Stile

Waves

How does someone on the other side of the world see and hear you?

Teaching Plan and Lab Guide

Communication technology
Phones, tablets and computers are incredible communication tools. How do sound and light travel through these devices so we can see and hear someone across the world?

Version 2.0

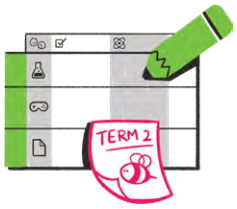
Contents

Teaching Plan

Lab Guide

Everything in one place

Stile is a complete science curriculum. Our digital lessons and hard-copy booklets are designed to help students be the best learners they can be and to give you the tools to do what you do best: teach.



Teacher resources

Student resources

Before class

Find out everything you need to know from the unit's **Teaching Plan** and **Lab Guide**.

In **Prepare Mode** for each lesson, you can:
- Read the detailed teaching notes
- Print a copy to refer to in class
- Customise resources for the needs of your students

Stile X phone app
- Front-load the unit's scientific terminology through flashcards and quizzes

During class

Within **Teach Mode** you can:
- Implement explicit teaching with learning goals and Key Questions
- Use videos, images and text to guide your instruction
- Facilitate discussion with live brainstorms and polls
- View student data instantly to inform your teaching

Stile Digital
- Engage in real-world phenomena through:
  - Practical activities
  - Research projects
  - Classroom lessons
  - Hands-on activities
  - Breaking news
  - Extension lessons
  - Engineering challenges
  - Open-ended investigations

After class

To **Analyse** student work:
- View data in Analyse Mode to determine your next teaching steps
- See a bird's-eye view of student progress in the Markbook
- Release model answers to students
- Provide written feedback where it matters most

Stile X booklets
- Consolidate and revise material learned in class by:
  - Creating structured revision notes
  - Recording definitions in the glossary
  - Completing practice test questions

Stile X phone app
- 60-second summary videos recap key ideas from the Stile lesson

Scan here to view **The Stile Guide**, the essential guide to supercharging your teaching with Stile

Why do gummy bears have different colours?
An object's material determines which wavelengths of light are reflected and which are absorbed.

Teaching Plan

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Storyline and real-world phenomenon

How does someone on the other side of the world see and hear you?

Thanks to new technology, the way we communicate has changed dramatically in the last 30 years. We can now reach out further and faster than ever! But despite our increasing dependence on this technology, few of us understand how it works.

In this unit, students develop models of global telecommunication by investigating how a round-the-world video call works. To explain this phenomenon, they examine how sound and light waves transfer information to digital devices like smartphones. As they progress through the unit, they revise their models to reflect their growing understanding of sound and light energy.

Big ideas

- How do sound and light waves transfer energy?
- How do sound and light interact with different materials?
- How can we use models to understand the flow of energy and information?
- What are the advantages of digital signals over analogue signals?
- How can we help bridge the digital divide?

Highlights

- Develop models to explain global telecommunication
- Complete group challenges to communicate without sound or digital devices
- Use simulations to investigate the properties of sound and light
- Explain why a red gummy bear stops a green laser in its tracks
- Model how information is sent over the internet via fibre-optic cables or satellite systems like Starlink
- Create a social media post to raise awareness about the digital divide
- Write programs for pocket-sized computers to send Morse code messages

*In this unit, students meet **Nigel Stanford,** a composer and musician who is known for his cymatics videos.*

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This unit at a glance

This unit is designed to take five and a half weeks, with four 45-minute class sessions per week.

- Classroom lesson
- Extension lesson
- Pre-test
- Check-in
- Glossary
- Test
- Breaking news
- Practical activity
- Research project
- Hands-on activity
- Engineering challenge
- Open-ended investigation

This icon indicates lessons that have additional revision and consolidation material available in **Stile X**, our hard-copy study booklet and accompanying app.

Waves

Students **activate prior knowledge** about light, sound and colour in this **formative assessment**.

- Pre-test: Waves
- 1. Shining a light on communication
- Micro:bit Lesson 1: Light into sound
- 2. Modelling global communication
- 3. Sound
- 4. Wave properties
- Check-in #1

Students apply their learning so far to **revise and improve** their models of global communication.

- 5. Reflection
- 6. Refraction
- Updating our models
- 7. Brightness
- 8. Colour
- 9. How light interacts with objects
- Check-in #2

Regular **formative assessment** provides a quick check of student progress at pivotal points in the unit.

- 10. The electromagnetic spectrum
- 11. Radio waves
- Micro:bit Lesson 2: Morse code via radio waves
- 12. Digital signals
- Check-in #3
- 13. Satellite communication
- 14. Long-distance communication
- 15. Re-modelling global communication
- 16. Bridging the digital divide

This **summative assessment** assesses students' **curriculum-aligned** knowledge.

- Glossary: Waves
- Test: Waves

Students engage in the **real-world phenomenon** of communication technology by creating and testing a solution to communicate across the room.

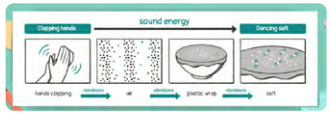
Students **work collaboratively** to **propose a model** of how global communication works.

Students **explore explanations** for the loss of internet connection in Tonga following a volcanic eruption.

Unit storyline

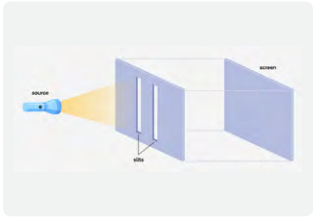
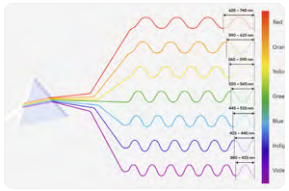
Throughout this unit, students engage with wave and particle models to understand light and sound. They use the context of communications technology to unpack how sound and light are carried around the world through video calls. The use of multiple phenomena supports students to develop scientific skills and understanding. The progression of these phenomena, and how they are observed within lessons, is detailed below.

Phenomenon	Lesson
Communicating without sound or technology 	**1. Shining a light on communication** – Students are introduced to the central theme of the unit – the use of waves in communication technology – and start modelling communication systems – They create and test a solution for communicating across the room using light, and test their solution in a scenario where line-of-sight is obscured
A video call between people on opposite sides of the world  Fast, reliable communication around the world is important to many of us. Have you ever stopped to wonder how it works?	**2. Modelling global communication** – Students build on their understanding of communication across a room to ponder the real-world phenomenon of a video call between people on either side of the world – They work collaboratively on a group model to explain this phenomenon, annotating each step with their thoughts and questions to create a Driving Questions Board

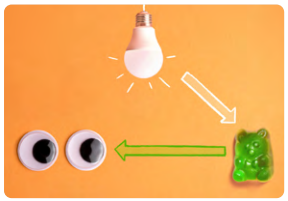
Phenomenon	Lesson
Dancing salt 	**3. Sound** – Students learn about sound and how it travels through mediums to explain the first step of their model – how their voice gets to their phone – They engage in a "Dancing Salt" activity to understand the role of vibrations in the transfer of sound energy
Rubens tube 	**4. Wave properties** – Students explore the phenomenon of a Rubens tube to understand the wavelike properties of sound – They use a simulation to independently investigate the relationship between pitch, wavelength and frequency, as well as volume and amplitude

Unit storyline

Phenomenon	Lesson
Visual occlusion 	**5. Reflection** – Students consider light's role in capturing images and sending information about the appearance of objects – They investigate how light reflects off different objects, and use models to explain how light reflects off their faces towards their phone's camera
Images of large objects captured on tiny sensors 	**6. Refraction** – Students investigate changing the size of an image with and without a lens, and how the properties of lenses affect how light refracts using a simulation – They explain, using refraction, how a lens can change the size of an image to capture a large object on a tiny light sensor in their phone

