GENERATION SCIENCE

EDINBURGH SCIENCE LEARNING

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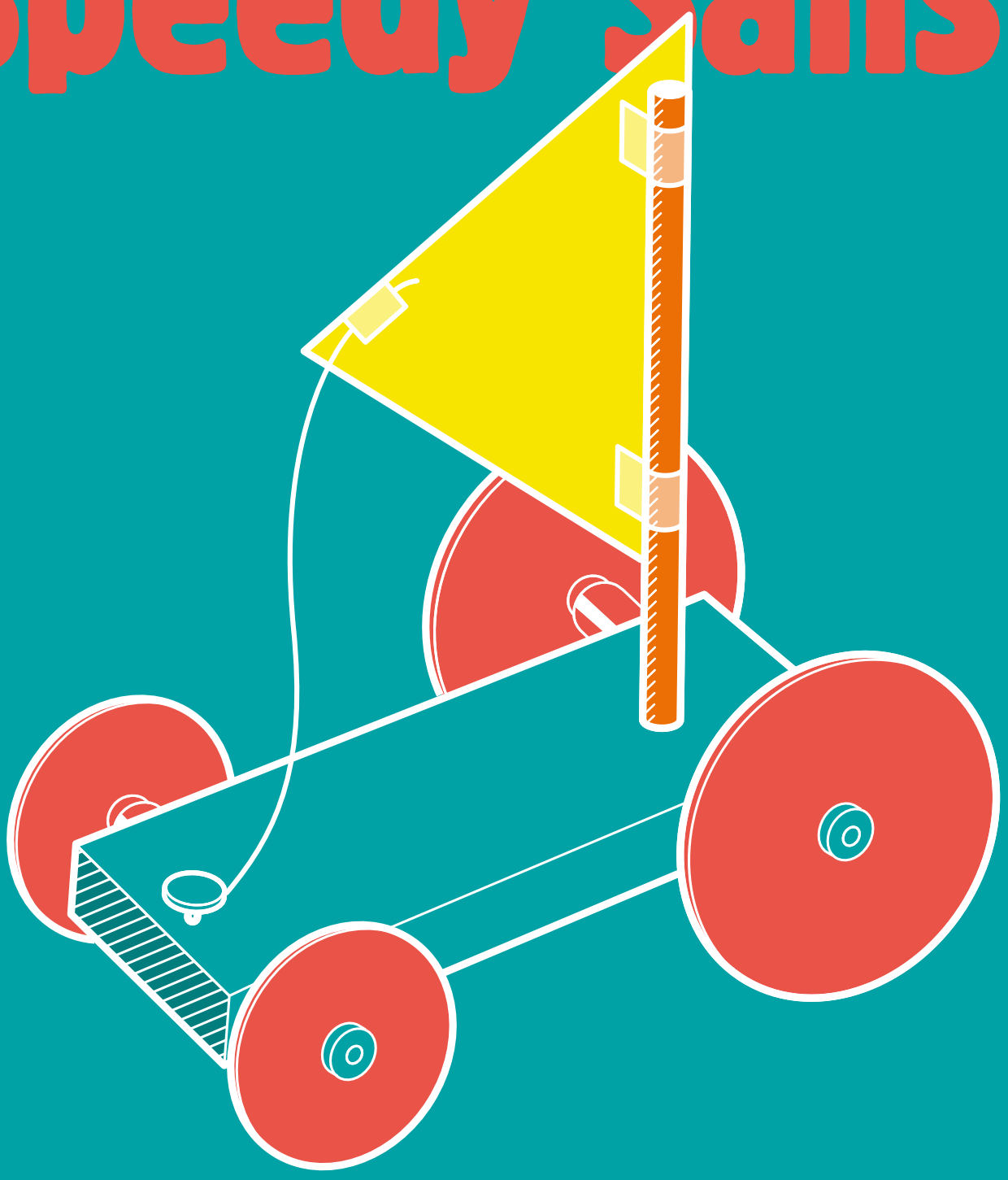
Speedy Sails



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BOX CONTENTS

Please note, this kit contains materials which are suitable for children aged seven and above. All materials should be used under teacher guidance and supervision.

