SCENARIO
Your team has been selected as one of the finalists in a competition to supply hovercraft to evacuate personnel from the Australian Antarctic base in the event of an emergency. Today each team will build a hovercraft that will be tested against all the other finalists to choose whose design will be selected.

AIM
The aim of this full-day activity is to design, build and fly a model hovercraft that is fast, manoeuvrable and has a good hover height.

WHAT TO DO
Each team will be given a lift fan, two motor/propellers, a battery, controller, balsa wood, polystyrene trays, plastic sheeting, and masking tape to construct a hovercraft. Masking tape is dispensed by the Activity Personnel and you may also ask for washers to use as ballast. A small saw, cutting block and scissors are provided as tools to use for your construction.

Use a polystyrene tray as the hull of your hovercraft. Plan with your team how you will construct your hovercraft and read the “Building a Skirt” handout to decide if you wish to attach a skirt. It is easiest to mount the lift fan on top of the hovercraft with a hole cut in the hull so the fan can push air beneath the hovercraft. The motor/propellers are mounted upright so they can be used to steer the hovercraft and propel it forward.

TIMETABLE

<table>
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<th>Session 1</th>
<th>Following a 5-minute briefing by your Activity Personnel, your team should spend the next 100 minutes building and trialling your hovercraft.</th>
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<td>Lunch Break (30m)</td>
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<td>Session 2</td>
<td>After the break, your team will begin testing. Roughly 30 minutes will be spent conducting the speed test, 30 minutes on the hover height test, and 35 minutes on the obstacle course. The last 10 minutes are left for pack up.</td>
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RULES
The saw may only be used to cut materials that are securely placed on the cutting block.

For all the tests, the lift fan and motor/propellers may only be turned on when a member of the Activity Personnel indicates that it is time do so.

Pulling on the controller cable to control the hovercraft is **not allowed**.

Safety glasses must always be worn when operating the hovercraft. Hovercraft may only be operated in the presence of Activity Personnel.
SCORING
The total score is obtained by adding together the results of 3 individual tests.

A **speed test** over 10 metres, worth a maximum of 100 points. This simulates the hovercraft’s ability to quickly cross open waters.

A **hover height test**, worth a maximum of 150 points. Gliding across a series of steps will simulate the climb out of water and across ice. Your team’s score for this test will depend on the number of steps crossed and the time taken.

An **obstacle course** worth a maximum of 200 points. Points will be awarded based on the time taken to negotiate the course and the number of obstacles hit. This tests the craft’s manoeuvrability.

⚠ **At the end, ensure your team’s score sheet is with the Activity Personnel.**

TIPS
The lift fan only blows air in one direction. Ensure it is oriented correctly.

Spin both propellers at the same speed to move the hovercraft forward. Slowing a single propeller causes the hovercraft to turn in that direction.

The central switch of the hand-held controller turns the lift fan on or off. The sliders on either side are connected to the motor/propellers via a long, flat cable. When centred, these sliders provide no power to the motors. When the sliders are moved forward or backward, the motor/propellers turn in the forward or reverse direction. The direction of the fan rotation can be reversed by flipping the switch immediately next to the slider.

Tape the rainbow controller cords to your hovercraft so that connections remain attached.

Be gentle when handling electronic components and always pull cords out by plug, not by the wires.

Consider in advance what characteristics are most important for your hovercraft.

Weight distribution and placement of the lift fan will affect handling, hover height and stability. If necessary, affix metal washers to balance your hovercraft.

The addition of a skirt will greatly increase the hover height and stability of the hovercraft but may slow it down. When inflated. The skirt should expand slightly when inflating and not drape loosely below the hovercraft.

The placement of the motor/propellers will dramatically change how the hovercraft controls.

Your hovercraft may experience drag which will slow it down and make it harder to turn. It may be worthwhile making the hovercraft more aerodynamic.

A **tail** is a short piece of balsa protruding from the back edge of the craft to support the controller cable. It ensures that the cable does not entangle the motor/propellers.

Get as much practice as possible controlling the hovercraft before testing. Experiment with different hovercraft characteristics to increase overall manoeuvrability across the tests. Improve the hovercraft design and pilot skill by practice, trial and error.
Hovercraft do not work like traditional aircraft. Instead of flying, hovercraft float on a cushion of air which reduces friction and allows them to glide across surfaces. The air cushion is generated by a downwards mounted fan on the bottom of the hovercraft, but a fan alone is unstable and does not lift the hovercraft very high.

This is where the skirt of a hovercraft comes in. Skirts can increase both the pressure and surface area of the air cushion, providing stability and allowing the hovercraft to float higher. Because a skirt can fold and deform, it also allows the hovercraft to negotiate rough surfaces and obstacles.

There are three main types of skirts: bag skirts, tube skirts, and segmented skirts. Each type of skirt, starting with the bag skirt, is superior to the last, but also much more difficult to construct. For this reason, it is strongly recommended to use a bag skirt. Tube skirts and segmented skirts are not recommended due to technical difficulty, time and materials constraints.

The tube and segmented skirt designs use a baffle underneath the lift fan to improve airflow, cushion formation and hover height. Setting up a baffle can be quite difficult. If your team uses a baffle and the performance of the hovercraft doesn’t improve, it may be better to remove it.

**Bag Skirt**

A bag skirt consists of one sheet of material that covers the base of the hovercraft and has holes in it to allow the air to escape. This type of skirt is very simple to manufacture and maintain. Start with only a few holes near the centre of the skirt as you do not want holes on the side of the skirt when it inflates. You can add more holes later to change the handling of your hovercraft.

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Cross-section through a hovercraft. View underneath a bag skirt.
Tube Skirt
A tube skirt differs from a bag skirt as the material instead forms a loop around the edge of the hovercraft, rather than covering the entire base. A baffle is mounted underneath the lift fan, channelling airflow towards the rim of the hovercraft. The top edge of the skirt is attached to the rim of the hovercraft and the bottom edge is attached to the edge of the baffle, forming a tube. Holes are placed on the inside wall of the tube, allowing the air to escape and form the air cushion.

This type of skirt is like those used in multi-terrain hovercraft. It is much more efficient, but also much more difficult to make and install.

Segmented Skirt
A segmented skirt is like a tube skirt but is composed of many individual segments. Each segment inflates to give a good hover height and excellent obstacle clearance.

This type of skirt is commonly used in racing hovercraft but SHOULD NOT be used on your model hovercraft as it is extremely tricky to make and install.