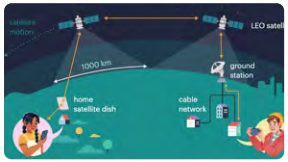
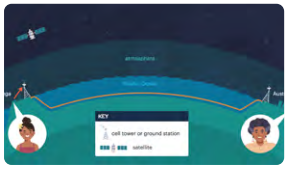
Phenomenon	Lesson
Double-slit experiment 	**7. Brightness** – Students apply an understanding of amplitude, wavelength and frequency to light waves to explain the double-slit experiment – They apply their understanding of the wave properties of light to account for changes in brightness in the images captured by their phones
Splitting white light through a prism 	**8. Colour** – Students explore light refraction through prisms using an interactive to understand colours according to the wave model of light – They apply their understanding of wavelength and frequency to explain the different colours in the video images they are sending across the world

Unit storyline

Phenomenon	Lesson
A red gummy bear stopping a green laser beam in its tracks 	**9. How light interacts with objects** – Students investigate lasers interacting with different coloured gummy bears to explain how the absorption and reflection of particular wavelengths of light make objects appear coloured – They use a simulation to investigate how filters affect coloured light and extend their understanding of colour perception to the pixels on their phone screens
Herschel's "invisible energy" experiment 	**10. The electromagnetic spectrum** – Students explore the next step in explaining video calls by considering how information is sent from their phones to cell towers – They discover visible light is just one type of electromagnetic radiation and explore features of the electromagnetic spectrum

Phenomenon	Lesson
Phone to cell tower communication 	**11. Radio waves** – Students examine why radio waves (and microwaves) are useful for long-distance communication – They explore features of the electromagnetic spectrum and examine the advantages of radio waves for sending messages from their phones to cell towers
Signal loss and noise on analogue and digital devices 	**12. Digital signals** – Students compare analogue and digital information to explain why digital signals are a more reliable way to transfer information from their phones across the world – They examine differences between analogue and digital inputs and outputs, and draw and compare models of analogue and digital signals

Unit storyline

Phenomenon	Lesson
Tonga's loss of the internet following a 2022 volcanic eruption 	**13. Satellite communication** – Students explore the next link in their communication model – how information gets from cell towers to other parts of the world via satellites – They explore explanations for why Tonga lost access to the internet following a volcanic eruption in 2022 and the role satellite tech played in reconnecting it
Optic-fibre lamps 	**14. Long-distance communication** – Students explore how optical fibres are used for most present-day long-distance communication – They model satellite internet and fibre internet, explain the key differences between them, and discuss the advantages and limitations of each type of communication for promoting fair access to the internet

Phenomenon	Lesson
A video call to someone on the other side of the world 	**15. Re-modelling global communication** – Students complete their final model explaining the phenomenon of a long-distance video call – They resolve their Driving Question Boards and reflect on the future of communication from a personal, social and global perspective
The digital divide 	**16. Bridging the digital divide** – Students discover more about the digital divide and why it's an important social issue – They discuss the digital divide and research one aspect of the problem and a potential solution – They create a social media post to communicate their key discoveries

Curriculum alignment

This unit focuses on wave and particle models of energy transfer. Detailed alignment information can be found at the links below.

Click here to view curriculum alignment for Version 8.4 of the Australian Curriculum

Click here to view curriculum alignment for Version 9 of the Australian Curriculum

Click here to view alignment for the NSW Syllabus for the Australian Curriculum

Click here to view curriculum alignment for the Victorian Curriculum

Click here to view curriculum alignment for the Western Australian Curriculum

Prior knowledge

This unit is written with the assumption that students have some existing subject knowledge.

Before beginning this unit, students should be familiar with:

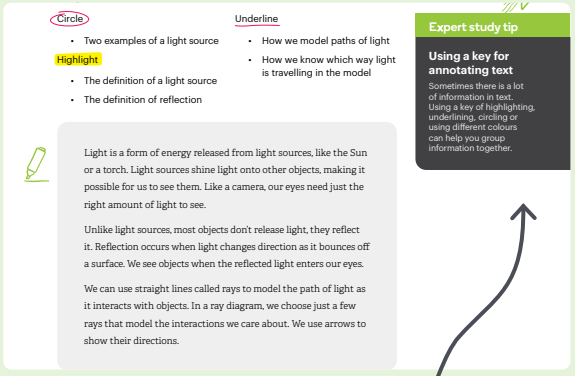
- Identifying sources of light (Primary School **Light** unit)
- Recognising that light travels in a straight path (Primary School **Light** unit)
- How shadows are formed (Primary School **Light** unit)
- The idea that light can be reflected and refracted (Primary School **Light** unit)
- Energy transfer and transformation in simple systems (**Energy** unit)

Stile X: Waves

What's in the Stile X booklet?

Model how to complete the structured **revision notes** as students fill in sections of these pages in class. Any remaining sections can be done at home before the next lesson. As students become more familiar with Stile X, increase independent use both at home and in class.

This unit includes **revision notes** for:
- Wave properties
- Reflection
- Refraction
- Brightness
- Colour
- How light interacts with objects
- The electromagnetic spectrum
- Radio waves
- Digital signals



Read **expert study tips** aloud and discuss them in class to help students build important study skills.

When you see a bolded word in Stile, ask students to turn to the **glossary** pages to record the definition in their own words.

The **practice test** is perfect for revision. Fast finishers can even complete questions as an extension activity during class time. Each question addresses a learning goal from the unit's core lessons.
- Explain how different sounds can be modelled using wave properties
- Explain how the path of light determines which objects we can see
- Explain how materials can be used to change the path of light
- Explain the result of the double-slit experiment using the wave model of light
- Explain colour and brightness by applying the wave model of light
- Model how light interacts with objects of different colours
- Explain how an object's material affects the way light interacts with it
- Explain why light waves can be transmitted through empty space
- Justify which type of wave is best for long-distance communication
- Explain whether digital or analogue signals are more reliable for sending information

Assessment

Stile's assessment tasks require students to apply general capabilities, skills and knowledge to explain phenomena and solve problems. We recommend using the formative assessment opportunities listed to gauge student progress, which will guide your next teaching steps. Self-assessment opportunities are also included in both Stile and Stile X to encourage metacognitive monitoring. Summative assessment tasks are designed to show what a student has learned throughout the unit and can be used to inform your reporting.

Formative assessment

Key Questions

A Key Question is an opportunity for students to demonstrate their progress against a learning goal. Stile lessons include one Key Question for each learning goal. Using the in-class analytics available in Teach Mode, you can use Key Questions to make quick, frequent judgements about student progress. We strongly recommend that you focus on these questions when providing feedback.

Check-ins

Three check-in lessons have been included as formative assessment opportunities in the unit. Check-ins contain self-marking multiple choice and drag and drop questions that will give you a quick snapshot of student learning at pivotal points in the unit. Student results in a check-in assessment will help you determine whether students are ready to progress to the next phase in the learning cycle, or whether further teaching is required.

Lesson type	Lesson name	Question types	Time
Check-in	Check-in #1	Multiple choice, drag and drop	15 minutes
Check-in	Check-in #2	Multiple choice, drag and drop	15 minutes
Check-in	Check-in #3	Multiple choice, drag and drop	15 minutes

Summative assessment

Test

This unit contains a test to provide summative assessment of student learning across the whole unit.

Lesson type	Lesson name	Question types	Time
Test	Test: Waves	Multiple choice, drag and drop, written response	45 minutes

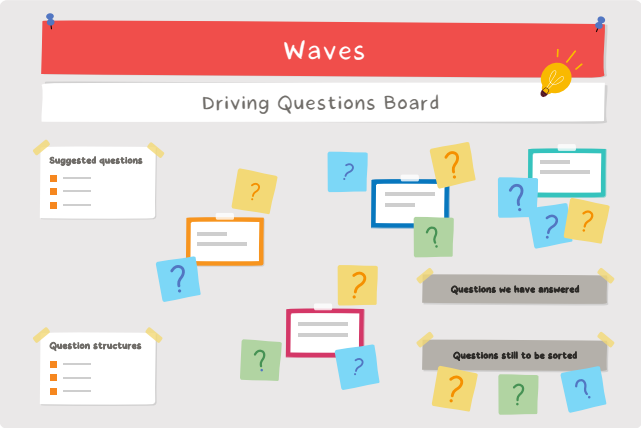
Scientific skills

One project within this unit can be used as a summative assessment of science inquiry skills.

