Teacher Resources
Year 8

Digital Ignition
Māpura Matihiko

Contents

Teacher Resource 1 (TR 1)

If I Could... I Would

Description

In this activity, students will explore the skills required to create digital solutions. They will design a digital product that solves a real-world problem they care about and consider what skills would be required to bring their idea to life. Students will explore the importance of collaboration as they review the different skills and roles required to create digital solutions.

Curriculum Alignment

New Zealand Technologies Curriculum	
Computational Thinking for Digital Technologies: Progress outcome 2	• Students undertand that digital devices impact humans and society and that both the devices and their impact change over time. • Students identify the specific role of components in a simple input-process-output system and how they work together, and they recognise the "control role" that humans have in the system.
Designing and Developing Digital Outcomes: Progress outcome 4	• In authentic contexts, students investigate and consider possible solutions for a given context or issue. With support, they use an iterative process to design, develop, store and test digital outcomes, identifying and evaluating relevant social, ethical and end-user considerations. They use information from testing and apply appropriate tools, techniques, procedures and protocols to improve the quality of the outcomes and to ensure they are fit-for-purpose and meet end-user requirements.
Technological Practice: Level 4	• *Planning for practice*: Students undertake planning that includes reviewing the effectiveness of past actions and resourcing, exploring implications for future actions and accessing of resources, and consideration of stakeholder feedback, to enable the development of an outcome. • *Brief development*: Students 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. • *Outcome development and evaluation*: Students investigate a context to develop ideas for feasible outcomes. Undertake functional modelling that takes account of stakeholder feedback in order to select and develop the outcome that best addresses the key attributes. Incorporating stakeholder feedback, evaluate the outcome's fitness for purpose in terms of how well it addresses the need or opportunity.

Nature of Technology: Level 2	• Students understand that technology both reflects and changes society and the environment and increases people's capability.
Nature of Technology: Level 4	• Students understand how technological development expands human possibilities and how technology draws on knowledge from a wide range of disciplines. • Understand that technological outcomes can be interpreted in terms of how they might be used and by whom and that each has a proper function as well as possible alternative functions.
Nature of Technology: Level 6	• Students understand the interdisciplinary nature of technology and the implications of this for maximising possibilities through collaborative practice.

New Zealand English Curriculum	
Listening, Reading, and Viewing and, Speaking, Writing, and Presenting: Level 4	• Students will integrate sources of information, processes, and strategies confidently to identify, form, and express ideas.

New Zealand Social Sciences Curriculum	
Social Studies: Level 4	• Students will understand how exploration and innovation create opportunities and challenges for people, places and environments. • Students understand how people participate individually and collectively in response to community challenges.

TR 1 - Workshop Details

Learning Objectives

Students will be able to:

- Identify their passions and how they want to contribute to their community.
- Collaborate with their peers to design digital solutions to problems.
- Consider digital solutions with the end user in mind, through the lens of user experience and user interface.
- Analyse digital technologies and identify the skills necessary to create solutions.
- Understand that there are many skills required to build digital solutions.
- Identify how digital technology skills can help them create jobs that solve real world problems.

Materials

Ensure you have the following material ready:

[ ] Job Descriptions Handout

[ ] Poster Boards and Sticky Notes

Preparation

- Print out one worksheet per student
- Arrange for access to computers with internet and Power Point
- Ensure access to audio-visual tech to play a video: https://www.youtube.com/watch?v=hLltkC-G5dY

Time Allowance

- 3 hours
  *Note: This activity can also be run over several lessons

TR 1 - Lesson Plan

Introduction / Learning Hook

1. Show students 'The Playful Wonderland Behind Great Inventions' as told by Steve Johnson: https://www.youtube.com/watch?v=hLltkC-G5dY. Play the video and ask students to keep an eye out for the skills inventors use to create.
2. Engage in a class discussion about the main ideas raised in the video and explore the computational thinking approaches that are necessary when you are inventing:
   - Tinkering (experimenting and playing)
   - Creating (designing and making)
   - Persevering (keeping going)
   - Collaborating (working together)
   - Debugging (finding and fixing errors)
3. Highlight how the technologies in the video have increased people's capabilities, and have changed society and the environment.
4. Clarify the interdisciplinary nature of technology, and the ways that collaboration can maximise possibilities. For example, this technology evolved generation after generation through different inventions in multiple disciplines. Each new inventor took an idea from a different craft and made it something new.

Running the Lesson: Part 1 - Identifying a problem

1. Ask students to think of a problem that is important to them. To narrow this down, teachers may set a theme for students. Possible themes could be: helping family (whānau) or protecting the environment/their land (whenua).

