instance any health condition.

You will also need to dynamically risk assess as you supervise the activity. CLAP is a useful tool to help you supervise and provide dynamic risk assessments:

- C** Communicate – give your group clear simple instructions and check they have understood the key points of the information,
- L** Line of sight – set boundaries and rules to ensure that you can see your group when they take part in activities with medium rated hazards.
- A** Avoid – Look for existing hazards and anticipate developing hazards, then take action early to avoid these becoming a risk to your group.
- P** Positioning – Try to move to the place where you can be the most effective in managing risk. This will change throughout the activity.

Severity Factor & Remaining Risk Assessment

Please pay particular attention to the “Medium” residual risk rating - these are items you must take action over during your activity.

Level	Severity Description	Residual Risk Description
Low.	Minor Injury requiring no treatment, or simple first aid.	Control have reduced the severity and/or likelihood of occurrence to minimal levels.
Medium.	Injury would require the participant/worker to stop continuing the activity/task; medical treatment is beyond the skills of a basic first aider.	Control measures have reduced severity and/or likelihood to an adequate level but hazard still requires dynamic risk assessment & conscious consideration.
High.	Injury would require expert medical attention and/or result in fatality.	Control measures are not sufficient to reduce the severity or likelihood to an acceptable level.

Standard Risk Assessment – Self-led Water Rockets

Hazards	Who may be harmed?	Foreseeable Severity	Control Measures in Place	Residual Risk
Rocket hits someone during take-off, flight or landing.	Participants	Medium	<ul style="list-style-type: none"> o Only one person (launch controller) to be close to rocket during launch/pumping o All other spectators to stand minimum of 10m away from launch and observe rocket, after initial launch rocket force is minimal. o Launch controller to be as far away as possible with length of pump hose, and to pump from a kneeling position. o Supervising adult to be ready to dynamically control situation and move the group if there is a problem – e.g. rocket falls over. o Rockets only to be filled 1/3 with water to prevent falling over during launch. 	Medium
Rocket hits an object or obstruction during flight	Participants	Low	<ul style="list-style-type: none"> o Supervising adult to complete a visual inspection of the launch areas for hazards prior to the session. o Continue to monitor for developing hazards throughout the session. 	Low
Bottle exploding due to damage or over pressurisation	Participants	Medium	<ul style="list-style-type: none"> o Only 2litre carbonated drinks bottles to be used o Bottles to be inspected for damage before each launch o system is designed to release at low pressure (approx. 25psi) 	Medium
Participants injure themselves using tools to build or repair rockets	Participants	Low	<ul style="list-style-type: none"> o Scissors are of a classroom safety type. o Supervising adult to count in and out scissors at end of sessions o Adult present to supervise all groups 	Low
Injury or accidents associated with group behaviour and adventurous activities	Participants	Medium	<ul style="list-style-type: none"> o A ratio of 1:12 for group members to supervising adult is recommended. o Supervising adult member to give a briefing and follow the session structure to ensure participants stay engaged. o Supervising adult to complete a visual check of the area before beginning the session to identify any unexpected hazards. 	Low
Health issues including personal injury or illness	Participants	Medium	<ul style="list-style-type: none"> o Supervising adult must be aware of significant medical requirements and ensure any essential medication is accessible. 	Low
Unsupervised use of the activity	Anyone in vicinity	Medium	<ul style="list-style-type: none"> o All groups are made aware not to use activity equipment without supervision. o Equipment to be returned to staff team after use (or agreed location) 	Low

Self-led Water Rockets

Minimum requirements

If you choose not to follow the structure in this guide then you must as a minimum follow the requirements set out below.

Supervision and Leadership



Please note it's a self-led session – as the adult in charge you are responsible for the supervision of your group, including ensuring the safety of all participants. You should complete a risk assessment for your activity.

Supervision, Equipment

Please read the following guidelines for use during your session.

- Scout Adventures may curtail the session at any time if it is deemed unsafe.
- Ensure equipment is suitable for your needs, and you understand how to operate it correctly.
- Participants should be supervised in line with your risk assessments.
- Suggested group size for this activity is 12 or per your risk assessments.
- Please report any damage to the equipment at reception.

Safety Requirements

- All bottles should be inspected for damage before launching. Bottles must not be cut or cracked.
- The rocket must only be launched in an outside open space.
- The person launching must kneel and operate the pump from as far away as the length of hose allows
- Spectators must be at least 10m from the launch areas.
- Supervising adult must check for overhead obstructions or hazards.
- After your session please return equipment to a member of staff.

Help and Assistance

If you have any questions about these guidelines please ask a member of staff before commencing the activity. Please contact the center's Duty Manager if you need assistance.

Visual reminder of key Controls