Lesson type	Lesson name	Question types	Time
Research project	16. Bridging the digital divide	Drag and drop, table, written response, open response	45 minutes

Important things to know about this unit

Driving Questions Board



The Driving Questions Board is a visible record of questions generated by students as they develop the curiosity that drives their learning throughout the unit. At the end of Lesson 2. Modelling global communication, students will create Driving Questions Boards in groups.

Throughout the unit, you'll be prompted to ask students to return to their boards and encourage them to review their thoughts, consider what they've learned, answer any questions, and formulate new ones. We encourage you to refer to the boards as you start and finish lessons to help students connect their questions to their learning.

Read more about Driving Questions Boards and how to use them in our blog post at **stileapp.com/go/dqbblog**.

Character conversations

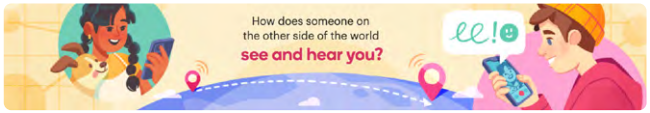
Elina, Lucca, Nigel and Moby the mobile phone are characters included throughout the unit. Speech bubbles are used as a bridge between sections of the lesson and to provide light humour. Where character conversations appear, they should be read in the same way as other sections of text. You might read the conversations aloud, or ask students to "play" the role of a specific character within the lesson.

Fast, reliable communication around the world is important to many of us. Have you ever stopped to wonder how it works?

The role of the guiding question

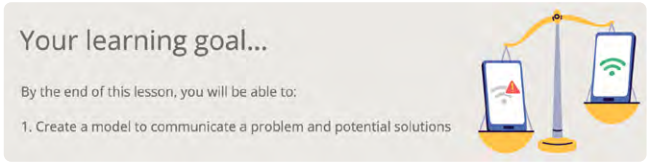
Student curiosity and questioning drive the learning in this unit. Students frequently contribute their questions to the Driving Questions Board, and these questions are drawn upon to drive the learning from the students' perspectives. The guiding question, "How does someone on the other side of the world see and hear you?", is introduced in Lesson 1.

It acts as a support around which you can facilitate discussion, and support students to connect their own questions to the targeted materials.



Learning goals

While student curiosity and questioning drive the learning, the design of the unit as a whole supports students to make sense of phenomena and model their understanding. The use of learning goals guides them toward specific outcomes in each lesson, so that their learning builds toward understanding the phenomenon and designing a solution to the problem. Evidence shows that students who know what is expected of them are more likely to engage in the learning process and achieve better learning outcomes (Hattie, 2012). These goals are introduced following an initial opportunity for students to explore the phenomenon, so that the opportunity for inquiry is maintained.



Important things to know about this unit

Parent email template

This unit includes a pre-written email template that you can use to inform parents about what students are learning in class. You'll find a link to this template in the teacher notes at the bottom of the unit's folder in your Stile subject or you can go to **stileapp.com/go/parentemailwaves**

Copy the text, paste it into an email, and modify it to suit. This is a great way to bridge the gap between school and home, and engage parents in their child's learning.

Lab Guide

The end of this document contains a Lab Guide that includes the materials and methods for this unit's hands-on and practical activities. Pages from the Lab Guide are also linked in the teaching notes of the relevant Stile lesson.

For each practical activity, hands-on activity, engineering challenge or open-ended investigation you'll find:

- Demo videos, which can be viewed before class to help with preparation, or shown to students during class for extra scaffolding
- Handy tips and tricks for making the activity a success
- A RiskAssess template
- An expected final outcome

Micro:bit lessons

This unit includes two optional hands-on activities that use micro:bit pocket computers. If you have access to micro:bit pocket computers, this is an excellent opportunity to integrate Digital Technologies and enhance the learning experience with an additional hands-on element. If you don't have access to these devices, the storyline of the unit will be unaffected if the lessons are omitted. Micro:bits can be purchased from most online electronics retailers. Search "buy microbit" for your closest supplier.

Using lessons in isolation

This unit has a storyline, with each lesson an integrated part of that story. However, we understand that sometimes you want to run a lesson as a stand-alone. In this instance, we recommend editing or removing the character conversations that start each lesson. They often serve the purpose of connecting to the previous lesson in the sequence. Consider adding custom introductory text and images to these lessons to establish the context for your needs.

Light and colour poster

This unit has an accompanying poster about light and colour, available for purchase from the **Stile Shop**. Display this poster on your classroom wall to help students appreciate the amazing beauty and power of light and the science behind it.

Lesson Planning Guide

Week 1 · Week 2 · Week 3 · Week 4 · Week 5 · Week 6

The guide below is based on four 45-minute sessions per week.
Click here to download an editable version of this planning guide.

	Lesson name	Learning goals	Preparation required	Ice breaker	Core of lesson	To close	Revision and mastery
Session 1	**Pre-test: Waves**		Review teaching notes in Prepare Mode Collect Stile X booklets for this unit Find out more about using Stile X in **The Stile Guide** **Send parent email template** 10 minutes	Explain that you are starting a new unit about waves, and students will complete a pre-test to help you find out what they already know	Students complete a pre-test to show what they already know about waves	Hand out Stile X booklets and activate Stile X app	Identify any familiar terms in the glossary section
Session 2	**1. Shining a light on communication** MATERIALS REQUIRED	1. Explain a successful form of communication using a model	Review student answers to Pre-test: Waves in Analyse Mode to gauge students' prior knowledge Review teaching notes in Prepare Mode Print **Morse code sheets** Collect the required materials listed in the **Lab Guide**. 30 minutes	As a class, consider students' use of technology to communicate using a "five-finger" activity	Students work in groups to send a message across the room. First they do this without using devices or sound, then with no line of sight	Students create a model to describe the input, process and output of their communication method	Stile X app: Flashcards Glossary terms: encoding
Session 3	**Micro:bit Lesson 1: Light into sound** MATERIALS REQUIRED ▶▶ *This lesson is optional and can be skipped if you don't have access to micro:bit computers*	1. Create a program that can convert light pulses into sound	Provide feedback on the Key Question from the previous lesson in Analyse Mode Review teaching notes in Prepare Mode Print **Morse code sheets** Collect the required materials listed in the **Lab Guide**. 30 minutes	As a class, read about the use of sound to send messages by Morse code	Students design, write and test code using micro:bit editor	Students play with morse receiver produced	Stile X app: Flashcards
Session 4	**2. Modelling global communication** MATERIALS REQUIRED	1. Model your current understanding of how a long-distance video call works	Provide feedback on the Key Question from the previous lesson in Analyse Mode Review teaching notes in Prepare Mode Print **individual model templates**, **group model templates** and **Driving Question Board title cards** 25 minutes	Consider the 2022 volcanic eruption that left Tonga without access to communications technology	Students create and share models of how information flows around the world during a video call	Students use their group models to construct a Driving Questions Board	Stile X app: Flashcards

