

MISSION 4 (Intermediate)

Gear Up, Gear Down!



Mission Aim:

Explore how combining gears in different combinations can affect speed and strength

Success Criteria:

- Understand how different gearing affects speed and force
- Explore what gear ratio is
- Test how different gear combinations perform in different real-world challenges

Key words:

Gears: Gears are wheels with teeth that fit together. When one gear turns, it makes the next gear turn too - but in the opposite direction

Gearing up: More speed, less power. A small gear turns a big gear = goes faster

Gearing down: More power, less speed. A big gear turns a small gear = goes slower but stronger

Torque: Torque is the power that makes something turn. It's like the 'twisting force' that helps wheels or gears spin

More torque = Stronger turning power (good for climbing or pushing)

Less torque = Weaker turning power, but can go faster

Resources for Mission 4:

Pre-build Models: (Build Guides in the Build Guide Folder):

- Build (or have pupils build) **ONE SPIKE SPEEDY** and **ONE SPIKE STRONG** using the Build Guides. They look like this:



- Build (or have pupils build) **TWO SPIKE SLEDGES** (to carry water bottles). They look like this:



Additional resources:

- Create a 'racetrack' and a ramp – use cardboard/table/wood
- X4 500ml water bottles and water (see PP Notes)
- Print pupil certificates ([CS5_Certificate](#))

Mission 4 Summary:

- Pupils will be introduced to gears, gear ratios and the different gear combinations used in SPIKE SPEEDY and SPIKE STRONG
- Pupils will test how different gearing combinations can affect speed and strength in a flat track race and a ramp challenge

Mission 4: FLEXIBLE LEARNING PLAN

ENGAGE:

10-15 mins approx.

- Briefly introduce pupils to Mission 4 and the Mission 4 Aims by showing **SLIDES 1-3** of the Mission 4 Learning Presentation ([CS5_IM4_Presentation.pptx](#)).
- Show **SLIDES 4-6** to introduce gears (gearing down and gearing up). Note: Animated slides will aid explanations.
- Show **SLIDE 7** to check understanding: ask pupils to vote on whether each machine or situation is geared for strength or speed.

SUPPORT AND/OR CHALLENGE:

Teacher might create a glossary of new terminology to the board to support literacy skills.

EXPLAIN:

10-15 mins approx.

- Play **SLIDE 8** to show how SPIKE SPEEDY and SPIKE STRONG were constructed and reveal the two pre-built models.
- Show **SLIDE 9** and give pupils the opportunity to examine the 2 gear setups.
- Show **SLIDES 10-11** to explore the direction the gears move and to explain how SPIKE SPEEDY'S gears have been combined.
- Show **SLIDES 12-13** to introduce gear ratio and to explore how it is calculated.

SUPPORT AND/OR CHALLENGE:

If pupils are new to gears, they might need to consolidate their understanding of gears and gear combinations (**SLIDES 8-11**) rather than introducing gear ratios in this mission.

If pupils are confident with gears, they might be ready for you to introduce gear ratios (**SLIDES 12-13**).

EXPLORE

30 mins approx.

- Show **SLIDE 14** to explore the code used for SPIKE STRONG and SPIKE SPEEDY
- Display **SLIDE 15**, reveal the SPIKE Sledge build and introduce the two experiments:
- Set up the racetrack experiment (with the Sledge and water bottles). Run the code on each robot - found in the Programs folder. There is code for SPIKE SPEEDY and code for SPIKE STRONG.
- Show **SLIDES 16-19** to conduct Experiment One (Light Load), Experiment Two (Medium Load), and Experiment Three (Heavy Load). See Presentation Notes for detail.
- Set up the 'The Ramp' experiment (without the Sledge) and show **SLIDES 20-22** to conduct Experiment Four (Ramp 10 Degrees), Experiment Five (Ramp 20 Degrees), and Experiment Six (Ramp 30 Degrees). See Presentation Notes for detail.

SUPPORT AND/OR CHALLENGE:

To simplify the experiment for pupils, you could just race SPIKE SPEEDY and SPIKE STRONG once or twice on a racetrack and once or twice up a ramp and compare how they perform.

Some pupils might want to develop each experiment further - see **SLIDE 19** and/or **SLIDE 22** - see Notes: (OPTIONAL) Next Steps for teaching.

EVALUATE AND CELEBRATE:

5 mins approx.

- Show **SLIDE 23** and review 'What Happened?'
- Show **SLIDE 24** to review the Mission 4 Aims
- Show **SLIDE 25-26** to summarise what pupils have learned about Smart Speed having taken part in the Coding Success 5 missions - celebrate their success and present certificates.

SUPPORT AND/OR CHALLENGE:

As an extra-curricular activity, pupils might research gears and geared vehicles in more detail.