WORKSHOP KIT

16 x Challenge Cards, double sided
1 x Floor Fan

WORKSHOP CONSUMABLES

25 x block body (land yacht)
25 x wedge body (land yacht)
30 x cardboard wheel (40mm)
30 x cardboard wheel (50mm)
30 x plastic wheel (40mm)
40 x wooden wheel (70mm)
40 x wooden wheel (30mm)
20 x foam wheel (50mm)
50 x long axel (150mm)
50 x short axel (100mm)
75 x mast (300mm)
18 x card sail (Design 1)
18 x card sail (Design 2)
18 x card sail (Design 3)
18 x card sail (Design 4)
200 x rubber grommets/O-rings
100 x lolly sticks
100 x thumb tacks
100 x elastic bands
5 x rolls tape
250 x paper straws
6 x balls of string
80 x lengths of string, plus one spare string ball
150 x sheets of A4 paper

GENERATION SCIENCE 2022: HOW-TO GUIDE

HOW TO USE THIS BOOKLET

This booklet has three sections: *Before, During* and *After the Workshop*.

Read the *Before* section in detail before you start running the workshop. It contains a guide to the videos and materials, gives you some background information and tells you how to prepare the classroom.

You can familiarize yourself with the *During* section beforehand, but also use it as a guide to the activities in real time. This contains some more details on the activities and videos.

The *After* section provides some links, resources and follow up activities that you can include at the end of the lesson or a few days later to support the learning outcomes. You can choose to run this in one session or over multiple days.

All videos, documents, printouts and support resources referenced in this document can be found on a dedicated section of our website. Go to **generationscience.co.uk** and click **Sign in**. Use the account details below to sign-in and select which product you have.

Username: generationscience@scifest.co.uk
Password: GenSci2022

SUPPORT

Should you find yourself stuck with anything related to the activity, we have set-up a dedicated email address on which to contact our staff. Whether it is on technical, scientific or practical matters we are here to help. Simply contact us at **generationscience@scifest.co.uk** with your questions.

We have also created bespoke teacher CLPL to support you and your colleagues in the development and delivery of STEM-related activities. This resource has been designed to be used by any teachers at your school, not just those that have access to this box, and can be found at the website address detailed above.

SPEEDY SAILS: BEFORE THE WORKSHOP

DETAILS

Target age group: P4-7

Minimum time required: 60 minutes

AT A GLANCE

Pupils will find out about forces and basic design principles and apply this knowledge to build the fastest land yacht they can! Following a series of e-demonstrations, pupils will undertake activities – including drawing a design sketch and prototyping a paper airplane – before they build, test and tweak a racing land yacht.

SESSION OVERVIEW

Speedy Sails explores the design process and asks how forces affect the movement of objects. In a series of 'training videos' pupils watch demonstrations on forces and design a racing land yacht, before testing it and making changes to make it more efficient.

The session is delivered via a series of **pre-recorded videos**, after which pupils **carry out specified activities**:

1. INTRODUCTION	**Video**	Introduction to the storyline.
	Activity	Draw a design sketch for a vehicle that is half boat, half car.
2. DESIGN	**Video**	Pupils learn about the basic principles of design.
	Activity	Choose a land yacht body and evaluate the material chosen.
3. FORCES	**Video**	Pupils explore the basic concepts behind forces.
	Activity	Build a paper airplane to explore the effect of shape on forces.
4. DRAG	**Video**	Pupils explore streamlined shapes and their effect on drag.
	Activity	Attach a sail to their land yacht design.
5. FRICTION	**Video**	Pupils explore friction and where it occurs on their land yacht.
	Activity	Finish building the yachts, test them and evaluate their designs.
6. TROUBLESHOOTING	**Video**	This optional video allows the class to explore common problems and how to fix them.
	Activity	Continue to tweak and test designs.
7. GOODBYE	**Video**	Workshop wrap-up
	Activity	Teachers are encouraged to take photos of the designs and share them with us.

KEY LEARNING OUTCOMES

Pupils will be able to represent their current understanding as they:

- Recall that designers prototype and test their designs to make them better.
- State that a force is a push or pull on an object.
- Identify the forces drag, friction and gravity.
- Predict why one design is more efficient than another.

CURRICULUM LINKS

Speedy Sails complements the following experiences and outcomes:

SCN 1-07a: By investigating forces on toys and other objects, I can predict the effect on the shape or motion of objects.