	Lesson name	Learning goals	Preparation required	Ice breaker	Core of lesson	To close	Revision and mastery
Session 5	**3. Sound** MATERIALS REQUIRED	1. Explain how sound is transmitted between two places	Provide feedback on the Key and Challenge Questions from the previous lesson in Analyse Mode Review teaching notes in Prepare Mode Collect the required materials listed in the **Lab Guide** Complete the **Risk Assessment Template** 25 minutes	As a class, watch a cymatics video. Complete a *See, Think, Wonder* thinking routine and discuss students' responses	Students complete a hands-on activity to investigate and explain the particle model of sound	Students use a model to explain how voices transfer energy and information	Stile X app: Flashcards Glossary terms: sound, transmission, medium
Session 6	**4. Wave properties**	1. Explain how different sounds can be modelled using wave properties	Review teaching notes in Prepare Mode 10 minutes	As a class, watch a video to observe the wave patterns formed by sound travelling through a Rubens tube	Students investigate frequency and amplitude using a simulation. They describe different representations of sound waves Direct students to the corresponding Stile X revision notes to complete the question: Annotate the waveform with the following terms	Students explain how a Rubens tube models the wave properties of different sounds Assign **Check-in #1** as homework to be completed before the next lesson	Stile X app: Wave properties video Stile X Revision notes: Wave properties Glossary terms: density, amplitude, frequency, wavelength, wave, waveform
Session 7	**5. Reflection**	1. Explain how the path of light determines which objects we can see	Review student results **Check-in #1** in Analyse Mode to determine if students are ready to move on or whether further teaching is required Provide feedback on the Key Question from the previous lesson in Analyse Mode Review teaching notes in Prepare Mode 45 minutes	Students complete a live poll about how light allows us to see	Students distinguish between created and reflected light and investigate how light reflects off different objects	Students create a model to explain how cameras use reflected light to create images Direct students to the corresponding Stile X revision notes to complete the question: Summarise the process of reflection by annotating this diagram	Stile X app: Reflection video Stile X Revision notes: Reflection Glossary terms: reflection, ray
Session 8	**6. Refraction** MATERIALS REQUIRED	1. Explain how materials can be used to change the path of light	Provide feedback on the Key and Challenge Questions from the previous lesson in Analyse Mode Review teaching notes in Prepare Mode Collect the required materials listed in the **Lab Guide** Complete the **Risk Assessment Template** 30 minutes	Observe the multiple sensors on our mobile phones and recognise that those sensors are very small	Students use a hands-on activity and simulation to observe refraction and explain how a lens can change the size of an image	Students apply their understanding of refraction to explain how lenses change the size of images Read the note-taking tip on the last page of the corresponding Stile X revision notes and briefly discuss the concept of summarising as a class	Stile X app: Refraction video Stile X Revision notes: Refraction Glossary terms: lens, refraction

	Lesson name	Learning goals	Preparation required	Ice breaker	Core of lesson	To close	Revision and mastery
Session 9	**Updating our models**		Provide feedback on the Key and Challenge Questions from the previous lesson in Analyse Mode Review teaching notes in Prepare Mode 25 minutes	Students reflect on their models and discuss possible improvements	Students update their group models and upload a photo	Groups review their Driving Questions Board to mark off answered questions and add any new ones	Stile X app: Flashcards
Session 10	**7. Brightness**	1. Explain the result of the double-slit experiment using the wave model of light	Provide feedback on the Key Question from the previous lesson in Analyse Mode Review teaching notes in Prepare Mode 25 minutes	As a class, make and discuss predictions about the results of the double-slit experiment	Students learn about different models of light used to explain light's properties Direct students to the corresponding Stile X revision notes to complete the question: Illustrate how the amplitude of a light wave changes with changing brightness	Students explain how interference between light waves produces the pattern observed in the double-slit experiment	Stile X app: Brightness video Stile X Revision notes: Brightness Glossary terms: wave model, particle model, interference
Session 11	**8. Colour**	1. Explain colour and brightness by applying the wave model of light	Provide feedback on the Key Question from the previous lesson in Analyse Mode Review teaching notes in Prepare Mode 25 minutes	As a class, read a comic about Newton's discovery about light	Students use a simulation to explore the refraction of light through prisms Direct students to the corresponding Stile X revision notes to complete the question: Use the information from the paragraph to illustrate how light separates into the colours of the visible spectrum	Students relate the wavelength and frequency of light waves to colour	Stile X app: Colour video Stile X Revision notes: Colour
Session 12	**9. How light interacts with objects**	1. Model how light interacts with objects of different colours 2. Explain how an object's material affects the way light interacts with it	Provide feedback on the Key Question from the previous lesson in Analyse Mode Review teaching notes in Prepare Mode 25 minutes	As a class, watch a video of a laser interacting with different coloured gummy bears	Students explain how absorption and reflection of light makes objects appear different colours, and they use a simulation to investigate filters Direct students to the corresponding Stile X revision notes to complete the question: Use coloured pencils or markers to model how light from the Sun interacts with the leaf	Students apply their new understanding to explain the laser video Assign **Check-in #2** as homework to be completed before the next lesson	Stile X app: How light interacts with objects video Stile X Revision notes: How light interacts with objects Glossary terms: absorption, filter, photon

	Lesson name	Learning goals	Preparation required	Ice breaker	Core of lesson	To close	Revision and mastery
Session 13	**10. The electromagnetic spectrum**	1. Explain why light waves can be transmitted through empty space	Review student results for **Check-in #2** in Analyse Mode to determine if students are ready to move on or whether further teaching is required Provide feedback on the Key and Challenge Questions from the previous lesson in Analyse Mode Review teaching notes in Prepare Mode 45 minutes	Revisit the group models and Driving Questions Boards to identify relevant questions and ideas	Students explore different types of radiation in the electromagnetic spectrum Direct students to the corresponding Stile X revision notes to complete the question: Summarise the differences between sound waves and radio waves using this Venn diagram	Students compare sound and light waves for use in long-distance communication Read the expert study tip on the last page of the corresponding Stile X revision notes and talk about the benefits of writing practice questions as a class	Stile X app: The electromagnetic spectrum video Stile X Revision notes: The electromagnetic spectrum Glossary terms: radiation, electromagnetic spectrum
Session 14	**11. Radio waves**	1. Justify which type of wave is best for long-distance communication	Provide feedback on the Key Question from the previous lesson in Analyse Mode Review teaching notes in Prepare Mode 25 minutes	As a class, recall and discuss different parts of the electromagnetic spectrum	Students examine the advantages of radio waves for communication Direct students to the corresponding Stile X revision notes to complete the question: Describe the properties of radio waves by completing the sentences	Students revisit and revise their group models	Stile X app: Radio waves video Stile X Revision notes: Radio waves
Session 15	**Micro:bit Lesson 2: Morse code via radio waves** MATERIALS REQUIRED ▶▶ *This lesson is optional and can be skipped if you don't have access to micro:bit computers*	1. Create a program for sending Morse code using radio waves	Provide feedback on the Key Question from the previous lesson in Analyse Mode Review teaching notes in Prepare Mode Print **Morse code sheets** Collect the required materials listed in the **Lab Guide** 30 minutes	Introduce students to the task of upgrading their light-based communication method to use radio waves	Students design, write and test code using micro:bit editor	Students connect the activity back to the unit's guiding question	Stile X app: Flashcards
Session 16	**12. Digital signals**	1. Explain whether digital or analogue signals are more reliable for sending information	Provide feedback on the Key Question from the previous lesson in Analyse Mode Review teaching notes in Prepare Mode 25 minutes	As a class, brainstorm and discuss the advantages and limitations of instant cameras and smartphone cameras	Students draw and compare models of analogue and digital signals Direct students to the corresponding Stile X revision notes to complete the question: Use the empty gridlines to redraw these images at half their original size	Students explain and evaluate choices between analogue and digital forms of communication Assign **Check-in #3** as home work to be completed before the next lesson	Stile X app: Digital signals video Stile X Revision notes: Digital signals Glossary terms: analogue information, digital information