Some pupils might enjoy extending their learning outside lesson time, by taking part in **Coding Success: CLUB (SLIDE 28)**

Discover more:

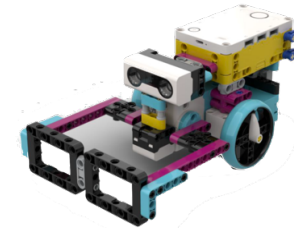
For more Coding Success lessons that demonstrate how to apply SPIKE Prime coding skills to new challenges, why not try...

CODING SUCCESS 1



Lesson 5 builds on previous CS1 Missions: pupils will code the SPIKE Prime Rescue Vehicle supporting islanders affected by an earthquake to tackle a series of mat-based challenges. Available at 2 different levels: Beginner (Word Blocks) and Advanced (Python).

CS1 Lesson 5: Tsunami Situation

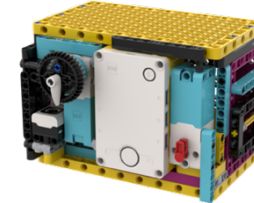


CODING SUCCESS 2



Mission 4 can be delivered as a stand-alone lesson. Pupils will learn what encryption and decryption are. They will decrypt 4 encrypted messages that provide the code needed to crack open the SPIKE Prime Safe. Available at 3 different levels: Beginner and Intermediate (using Word Blocks) and Advanced (using Python).

CS2 Mission 4: Cyber Secure



CODING SUCCESS 3



Mission 4 builds on previous CS3 Missions: pupils are challenged to code a SPIKE Prime Electric Vehicle (EV) to retrieve, relocate or recycle 'green' infrastructure without running out of charge! Pupils develop strategic thinking and applying their maths and coding skills to tackle new mat-based challenges! Available at 3 different levels: Beginner and Intermediate (using Word Blocks) and Advanced using Python.

CS3 Mission 4: Charging Up!



CODING SUCCESS 4






Mission 4 can be delivered as a stand-alone lesson. Pupils are introduced to the theme of Artificial Intelligence by exploring hardware and code of the SPIKE Prime Learner robot, evaluating whether Learner has features of AI. They will also explore the importance of human qualities and skills in the world of robotics and AI. Available at 3 different levels: Beginner and Intermediate (using Word Blocks) and Advanced using Python.

CS4 Mission 4: Skills Boost!



Computing/Computer Science Links

	<p>Key Stage 2</p> <ul style="list-style-type: none"> • Design programs that accomplish specific goals. • Debug programs that accomplish specific goals. • Use repetition in programs. • Control or simulate physical systems. • Use logical reasoning to detect and correct errors in programs. • Work with various forms of input. • Work with various forms of output. 	<p>Key Stage 3</p> <ul style="list-style-type: none"> • Design, use and evaluate computational abstractions that model the state and behaviour of real-world problems and physical systems. • Understand several key algorithms that reflect computational thinking • Use logical reasoning to compare the utility of alternative algorithms for the same problem • Understand simple Boolean logic and its uses in programming
	<p>Second Experience & Outcome (to end of P7)</p> <ul style="list-style-type: none"> • TCH 2-14a: I can explain core programming language concepts in appropriate technical language. • TCH 2-15a: I can create, develop and evaluate computing solutions in response to a design challenge. 	<p>Third & Fourth Experiences & Outcomes (S1 – S2)</p> <ul style="list-style-type: none"> • TCH 3-13b: I am developing my understanding of information and can use an information model to describe particular aspects of a real-world system. • TCH 3-15a: I can select appropriate development tools to design, build, evaluate and refine computing solutions based on requirements. • TCH 4-13a: I can describe in detail the processes used in real world solutions, compare these processes against alternative solutions and justify which is the most appropriate. • TCH 4-13b: I can informally compare algorithms for correctness and efficiency. • TCH 4-15a: I can select appropriate development tools to design, build, evaluate and refine computing solutions to process and present information whilst making reasoned arguments to justify my decisions.
	<p>Progression Step 3</p> <ul style="list-style-type: none"> • I can use conditional statements to add control and decision-making to algorithms. • I can identify repeating patterns and use loops to make my algorithms more concise. • I can use sensors and actuators in systems that gather and process data about the systems' environment. • I can explain and debug algorithms. 	<p>Progression Step 4</p> <ul style="list-style-type: none"> • I can plan and implement test strategies to identify errors in programs. • I can apply design principles in order to design a range of efficient user interactions.

Skills Builder – Universal Framework



During each lesson, you might wish to highlight one or more of the essential skills that students build over their lifetime. You might give students the opportunity to reflect on how successful they have been in developing these skills. You can download resource M1_SkillsBuilder for further details of how the 'Universal Skills Builder Framework' links to the [Coding Success 5](#) project. Further details of the Skills Builder Framework and assessment opportunities can be found at www.skillsbuilder.org

Gatsby Framework

The Gatsby Career Benchmarks is a framework of eight guidelines about what makes the best careers provision in schools and colleges. The resource M1_Gatsby (in Mission 1 resources) provides further details of how the 'Gatsby Framework' links to the [Coding Success 5](#) project.