   Explain to students that they are going to create a digital solution to solve this problem. This digital solution could be a website, app or game. Students may also include sensors in the environment that provide information to their app/website/game. For example, if students want to create an exercise app, they might also design a shoe that includes a sensor that can detect steps.
2. Introduce the design process, and explain that process helps designers to make successful products that solve problems and meet the needs of the end users:
   a) **Empathising:** Understanding the problem from many perspectives, including understanding the needs of the people it impacts.
   b) **Ideation:** Finding as many possible ideas that could be useful to solve the problem.
   c) **Design:** Picking the best idea and determining the details that will meet the needs of the end user.
   d) **Prototyping:** Creating a working model of the solution.
   e) **Testing:** Testing the prototype with users (user testing), observing how it is used and gathering feedback that will improve the prototype.
   f) **Evaluation:** Evaluating the solution once it is available to the end users to determine if the product meets the needs as predicted or is there anything more to learn.

3. Break the students into groups of four or more.

4. Ask each group to decide on a problem for which they would like to create a digital solution. For example, they might try to solve the excess of wasted paper with handouts at school.

5. In the form of a research task, begin with step 1 of the design process (empathising). Ask the students to research their group's problem individually. They should consider:

   - What is the problem?
   - What is causing the problem?
   - Who does the problem impact? Who are we designing the solution for (the end user)?
   - What are the needs of end user in relation to the problem or solution?
   - What are the barriers to end users using a solution (e.g. time, money, understanding of technology)?
   - What have other solutions to this type of end user or similar problems done well/not well?
   - What are other products that have been designed for this type of end user? How have they met the end users' needs?

6. This may involve tasks like researching the scope and causes of the problem, interviewing the people who are impacted by the problem, and researching other ways that people around the world have solved this, or similar, problems.

7. Throughout this process students should gather inspiration that might inform the creation or design of their solution.

Running the Lesson: Part 2 - Inventing a solution

1. Allow students to share the information they have gathered with their group.

2. Remind students that their digital solution should be a website, app or game. Students may also include sensors in the environment that provide information to their app/website/game. For example, if students want to create an exercise app, they might also design a shoe that includes a sensor that can detect steps.

3. Explain to students that they will now complete step 2 of the design process (ideation). Give the groups 10 minutes to brainstorm as many ideas for solutions to the problem as possible. Encourage students to come up with at least 50 different ideas.

   Reiterate that brainstorming is used to record ideas not to judge or explore them – the more ideas you have, the more likely you will find a suitable solution. At this phase of the process, students should not judge their own or each other's ideas, think as big as possible, and use 'yes, and' to build on the ideas.

   Students should write their ideas on sticky notes, and stick them on a large piece of paper, or on the wall of the classroom. Explain that this method allows them to move ideas around, and group and organise them.

   *Note: Brainstorming can be run in multiple ways. For instance, students can take 3 minutes to silently write as many ideas as they can think of, before coming together as a group to share and build on ideas.

4. Give students time to discuss and choose the idea they wish to develop. It may help for them to cluster ideas into similar themes, and to do 'silent' votes for their top three ideas (each student writes down their top three favourite ideas without input from the group, and votes are tallied to identify the most popular/promising ideas, and to provoke discussion). The final solution should be a digital solution.

   Students should consider:

   - How will it solve the problem?
   - Who will use this solution? Is the solution suitable for that user?
   - Who will be impacted by this solution? Will it cause any negative impacts, if so, how will you mitigate this?
   - What will encourage people to use this solution (necessity, good design, fun etc)?

5. Give students the time to design their invention (step 3 of the design process). They should draw or describe the invention, identifying the parts of the invention that constitute the user interface, highlighting different features and how they are suitable for the end user. Students should also describe what their invention does, and how it will work.

   When designing their inventions, they should consider:

   - Goals: What is the end users goal when using the app/game/website? Is it to learn something, to entertain, to help someone?
   - Components: What are the different features of the app/game/website? Are these features appropriate for the end user and do they meet the goal?
   - Mechanics: What is needed to make the app/game/website work properly? Are any sensors required?
   - Instructions: Does the app/game/website need instructions? How will the user know how to use it?
   - Experience: What is the look (user interface) and feel (user experience) of the app/game/website? How can the user interface be designed to suit the needs of the end user? What features will contribute to a good user experience?
   - Challenge: Is it easy/difficult to use?
     *Note: You may need to remind students what a user interface and user experience is:
   - The user interface is the part of a digital device that the user interacts with (such as the display, buttons, sound or camera).
   - The user experience is how a person feels when they use digital technology.
     *Note: You can set any design limitations that you want students to consider when creating their design. For instance, whether or not the technology that they want to already exists. Students might also consider costs, limitations, and how their solutions will function in the real world.