	Lesson name	Learning goals	Preparation required	Ice breaker	Core of lesson	To close	Revision and mastery
Session 17	**13. Satellite communication**	1. Explain how digital signals are sent around the world using satellites	Review student results for **Check-in #3** in Analyse Mode to determine if students are ready to move on or whether further teaching is required Provide feedback on the Key Question from the previous lesson in Analyse Mode Review teaching notes in Prepare Mode 45 minutes	As a class, consider possible explanations for Tonga's loss of communication technology following a volcanic eruption	Students compare types of satellite and consider their suitability for providing internet connection They apply their knowledge to explain how satellite communication and digital signals connect video callers over long distances	Students explore an interactive map of Starlink satellites and complete a thinking routine to interpret data and support a claim with evidence	Stile X app: Flashcards
Session 18	**14. Long-distance communication**	1. Explain how digital signals are sent around the world via the internet	Review teaching notes in Prepare Mode 10 minutes	Students examine fibre-optic lamps and propose explanations for how light travels along curved fibres	Students explore the use of optical fibres in present-day long-distance communication and use models to compare satellite and fibre internet	Students apply their understanding to explain why Tonga lost some, but not all, of its communications with the rest of the world after a volcanic eruption	Stile X app: Flash quiz 1–2
Session 19	**15. Re-modelling global communication** MATERIALS REQUIRED	1. Explain, using a model, how a video call across the world works	Provide feedback on the Key and Challenge Questions from the previous lesson in Analyse Mode Review teaching notes in Prepare Mode Collect sticky notes and coloured pens, pencils or markers for students to annotate their models 40 minutes	Students work in groups to iterate on their models of global communication from earlier in the unit	Students revisit the questions on their Driving Questions Boards, resolve any questions they can answer and discuss any final comments or new questions	As a class, discuss students' reflections on the importance of telecommunication from a personal, social and global perspective	Stile X app: Flash quiz 1–2
Session 20	**16. Bridging the digital divide**	1. Create a model to communicate a problem and potential solutions	Review teaching notes in Prepare Mode 10 minutes	As a class, discuss the digital divide and brainstorm benefits of access to digital technology	Students research an aspect of the problem and propose a potential solution	Students create a social media post to communicate key discoveries	Stile X app: Flash quiz 1–2

	Lesson name	Learning goals	Preparation required	Ice breaker	Core of lesson	To close	Revision and mastery
Session 21	**Unit review**		Review Key and Challenge Questions from the unit in Analyse Mode to identify areas to revisit with students during the lesson 45 minutes	Introduce students to the practice test section of Stile X and explain how it will help them prepare for the test	Revisit any areas of difficulty as a class or with groups of students	Encourage students to review feedback and model answers from the unit for revision	Stile X app: Flash quiz 1-2 Study Stile X Revision notes in preparation for **Test: Waves**
Session 22	**Test: Waves**		Ensure each student has access to a device	Seat students appropriately for the test	Supervise students as they complete the test	Fast finishers can complete mindful colouring activities in Stile X	Stile X: Reflection

Lab Guide

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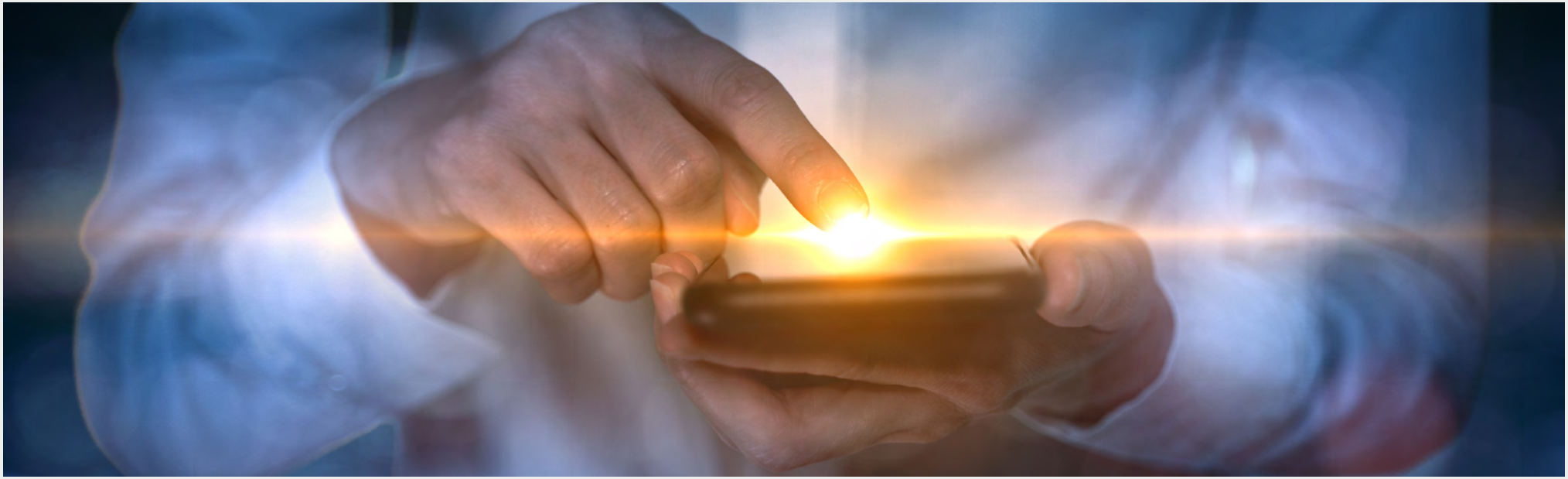
Complete unit material list

Sourcing all of the materials you need can be hard. To make it easier, we've compiled the list below to show you where we purchased the materials we used in our development and testing of the unit.

Equipment	Supplier	Purchase link	Quantity required per group
fibre-optic cable	Jaycar	**5m TOSLINK Fibre Optic Audio Cable**	1 x 5 m cable
torch	Officeworks	**Mini LED Metallic Torch Black**	2 torches
hand mirror	Chemist Warehouse	**Manicare Make-Up Shaving Mirror**	2 mirrors
mixing bowl	Coles	**2.5L Stainless Steel Mixing Bowl**	1 2.5 L mixing bowl
baking tray	Coles	**Baking tray**	1 tray
cling film	Coles	**Cling Wrap | 60 metre**	1 length (30-40 cm)
table salt	Coles	**Table Salt | 500g**	5 g
large elastic band	Officeworks	**J.Burrows No.64 Rubber Bands 500g**	1 large elastic band
tuning fork (optional)	Target	**Golden Gate TF-1 Tuning Fork**	1 tuning fork
micro:bit pocket computer	pakronics	**BBC Microbit v2.2 starter kit**	1 micro:bit pocket computer starter kit
scissors	Officeworks	**Soft Grip Student Scissors 6.5"/165mm**	1 pair of scissors

ACTIVITY

Shining a light on communication



Watch the demo video

stileapp.com/go/commchallengevideo

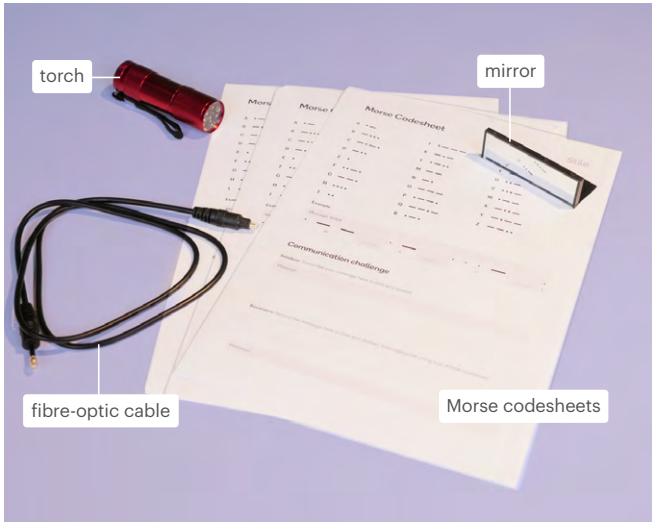
Activity purpose: Introduce the central theme of the unit – the use of waves in communication technology – and start modelling communication systems.

45 minutes	Lesson: **stileapp.com/go/waves-shining-a-light**
4–6 students per group	RiskAssess: **stileapp.com/go/racommunicationchallenge**

Materials

Each group of students will need the following materials for both challenges:

- 1 fibre-optic cable (5m long)
- 2 torches
- 2 mirrors
- **4 Morse codesheets**



Before class preparation

CHALLENGE 1

Prepare a secret message to send through the receiver. It should be brief instructions that the receivers must follow to demonstrate they understand the message. Examples include:

- jump
- clap
- sing

CHALLENGE 2

Determine a way to break the line of sight between senders and receivers. You could:

- ask the receivers to stand in the corridor or another room
- erect a barrier or partition in the middle of the room

Tips and tricks

Things we learned from testing the lab ourselves

Demonstrate how the fibre-optic cable works by shining a torch at one end and letting them see the light at the other.

