

Formula One

Science, Technology and Mathematics - Level 4

The Learning Context:

In this unit students will work in co-operative groups to design and make a non-motorised go-kart that can be raced in a 'Formula One' event. This unit can be implemented across a senior syndicate or the entire school (with slight adaptations to the achievement objectives and learning outcomes).

In the first part of this unit students will carry out a range of investigations to explore the scientific ideas of kinetic energy, friction, and gravity. In this exploratory phase students will also identify the main structural parts of a go-kart and understand how they are assembled by viewing several different go-kart models (either real examples or from photographs) and/or interviewing a go-kart enthusiast.

In the next part of the unit students will brainstorm and source a range of material resources that are needed for the construction of their go-karts. Some resources could be salvaged from the local recycling station, builders' yards, etc, and some materials will need to be purchased. Each group will need to fundraise or apply for sponsorship from a local business to finance their go-kart. Business names could be painted across the go-karts in exchange for funding.

Students will then design and construct their go-karts using shared success criteria to guide them. Adult family members (eg: dads, mums, uncles, older brothers, etc) could assist students in the construction phase of the project. Once constructed, the go-karts will need to be tested and modified if necessary.

*In the final part of the unit the 'Formula One' racing event will be organised and held. Each group will race their go-karts in a round of heats and students will take it in turns to be the drivers and crew members. The fastest and most durable go-karts will be entered into the final race and an overall champion will be announced.
Approximately 15 lessons*

Achievement Objectives:

SCIENCE CURRICULUM: Level 4:

Investigating in Science:

Build on prior experiences, working together to share and examine their own and others' knowledge.

Ask questions, find evidence, explore simple models, and carry out appropriate investigations to develop simple explanations.

Physical Enquiry and physics Concepts: *Students will explore, describe, and represent patterns and trends for everyday examples of physical phenomena, such as movement, forces, electricity and magnetism, light, sound, waves, and heat. For example, identify and describe the effect of forces (contact and non-contact) on the motion of objects; identify and describe everyday examples of sources of energy, forms of energy, and energy transformations.*

Enterprising Attributes:

- Generating, identifying and assessing opportunities.
- Generating and using creative ideas and processes.
- Identifying, solving and preventing problems.
- Matching personal goals and capabilities to an undertaking.
- Working with others and in teams.
- Identifying, recruiting and managing resources.
- Planning and organising.
- Identifying, assessing and managing risks.
- Communicating and receiving ideas and information.

Teachers to observe and collect evidence of these enterprising attributes in action

<p>TECHNOLOGY CURRICULUM: Level 4:</p> <p>Technological Practice: Brief Development: Justify the nature of an intended outcome in relation to the need or opportunity. Describe the key attributes identified in stakeholder feedback, which will inform the development of an outcome and its evaluation.</p> <p>Technological Knowledge: Technological Products: Understand that materials can be formed, manipulated, and/or transformed to enhance the fitness for purpose of a technological product.</p> <p>MATHEMATICS AND STATISTICS CURRICULUM: Level 4:</p> <p>Number and Algebra: Number Strategies: Find fractions, decimals, and percentages of amounts expressed as whole numbers, simple fractions, and decimals.</p> <p>Geometry and Measurement Strand: Measurement: Use appropriate scales, devices, and metric units for length, area, volume and capacity, weight (mass), temperature, angle, and time.</p>	<p>Resource Requirements:</p> <ul style="list-style-type: none"> • A range of recycled materials to make go-karts from, eg: tyres, off-cuts of timber, nails, screws, corflute, rope, etc. These may be acquired from local recycling stations, builders' yards, hardware shops, signage shops, etc. • Go-kart instructions. See: www.things2make.com www.stotfoldscouts.org.uk/soapbox/instruct.htm www.kartbuilding.net/Wooden_Go-Kart_Plans/index.html • A go-kart enthusiast. • Adult family members or friends to help during the construction process. <p>Suitable racing venue with slight downhill runs if possible, eg: school field, local park, etc</p>
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Learning Outcomes:

Students will be able to:

1. Explain how the energy of movement can be affected by friction and gravity.
2. Describe the key components of a go-kart and explain how they work.
3. Identify and source a range of resources that can be manipulated and used for the construction of a go-kart.
4. Work in co-operative groups to design and construct a non-motorised go-kart for a 'Formula One' race that uses a simple steering system and a brake mechanism.
5. Complete a financial plan to estimate the cost of the go-kart project and keep financial records to document income and expenditure.

Evaluate the success, or otherwise, of their completed go-kart.

Teaching and Learning Sequence

NB: Teachers are encouraged to gauge the prior knowledge of their students before implementing each unit so that they can provide personalised and meaningful learning opportunities. The teaching and learning sequence provided in each unit is to be viewed as a guide only. Teachers will need to adapt this sequence to meet the needs of their students, school and community.

