SparkLab, Sciencentre

Maker Space: *Land sailing rovers*

The Challenge

How far will your wind-powered vehicle travel down a test track?
Create your own customised mast and sail to propel your rover through some all-terrain challenges!
Place it in front of a table-top fan to test your design and see how far it can go!

Learning Outcomes

- Explore the effect different forces have on the rover's movement and consider these forces during design.
- Explore the properties of different materials—weight, rigidity, flexibility, smoothness, porous—and how you can manipulate materials to design a land sailing rover.
- Increase participant's understanding and confidence of the testing and design process; observing areas of the design that need improvement, posing a new design solution, making a change and observing the impact of that change.
- Feel and recognise success in implementing creative solutions to real world challenges. Apply this approach in their wider life.
- Understand how wind energy—a sustainable and renewable resource—can be used to make something move.
- Gather data, such as distance travelled, time taken, rover mass and sail area. Use this data to compare different designs and the effectiveness of designs.
- Express enjoyment in engaging in the challenge and sharing ideas and understandings.
- Increase the challenge by adding in different surfaces (carpet, artificial grass or sand) or obstacles (ramps or low bridges) and change the design to respond to this challenge.

Equipment

- Rover body (wooden or cardboard car body or large toy car).
- Axel (wooden skewers, paper straws, tubes)
- Wheels (various lids, toy wheels or discs)
- Fan
- Floor or long table for track
- Scissors
- Measuring tape

Design Materials

- Various fabrics
- Paper and tissue paper
- Papers straws
- Paddle pop sticks
- Masking tape
- Pipe cleaners

Optional materials

- Additional surfaces (carpet, artificial grass, sand)
- Ramps and bridges (Cardboard, blocks)
- Stopwatch (or smart phone)

Set-up steps

1. Set up a testing track by placing a desktop fan at the end of a table or track.
2. Put your rover together using the body, axel and wheels of your choice. Make sure your wheels are spinning freely.
3. You're now ready to start designing and testing!

Design process

This activity follows a design process. Below are some questions that will help at each stage of the process.

Think of some solutions

- What direction does the wind blow? How might this move my rover?
- How might the size, shape and angle of my sail affect the way my rover moves?
- Is it better for my mast and sail to be light or heavy, strong, rigid or flexible?
- What are some real world examples that you have seen before?
- What ideas do you have for a design?

Make a prototype

- What materials will you use to build your rover?
- How can you use the different properties of the materials in your own design?
- How will you attach your sail to the rover body?
- What part of your design are you finding tricky to build?

Test it out

- Test out your design on the test track. For an added challenge, add try a different surface or an obstacle.
- How far did your land sailing rover travel? How long did it take to get there?
- What did you observe during testing? Did it move in the way you predicted? Did it travel in a straight line?
- What part of your design worked really well?

Improve your design

- How could you improve on your design? What is slowing it down your rover?
- How can you capture more wind?
- What ideas could you incorporate from someone else's design?
- What changes can you make so your rover can travel on a different track surface, up a slope or under a bridge?
- If you started again, what would you do differently? What would you do the same?

Background science

Forces push or pull objects. There are lot of forces that we can notice when testing our rovers! Gravity is the downward force which pulls our rovers towards the centre of the Earth. Friction between surfaces and drag from the air are forces that act in the opposite direction that an object is moving. Wind can push on the sail to move the rover forward. The normal force is the force on the object from the surface it is sitting or travelling on and always acts in the direction perpendicular to the surface.

When the land sailing rover is stationary, or moving at a constant speed, all the forces acting on the rover are balanced. The push and pull of gravity, the normal force, friction, drag, and the wind are even and so the rover doesn't change speed. When the forces become unbalanced, such as when the fan speed increases, there is a greater force pushing the rover forward so it accelerates forward. Friction and drag forces oppose the forward motion, and when they become greater than the forces pushing the rover forward the rover will decelerate (negative acceleration). Changing the sail design, total weight, and even track surface can change the amount of force required from the wind to get the rover moving.