Running the Lesson: Part 3 - Hiring the crew

1. Once the students have designed an invention in their group, ask them to individually write a list of roles that they would need to hire for and what each of those positions would be responsible for to create a prototype of their invention.
2. Give students a copy of the Job Descriptions handout to help them determine the appropriate skills and people required to make their creation. However, encourage students to go beyond this list, researching any skills or jobs that may be necessary but are not included on the worksheet, for example, if the students wanted to design a shoe that tracks their steps, they would also need a shoemaker (hūmeka).

Extension - Pitching the invention

1. Have students share their inventions with the class in a group presentation. When pitching their invention, they should clearly identify what their initial problem was, what their invention is, how it solves that problem and what considerations they had to make when they designed with the end user in mind. Teachers can take on the role of a 'Shark Tank'-style judge and ask questions about the design.

Conclusion

1. In a class discussion, allow students to reflect on their experience completing 3 of the 6 steps in the design process.
2. Ask students to share any interesting insights they had during the process of creating their invention.
3. Students undertand that digital devices impact humans and society and that both the devices and their impact change over time.

Glossary - New words to learn	
End user	The 'end user' is the person who actually uses a particular product.
User Experience	How a person feels when they use digital technology.
User Interface	Is the part of a digital device that the user interacts with (such as the display, buttons, sound or camera)

TR 1 - Lesson Resources: Relevant Links

Useful Links	
The Playful Wonderland Behind Great Inventions' by Steven Johnson	• https://www.youtube.com/watch?v=hLltkC-G5dY

Student Handout: Job Desciptions

Job Title	Job Description
Visual /Graphic Designer	Responsible for any images used in the digital solution, Visual/Graphic Designers are concerned with how it looks.
Animator	Animators create any images that move. Sometimes they can also be a Visual or Graphic Designer. They too are concerned with how the digital solution looks.
Sound Designer	Sound Designers find or (more likely) create the sounds that the user hears. There are often two kinds of sounds which the sound designer would be responsible for, the background music and the sound effects.
User Experience (UX) Designer	UX Designers are concerned with how the user likes the overall feel of the product. They'll ask questions like, who is the user? What are they using? When are they using it? Where are they using it? And how are they using it? They ask these questions, so they can design an experience that matches the needs and wants of the user.
User Interface (UI) Designer	UI Designers make sure that every page and every step a user takes in their interaction with the finished product matches the overall vision created by UX designers.
User Researcher	The User Researcher focuses on understanding user behaviours, needs, and motivations through looking at the lives and actions of different users and asking them questions. They'll give this information to the UX Designer to help shape the user experience.
Content Writer	Any text that the digital solution requires, including instructions, are written by a Content Writer. They are responsible for understanding how to write in a way that engages the user and gives them the information they need in a useful way.
Cultural Advisors	Depending on the needs of the invention, Cultural Advisors check that all elements of the digital solution are culturally inclusive and/or culturally accurate.

Project Manager	Project Managers make a plan for the design and creation of the digital solution. They are then responsible for communicating with everyone who is working on the project, making sure they have what they need and can finish their task on time.
Educational Advisor	Educational Advisors understand how people learn. They make sure that the digital solution is made in a way that enables the intended user to learn or they create instructional content.
Coder	A Coder designs, writes and tests computer programs. They are responsible for writing the code that the digital technology needs to work.

This is not a complete list of jobs. Depending on your invention, you may need to research other job descriptions. For example, if you designed a shoe that tracks the user's steps, you will also need a shoemaker (hūmeka).

Teacher Resource 2 (TR 2)
I'll Go With You On One Condition

Description

In this activity, students will create a digital 'choose your own adventure' story using conditionals while considering user experience and user interface.

Curriculum Alignment

New Zealand Digital Technologies Curriculum	
Designing and Developing Digital Outcomes: Progress Outcome 3	• In authentic contexts, students follow a defined process to design, develop, store, test and evaluate digital content to address given contexts or issues, taking into account immediate social, ethical and end-user considerations. They identify the key features of selected software and choose the most appropriate software and file types to develop and combine digital content.
Computational thinking for digital technologies: Progress Outcome 4	• In authentic contexts and taking account of end-users, students decompose problems to create simple algorithms using the three building block's of programming: sequencing, selection and iteration.