The Future Focus issues of Citizenship and Enterprise can be explored during this unit. Students will explore being innovative and enterprising through designing, making and racing their go-carts. They will then create an event that people in the community can enjoy. They will see citizens in the community helping them through sponsorship and design ideas. Enterprising people work in partnership with the community.

The numbered activities listed below are learning steps rather than lessons. Teachers may choose to combine two or three learning steps into one lesson. Alternatively, they may spread one learning step out over several lessons. This will be largely dependent on students' prior knowledge and their subsequent learning needs.

Getting Started:

The students complete the Taster/Starter Activity called 'Classroom Grandprix' (page 17) where they make and race a movable vehicle out of vegetables and fruit.

The unit and focus for learning is described to the students. Explain that students will be designing and constructing a 'real' go-kart that will be raced in a 'Formula One' event. Students will need to:

- Carry out a range of investigations to explain the scientific ideas of kinetic energy, friction and gravity.
- Identify the main structural parts of a go-kart and understand how they are assembled.
- Create a design brief for their prototype go-kart.
- Source a range of material resources that are needed to make go-karts.
- Carry out fundraising or organise sponsorship to finance the project.

The class creates a timeline for the unit with key dates for critical actions. This process will make the teaching sequence of the unit explicit to the students.

Exploring:

1. The teacher asks students what they already know about movement, force, friction and gravity. Students' prior knowledge is recorded on posters.
2. The teacher sets up the opportunity for students to carry out several investigations to explore the scientific ideas of kinetic energy, friction and gravity. See the ideas listed below:
 - Make a long ramp by laying a wide piece of wood against a table or chair. Run a toy car down the ramp several times and observe what happens. Use a different toy car that has larger, more textured wheels. Observe what happens. Use a heavier toy car and observe what happens. Compare a heavy, small car to a heavy large car. Which moves more quickly?
 - Place felt, carpet or another type of thick material over the wood and run a toy car down the ramp again. What happens to the speed of the cars?
 - Change the gradient (steepness) of the ramp. What happens to the speed of the cars now?
 - Take 2 cars, one that is lighter than the other, and push them across a smooth flat surface. Which car travels the furthest?
 - Students draw conclusions from their investigations. Students should consider the weight, size, and aerodynamics of each car tested.
 - Students make connections between the scientific knowledge gained in these investigations and the future design and construction of their go-karts. Should they use heavy materials or light materials? What would the best wheel surface be? Are big wheels or small wheels better? Would big go-karts or small go-karts move faster? etc. Learning Outcome 1, **Communicating and receiving ideas and information**

LINKS TO BES Best Evidence Synthesis

5. Quality teachers create effective and sufficient learning opportunities.

3. Quality teachers recognise and build on students' prior knowledge.

4. Quality teachers use the existing effective models as defined in science.

8. Quality teachers ensure tasks and classroom interactions provide support and guidance to facilitate student learning.

3. Students observe a range of non-motorised go-karts by viewing 'real' vehicles or looking at photographs. Students sketch observational drawings of the go-kart/s and determine the life span of the go-kart they will make, e.g. one race, many races, etc.
4. A go-kart enthusiast (this could be a parent or grandparent who has made a go-kart in their youth) is invited to school to explain the main parts of a go-kart, and to demonstrate how go-karts are assembled and how the brakes and steering can operate. Students may have a list of questions that they want to ask the guest speaker to gain the required knowledge and skills to make a go-kart of their own. Learning Outcome 2, **Communicating and receiving ideas and information**
5. Students revisit their observational sketches that they made at step 3 and label the different parts of the go-kart using the knowledge that they gained from the guest speaker. Learning Outcome 2, **Communicating and receiving ideas and information**
6. The teacher and students obtain a range of written instructions for making non motorised go-karts (see recommended websites in resource list and library books) and they read these during guided reading sessions. Students list the material resources that are recommended within these instructions and also create posters to explain the different aspects of assembly, eg: constructing an axle, attaching the wheels, making a brake mechanism, creating a steering system, etc. Learning Outcomes 2 and 3, **Communicating and receiving ideas and information, Identifying, recruiting and managing resources**

Planning and Organising

7. The teacher takes the students to the 'Formula One' race track and explains the circuit.
8. The teacher and students create a list of shared success criteria for their completed go-karts. Suggested criteria could include: Go-karts have a brake that works; Go-karts can be steered by the driver; Go-Karts are durable and do not fall apart; Go-karts move quickly; Go-karts are creatively presented with paint, signs, flags, ribbons, Go-karts last more than one race – can be used over Christmas break, etc. **Excellence**
9. Students prepare a final design brief for their go-kart prototypes.
10. The teacher and students add further ideas to the list of material resources that they began at step 6 using the success criteria to guide them. Students investigate where they could obtain each resource from and find out the cost of the resource if it is to be purchased. The students write a letter to the local recycling station and to local trades-people asking for donations of wood, nails, scrap metal, pram wheels, etc. The teacher and students begin collecting donated resources. Learning Outcome 3, **Identifying, recruiting and managing resources, Generating, identifying and assessing opportunities**