CHALLENGE 1

- Split students up into four groups. Give them 3 minutes to devise a strategy for communicating a short message across the room. If students need help getting started, ask them to consider how they might use the Morse codesheets and torches to send their message.
- Once groups have their strategies, split them into "receivers" and "senders". The receivers will go to the other side of the room. They will interpret a message sent by the senders.
- When the receivers are in position, give the senders the secret message they need to communicate to the receivers in their group.

Method

Method that students will follow in the Stile lesson

CHALLENGE 1

1. In groups, discuss your strategy to send a message across the room. Your teacher will give you your secret message after you've settled on your strategy.
2. When you have your strategy, choose half of your group to go to the other side of the room. They are the "receivers". The remaining members are the "senders".
3. Senders, ask your teacher for your secret message and use your communication strategy.
4. You will have completed this challenge when the receivers can act on the secret message.

CHALLENGE 2

1. If needed, you'll have 3 minutes to modify your communication method from Challenge 1.
2. When you're ready, send your receivers to another room or the corridor. Your teacher will then give your senders a new secret message.
3. Before you start, make sure both senders and receivers can't see each other.
4. Try your communication method. You'll know you've been successful if your receivers can act on the new secret message.

Final outcome

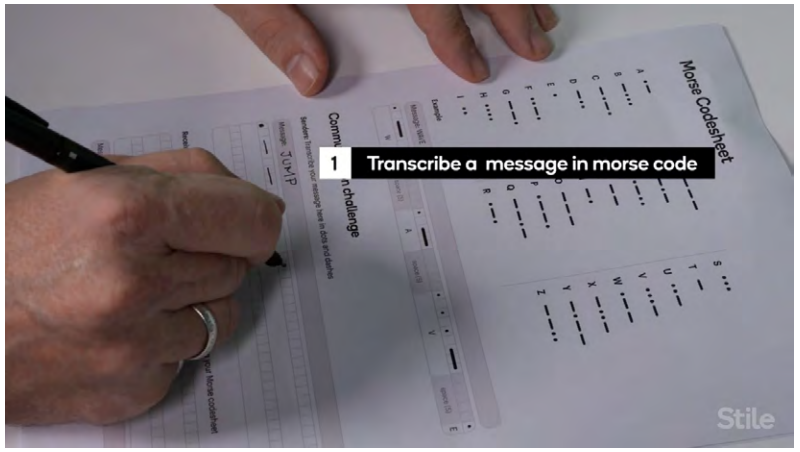
The outcome of the two challenges in this practical activity will vary depending on what materials students choose to use to communicate. Here are some possible outcomes:

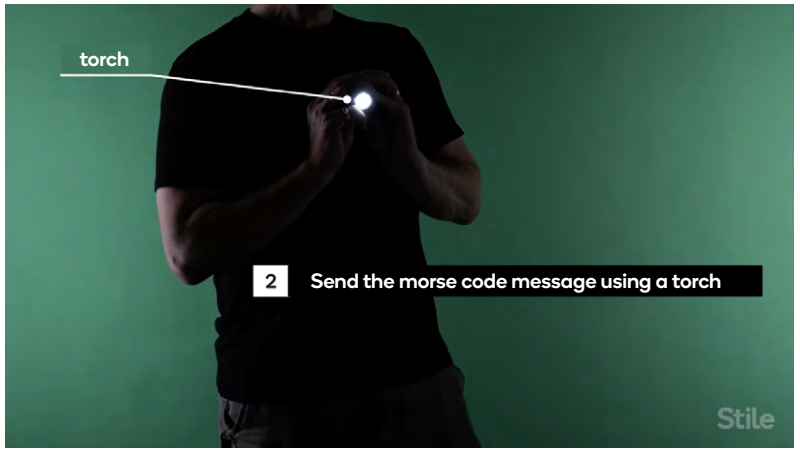
CHALLENGE 1

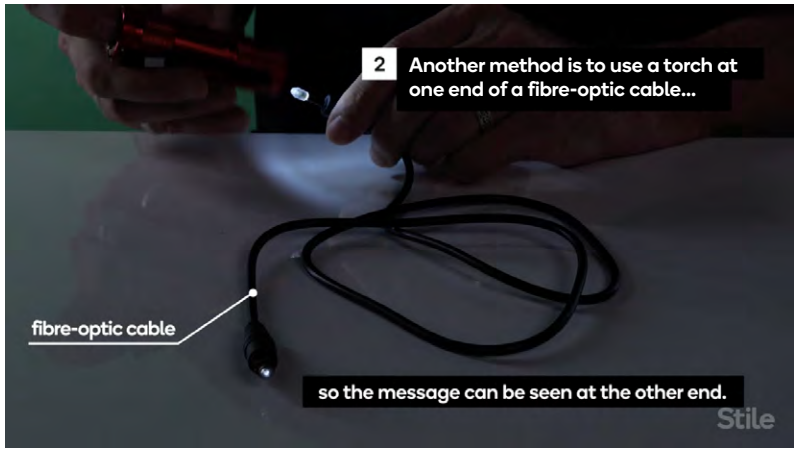
– Using torches to flash Morse code across the room
– Using the mirror to reflect dot and dash messages

CHALLENGE 2

– Using the fibre-optic cable to send the message in Morse code around a corner
– One of the senders standing at the barrier with a mirror to reflect a code, a written message or even a mimed action

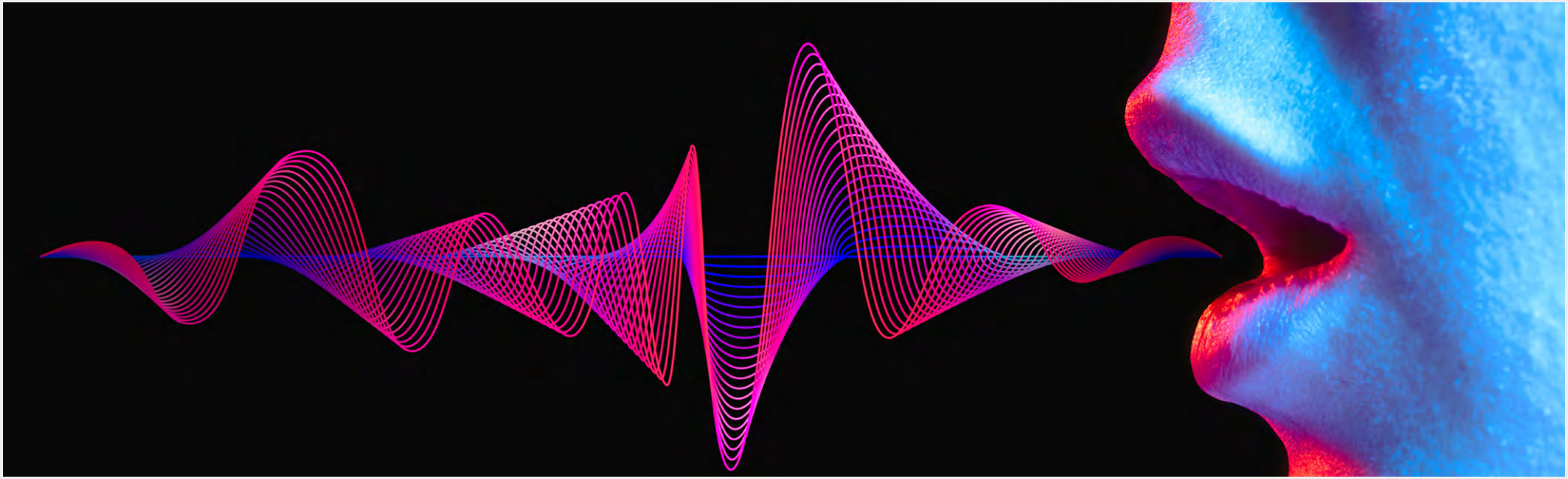






PRACTICAL ACTIVITY

Sound



Watch the demo video

stileapp.com/go/soundvideo

Activity purpose: Explore how speech sounds travel through air and other materials.