SCN 2-07a: By investigating how friction, including air resistance, affects motion, I can suggest ways to improve efficiency in moving objects.

TCH 1-09a: I can design and construct models and explain my solutions.

TCH 1-10a: I can recognise a variety of materials and suggest an appropriate material for a specific use.

TCH 1-11a: I can explore and experiment with sketching, manually or digitally, to represent ideas in different learning contexts.

TEACHER BACKGROUND INFORMATION

Forces and motion

A force is something that either pushes or pulls on an object. Sometimes this results in the object moving and sometimes it can cause the object to speed up or slow down. A force always has a direction, for example, when you walk into the wind the force driving you forwards is drawn in one direction and the force of the wind pushing against your body is drawn in the opposite direction.

Balanced and unbalanced forces

When two forces acting on an object are equal in size but in opposite directions, the forces are balanced. In this situation the object will stay still or continue moving at the same speed and direction. When two forces acting on an object are not equal, the forces are unbalanced. Unbalanced forces lead an object to speed up, slow down or change direction.

Friction and drag

Friction happens when two surfaces rub against one another. It causes the movement of an object to slow down. Drag is the name given to a type of friction when objects 'rub' against particles as they move through fluids (anything that flows) like water or air. Minimising friction is important for building a fast-moving object.

Streamlined shapes

Changing the shape of an object to make it more streamlined helps to reduce drag and allows it move through fluids (including air) more easily. One of the most streamlined shapes is a tear drop. When air hits the curved end it flows smoothly over the top of the shape towards the pointed end. Tapering the shape into a point stops turbulence forming at the back of the object.

Design principles

Although there is no single design process, there are some important shared principles:

- Prototyping – designs should be built, tested and rebuilt many times before going into production.
- Problem solving – designers should identify what problem needs to be solved before designing an item e.g., making a car fast enough to win a race or making a utensil that peels carrots efficiently.

EQUIPMENT

For the class:

- 1 x floor fan (you can add another fan or hairdryer to make a second testing space if you wish).
- Scissors.*
- Pens/pencils (for drawing).*
- Building materials (these can be split between groups or put into trays for students to take): string (pre-cut), paper straws, thumb tacks, rubber grommets (to secure the wheels), lolly sticks, elastic bands, tape.

For each pair or team of pupils:

- 2 x yacht body (one block, one wedge).
- 10-12 x wheel selection.
- 9 x sticks (3 lengths of 3 each, the longest for the mast, the shorter for the axels).
- 3 x sails of different shapes/sizes.
- 1 x challenge card, double sided (detailing yacht build and paper airplane build).
- 8 x sheets of A4 paper.

NB: There will be spares leftover for the redesign process.

Please note all items marked * are not supplied in the *Generation Science* 2022 kit. If you are unable to source these, please get in touch with the *Generation Science* team.

PREPARATION

Before the workshop:

- Read the this welcome booklet fully to prepare you for the workshop.
- Split the land yacht kits and building materials up as suggested below or in a way that suits your class and rules around sharing materials.
- Create a 1.5 x 0.5m space in the classroom (or appropriate other room) where pupils can test their yacht designs. You can use some of the tape in the kit to mark a start and end point if you wish. Place the fan at one end of the test space for use during the testing phase.
- Identify a space in the classroom (or appropriate other room) where pupils can test their paper airplanes. This could be at the front or down the side of the classroom where you can be sure no pupils will be hit. Pupils can take turns to ease congestion.
- Make sure all the pupils have a clear view of the videos.
- Collect scissors and distribute one pair to each pair of pupils. Make sure they all have pens/pencils and paper for drawing activities.
- Decide if you want the pupils to build one land yacht per pair, or one each – for larger classes (25+) building in a pair will give them more options for changing their designs later and alleviate the problem of sharing or swapping kit.
- Watch the first two videos to give yourself a sense of the style of the video and the links to activities.
- Decide who will be the 'Chief Tester' who manages the land yacht testing area by operating the fan – this can be you, a classroom assistant, or the pupils themselves.
- If you have stopwatches available, you can time the land yachts. This is not essential to the workshop.