2. Quality teachers encourage learners to work as a community.

11. Students form groups with 3 or 4 members and begin designing their go-karts (each group will produce one go-kart). Students need to draw and label the go-kart that they intend to make, list the required resources to meet specifications and success criteria, identify which resources are 'free' (ie: donated materials) and which resources will need to be purchased, keep a record of income and expenditure, and write instructions to outline how they will construct the vehicle. Students will need to find out the price of the resources that need to be purchased and either fundraise to meet the costs or apply to local businesses for sponsorship (potential fundraising ventures could be a lunch time car wash for teachers; making and selling popcorn to students; or weeding neighbour's gardens). Students will also need to access the required tools (hammer, saw, measuring tape, etc) and they may choose to invite an adult family member to school to help in the construction process. Learning Outcomes 3, 4 and 5, **Generating and using creative ideas and processes, Working with others and in a team, Planning and organising, Identifying, recruiting and managing resources** **Respect**

3. Quality teachers establish effective partnerships with families.

Constructing and Testing:

12. The go-karts are constructed. NB: A range of roles and responsibilities will need to be allocated to students within each group during the construction phase. These could include: resource manager, financial controller, builder/s, decorator/s, time manager, quality controller, etc. Each student will need to accept 2 or 3 roles. Learning Outcomes 4 and 5, **Matching personal goals and capabilities to an undertaking, Working with others and in a team, Identifying, recruiting and managing resources** **Integrity**
13. Students in their groups identify the risk associated with their Formula One Go-cart race and formulate a plan to manage those risks. The groups compare notes, and decide on the rules for the race to keep spectators, drivers and race crew safe. **Identifying, assessing and managing risks.**
14. Students test drive the completed go-karts and use the success criteria to evaluate them. Students make any necessary modifications. Learning Outcome 4, **Identifying, solving and preventing problems**

The 'Formula One' Event:

15. Students promote the 'Formula One' event by visiting other classes (if being done by a single class or syndicate) and by writing invitations to parents and caregivers. Students may also choose to invite staff members from the building recycling station and/or trades-people who donated material resources. Local business managers who sponsored individual teams could also be invited to the event.
16. The 'Formula One' event is held. Students take it in turns to be the driver and race crew during the heats and finals. **Community and participation**
17. Students evaluate their go-karts against the shared success criteria and reflect on the learning that took place during the unit by discussing the reflective questions below: Learning Outcome 6

Reflective Questions:

Exploring new knowledge and skills

- What is kinetic energy?
- What slows down moveable objects?
- What speeds up moveable objects?
- What are the main structural components of a non-motorised go-kart?
- How well did we carry out our responsibilities when constructing our go-kart?
- How do we feel about our completed go-kart?
- Would we do anything differently next time?
- What other resources could be used to construct a go-kart?
- This unit links knowledge and skills from Mathematics, Technology and Science. How has each of these subjects contributed to your knowledge and how has that knowledge been used to design and race your go kart?
- How did the combining of knowledge from a range of learning areas lead to your innovation?

Exploring what it is to be innovative and enterprising

- What step/s were you doing when you used each of the Enterprising Attributes? Break each attribute into its separate words and refine your answers.
- How could you improve on using the Enterprising Attribute/s for next time?
- Can you transfer this learning to your other topics?

Exploring further future focus issues

- Who is responsible for organising community events? Why would we want to engage in innovation and enterprise, take risks, and do it for the community?
- What role do sponsorships have in supporting community events.

Possible Assessment Ideas/Activities:

Science: Students observe and handle a range of toy cars and select which car would travel the fastest down a slope giving justification for their decision. Students test their predictions.

Technology: The teacher observes how students work together to create a go-kart that meets the shared success criteria. The teacher pays particular attention to the way that students follow a technological process and make decisions about the construction.

Mathematics: The teacher observes how well students use measurement skills and number knowledge to create and budget for the go-kart.

Handy Hints:

- Make sure your parents are fully informed about their role in this activity. They also need to know that the key purpose of this activity is to learn about science and to learn how to work through a process applying the Enterprising Attributes. It is not about winning the race!
- The Ministry Publication “Building Science Concepts: Marbles – Exploring Motion and Forces’ is a useful text for exploring the scientific concepts of this unit.
- Students from a local high school could work in partnership with the students to construct the go-karts.