45 minutes	Lesson: stileapp.com/go/waves-sound
2–4 students per group	RiskAssess: stileapp.com/go/rasound

Materials

Each group of students will need:
- 1 medium bowl
- large dish or baking tray
- cling film (~30 cm)
- table salt (~5 g)
- *optional: large elastic band (may be needed if cling film does not stick well to bowl)*
- *optional: items for making additional sounds (e.g., tuning fork, sound system or speaker, musical instruments)*

Alternative materials:
- *Sand or sugar can replace table salt*

Before class preparation

Measure out ~5 g of table salt per group.

Tips and tricks

Things we learned from testing the lab ourselves
A large rubber band can help keep the cling film tight if it is too loose to show the salt dancing. Encourage students to make their own sounds. If available, students could use tuning forks or play sound from an instrument or speaker.

Method

Method that students will follow in the Stile lesson
1. Tightly cover the bowl with cling film so that the surface is smooth and without wrinkles.
2. Place the bowl in a large tray and evenly sprinkle the surface with salt.
3. While humming, bring your lips close to the bowl without touching it. Try changing the volume of your humming.
4. Make other sounds near the bowl like clapping. Avoid bumping the salt or the bowl.

Final outcome

Students may observe slight variations in the salt's movement. But the general outcome will be the same. Likely observations may include the following:

	Sound	Observation
	Quiet humming	Example: Quiet humming made the salt vibrate a little. Little clumps formed in places on the cling film.
	Loud humming	Example: Louder humming made the salt vibrate more. Different patterns formed when I changed the tone of my humming from high to low.
	Clapping	Example: Clapping caused the salt to jump and settle in place. The louder the clap, the more the salt moved.

PRACTICAL ACTIVITY

Refraction

Watch the demo video

stileapp.com/go/refractionvideo

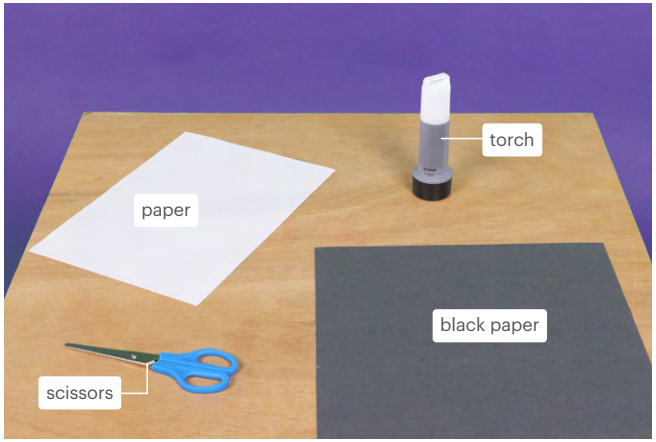
Activity purpose: Explore images to explain how the path of light changes through transparent materials.

45 minutes	Lesson: stileapp.com/go/waves-refraction
2–3 students per group	RiskAssess: stileapp.com/go/racreatinganimage

Materials

Each group of students will need:
- sheet of white paper
- sheet of black paper
- scissors
- torch

Alternative materials
- *A dark-coloured wall can replace the black paper*



Before class preparation

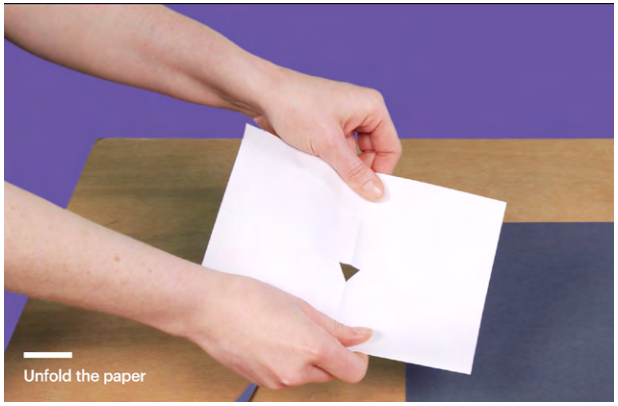
None.

Tips and tricks

Things we learned from testing the lab ourselves
- Though this activity works best with 2–3 students, it can be completed independently. Students can replace the black paper with a dark wall and shine their light towards the wall.
- Torches need to disperse light evenly to create a clean image. Avoid LED torches or lights with multiple sources.

Method

Method the students will follow in the Stile lesson
1. Fold the white paper in half.
2. Cut the white paper to create a small triangular hole.
3. Ask your partner to hold the black paper in front of them. Then shine the torch through the triangular hole onto your partner's black paper.
4. Experiment with how far away your partner stands and how far away the light is from the triangle.



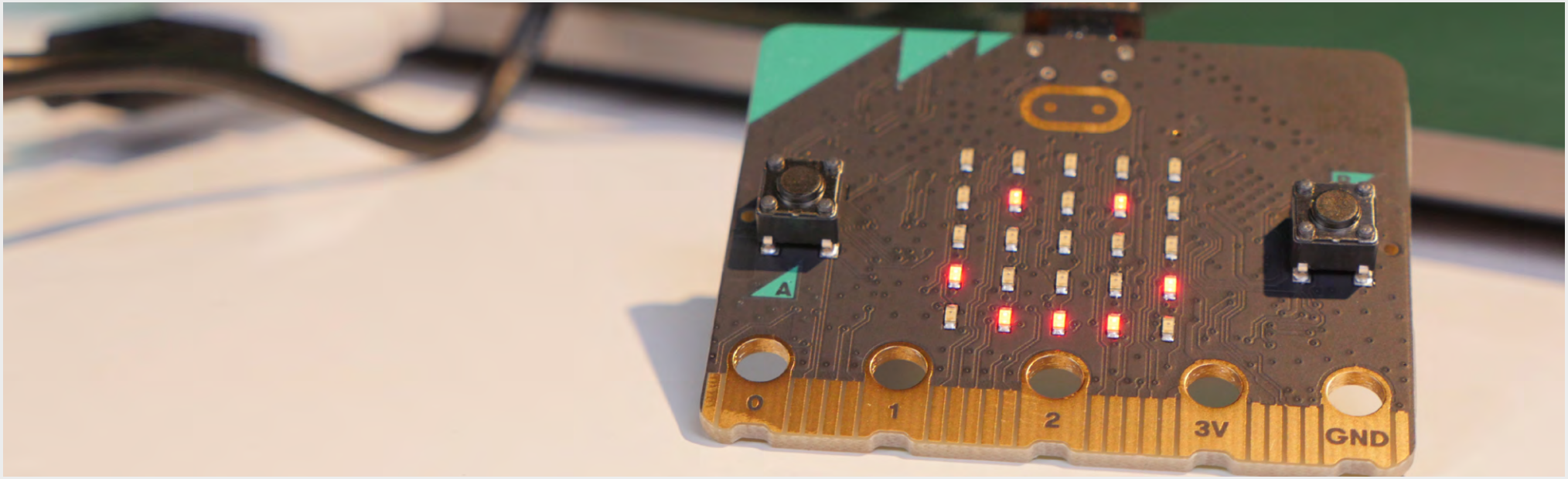
Final outcome

Students should see that they can make the triangle bigger by moving the black paper away from the torch and white paper. They can also make it the same size by moving the black paper close to the torch and white paper.

	Hole size	Image size	Possible? (yes, no)
larger			Yes
equal			Yes
smaller			No

PRACTICAL ACTIVITY

Micro:bit Light into sound



Watch the demo video

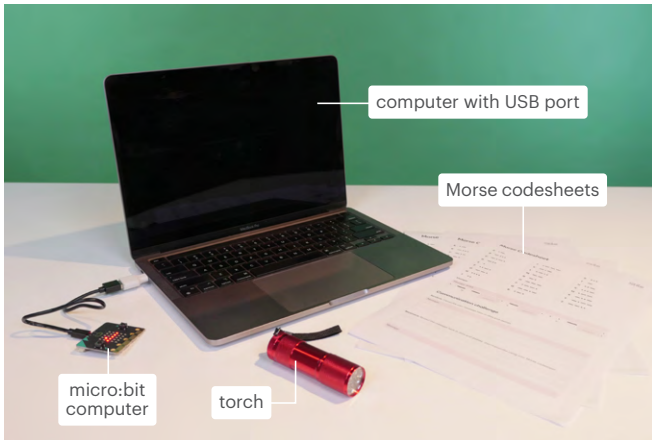
stileapp.com/go/wavesmicrobitlesson1video

Activity purpose: Introduce students to the potential for technology and programming to assist with communication.