SPEEDY SAILS: DURING THE WORKSHOP

LESSON PLAN

Details of the individuals activities can be found below. They are described in the suggested order but can be completed as you wish. In the 'Why not try' section, we have suggested way to frame the activity and short follow up activities to to emphasize the learning outcomes. Each section tells you if there is a video accompanying the activity.

SECTION	TEACHER GUIDANCE
Introduction video	1. Play the *Introduction Video*. 2. After the video, support the design sketch activity. Paper is provided if you need it. 3. Get feedback from the pupils on what they drew.
Design Video	1. Play the *Design Video*. 2. Facilitate answers to the question, *"What material would you choose to make a car, and why?"* You can pause for extra time. 3. At the end of the video, help pupils select a yacht body and get feedback on the question *"Why did we choose this material and are there are better ones you can think of?" [A: because it is light, strong and easy to change the design later].*
Forces Video	1. Play the *Forces Video*. 2. At the end of the video, support the students in making a paper airplane and ask them to write their name on their design. Use the paper plane challenge card to help you. 3. Take the pupils to the airplane testing zone as a group or in pairs. You might want to specify some safety rules to ensure a safe testing environment.
Drag Video	1. Play the *Drag Video*. 2. When the video presenter suggests it, demonstrate throwing 1] a normal sheet of paper to see how far it goes 2] a paper airplane in comparison. 3. At the end of the video, support pupils in attaching a mast and sail to their yacht bodies. Use the land yacht challenge card to help you.
Friction Video	1. Play the *Friction Video.* 2. At the end of the video, support the pupils to add wheels to their design. 3. Support the land yacht testing station, where pupils test their designs a couple of times, before going back to their desks to tweak them. 4. Ensure all pupils have tested their design at least once before playing the optional troubleshooting video.
Troubleshooting Video [optional]	1. Play the *Troubleshooting Video* [optional]. 2. At the end of the video, support the pupils in redesigning and testing their yachts.
Goodbye Video	1. Play the Goodbye Video. 2. If you wish, you can take photos of the pupils' designs and share them on social media tagging us **@EdSciFest**, we'd love to see what you create!

SPEEDY SAILS: AFTER THE WORKSHOP

LESSON SUPPORT

The lesson support section gives you a list of links to videos and websites that you can use to talk more about this topic. We have suggested whether each link is useful to watch as a class, for young people to do at home or as an activity for you prepare. Finally, we have suggested two follow up activities you can do with classroom resources to expand on the learning outcomes.

FOLLOW-UP IDEAS

Workshop:
Expand the land yachts. Pupils take their designs home and add materials they find there, or build a new vehicle using only materials they can find at home *#AtHome*
www.youtube.com/watch?v=_BQg2fc4cJM

Workshop:
Building hovercrafts. Students can build their own hovercraft, using videos like the one below to guide them: *#WatchTogether #Activity*
www.youtube.com/watch?v=DikofrxCiXs&ab_channel=MarthaStewart

Art project:
Rapid prototyping. Using playdough, or a similar material, give pupils three machines to design. These can be real or fictional machines that solve a problem. The ideas for these machines can be generated by the pupils themselves. *#Activity*

Art and design project:
Machines of the future. Pupils draw design sketches of vehicles from the future that solve a problem e.g., vehicles that fly you to school quickly, vehicles/cars that can't cause accidents. This can include detailed material lists, multiple designs for testing, and a fictional pitch to a design company like Edinburgh Science Studios explaining how their idea solves a problem. *#Activity*

Science experiment:
Explore thrust (a type of push force) and Newton's third law of motion using an alkaseltzer rocket. *#Activity*
sciencebob.com/build-a-film-canister-rocket/

Lesson plan:
Exploring renewable energy sources. Having used the wind as a renewable energy source for their land yachts, explore other renewable energy sources. This can include a report on current renewables and what we might use in the future.
#Activity #AtHome

USEFUL LINKS

BBC Bitesize forces and motion (for pupils and teachers). *#AtHome*
www.bbc.co.uk/bitesize/topics/znmmn39

Newton's third law of motion (for teachers):
www.physicsclassroom.com/class/newtlaws/Lesson-4/Newton-s-Third-Law

Confusion about Newton's third law (for teachers):
www.khanacademy.org/science/high-school-physics/forces-and-newtons-laws-of-motion/newtons-third-law-2/v/more-on-newtons-third-law