45 minutes	Lesson: **stileapp.com/go/waves-microbit1**
2–3 students per group	RiskAssess: **stileapp.com/go/rawavesmicrobitlesson1**

Materials

Each group of students will need:
- 1 micro:bit pocket computer
- 1 torch
- **2 Morse codesheets**
- 1 computer with USB port



Before class preparation

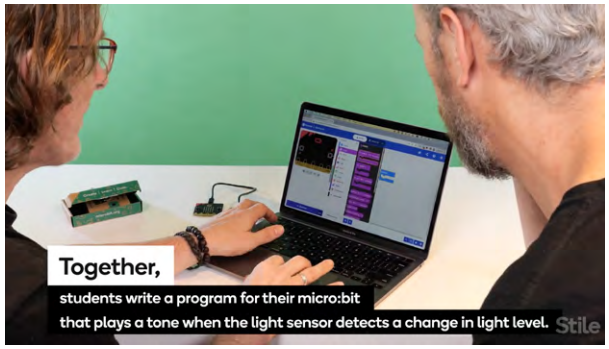
Print off **Morse codesheets**.

Tips and tricks

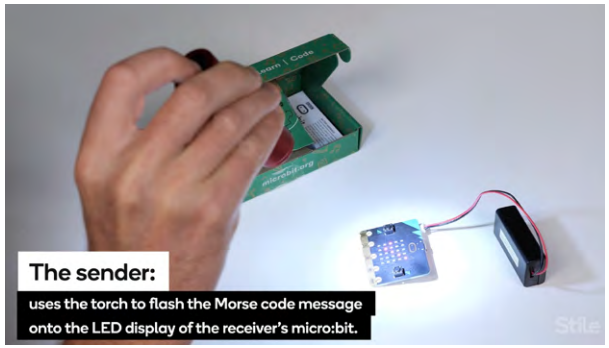
Things we learned from testing the lab ourselves
- Students will need to plug their micro:bits into a battery pack to power them when unplugged from computers.
- Keeping the light levels constant in the testing room will ensure the micro:bits only respond to torchlight.
- Separating groups in your room will make it less likely random torchlight from other groups will trigger the wrong micro:bits.
- Senders and receivers can start close together and move slowly further apart to test the limits of their signalling.

Method

Method that students will follow in the Stile lesson
1. Work in pairs. One of you will be the "sender", the other the "receiver".
2. The sender should:
   - come up with a short, one-word command (e.g. jump, clap, sing)
   - transcribe the command into Morse code
3. Together, write a program for your micro:bit that plays a tone when the light sensor detects a change in light level.
4. Plug your micro:bit into the computer and transfer the program onto it.
5. Get the sender to use the torch to flash the Morse code message onto the LED display of the micro:bit.
6. Get the receiver to:
   - listen to the tones representing dots and dashes and write them down
   - decode the Morse code message and act on the command



Together,
students write a program for their micro:bit that plays a tone when the light sensor detects a change in light level.



The sender:
uses the torch to flash the Morse code message onto the LED display of the receiver's micro:bit.

Final outcome

Students should hear a tone from the micro:bit computer when the LED light sensor detects flashes of light from the sender's torch.

PRACTICAL ACTIVITY

Micro:bit Morse code via radio waves

Watch the demo video

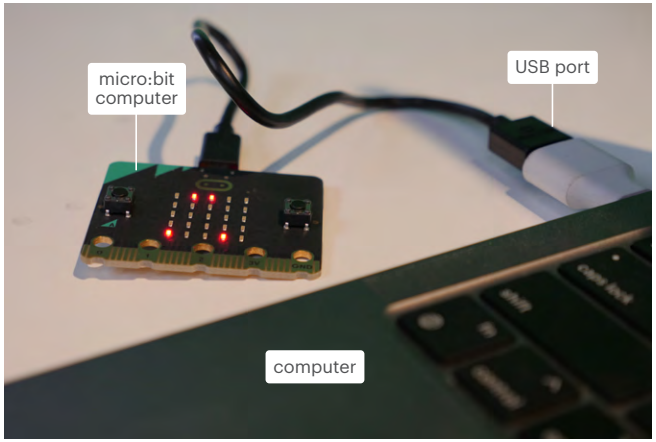
stileapp.com/go/wavesmicrobitlesson2video

Activity purpose: Introduce students to the potential for technology and programming to assist with communication.

45 minutes	Lesson: **stileapp.com/go/waves-microbit2**
3–4 students per group	RiskAssess: **stileapp.com/go/rawavesmicrobitlesson2**

Materials

Each group of students will need:
- 2 micro:bit pocket computers
- 1 computer with USB port
- 2 Morse codesheets



Before class preparation

Print off **Morse codesheets**.

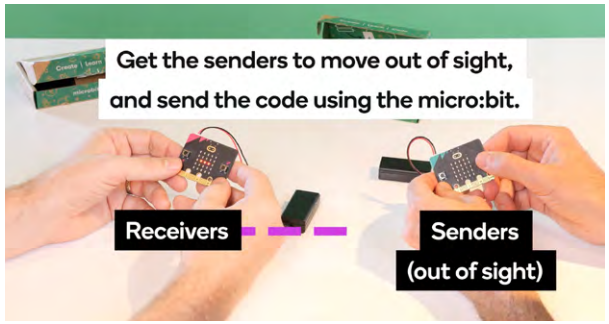
Tips and tricks

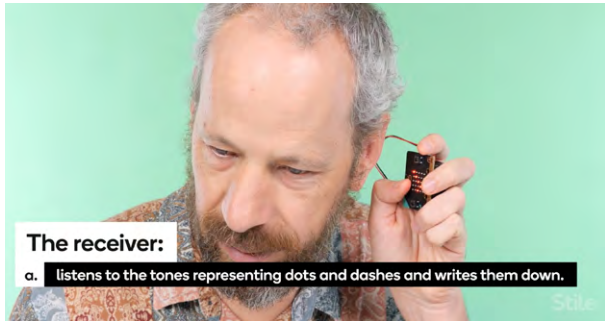
Things we learned from testing the lab ourselves
- Students will need to plug their micro:bits into a battery pack to power them when unplugged from computers.
- Check groups have set their unique radio group number to avoid picking up signals from other groups.
- This works best if senders and receivers take turns sending each other messages.

Method

Method that students will follow in the Stile lesson

1. Work in groups of 3–4. A pair from each group will be the "receivers", and the rest will be the "senders".
2. Get a unique radio channel assigned to your group by your teacher so you don't interfere with other groups.
3. The senders should:
   - come up with a short, one-word command (e.g. jump, clap, sing)
   - transcribe the command into Morse code
4. Together, write code that allows the micro:bits to send and receive Morse code signals by radio and convert them into sound.
5. Connect both micro:bits to the computer and transfer the code onto them.
6. Get the senders to move out of sight, and send the code using the micro:bit.
7. The receivers should:
   - listen to the tones representing dots and dashes and write them down
   - decode the Morse code message and act on the command


Get the senders to move out of sight, and send the code using the micro:bit.


The receiver:

a. listens to the tones representing dots and dashes and writes them down.

Final outcome

Receivers should hear a tone on their micro:bit computer and see a dot or dash on their LED screen matching the input from the sender's micro:bit.

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Call us on 1300 918 292

Email us at community@stileeducation.com

Swing by the office to say hi!
Level 5, 128 Exhibition Street, Melbourne, Victoria

Stile HQ is located on the traditional lands of the Boon Wurrung and Woiwurrung (Wurundjeri) peoples of the Kulin Nation. We acknowledge that sovereignty was never ceded and pay our respects to Elders past, present and future.