New Zealand English Curriculum	
Speaking, Writing and Presenting: Level 4	• Integrate sources of information, processes, and strategies confidently to identify, form, and express ideas. • Select, develop, and communicate ideas on a range of topics. • Use a range of language features appropriately, showing an increasing understanding of their effects. • Organise texts, using a range of appropriate structures.

TR 2 - Workshop Details

Learning Objectives

Students will be able to:

- Create, store and share a digital 'choose your own adventure' story.
- Apply conditionals to a story, allowing readers to follow unique paths depending on their choices.

Materials

Ensure you have the following material ready:

[ ] Plotting and Outlining Worksheet

[ ] Story Map Worksheet

[ ] Computers with access to the internet and PowerPoint

Time Allowance

- 3 hours

Preparation

- Print out one of each worksheet per student.
- Arrange for access to computers with internet and PowerPoint.
- Familiarise yourself with the process for creating a 'choose your own adventure' story in PowerPoint (Create a PowerPoint Template, How to hyperlink buttons), or other digital tool of your choice. See the Lesson Resources below for more instructions on creating 'choose your own adventure' stories in different software.

TR 2 - Lesson Plan

Introduction / Learning Hook

1. Show students 'The Technology of Storytelling' video: https://www.ted.com/talks/joe_sabia_the_technology_of_storytelling
2. Ask the students about their favourite stories and discuss what different technologies have been used to tell them.
3. Follow this discussion by showing students 'A Next-Generation Digital Book': https://www.ted.com/talks/mike_matas#t-213566
4. Highlight that there are many mediums that authors can use to tell stories. Tell the students that they are going to make their own kind of digital book.
5. Explain that they will be creating a 'choose your own adventure' story using conditional "IF" statements in PowerPoint.
6. Remind students what a conditional is – conditionals let computers run different code in different situations. They can come in the form of IF/THEN or IF/THEN/ELSE statements.
7. Explain the concept of 'choose your own adventure' stories – readers can decide the path that the main character takes.

8. Explain that students will create their own digital 'choose your own adventure' stories, with readers able to make choices that will take them to different outcomes. Explain that when their readers are faced with a choice, that choice should be presented in the form of a conditional. For example, IF you want to stay and fight, THEN, click here ELSE escape through the back door by clicking here.

Running the Lesson: Part 1 - Plan your story

1. Break students into pairs to discuss potential story ideas.
2. When the students have decided on the story they would like to tell, ask them to complete the Plotting and Outlining Worksheet.
3. Students should then plan out their story in a flowchart format. This may be done using free online flowchart software for convenience. Students can refer to the Story Map Worksheet for example story structures.

   Free online flowchart software: https://www.makeuseof.com/tag/best-free-flowchart-tools-windows/

   Teacher's Note:

   - The worksheet is intended for conceptual planning only. Students do not need to include details.
   - To maintain a manageable workload, story length should be restricted to the time you have available in class.
   - Encourage students to keep their story length 30 scenes or less.

Running the Lesson: Part 2 - Set up template slides in PowerPoint

1. Teach students how to create the template they will use to write their story in PowerPoint.
2. Ask students to write the instructions for readers using the conditional IF statement format. E.g. IF you want to do 'x', THEN click 'y'. ELSE click 'z'.
3. Show students how to create buttons that can be linked to specific slides.

   Teacher's Note:

   - If you do not have access to PowerPoint, students can create their stories using Google Forms: https://www.youtube.com/watch?v=ycI6WwOelKo
   - If your students have some experience with coding, they can create their stories using Scratch: https://www.youtube.com/watch?v=EL6SAq7ND7U

Running the Lesson: Part 3 - Writing the story

1. Allow time for the students to write and illustrate/add imagery to the stories they have planned out on their worksheets using PowerPoint. Students should also link their choice buttons to appropriate slides.

Conclusion

1. Invite students to share their interactive stories with their peers and discuss the alternative endings.
2. Ask the students to explain how using conditionals helped the audience decide which story they wanted to follow.

Glossary - New words to learn	
Condtionals	Conditionals let computers run different code in different situations.

TR 2 - Lesson Resources: Relevant Links

Useful Links	
The technology of storytelling	• https://www.ted.com/talks/joe_sabia_the_technology_of_storytelling
A next-generation digital book	• https://www.ted.com/talks/mike_matas#t-213566
Create a PowerPoint Template	• https://www.youtube.com/watch?v=Y11HtHCTbaQ
How to hyperlink buttons	• https://www.youtube.com/watch?v=rRDKTQ6xr1w
Google Forms	• https://www.google.com.au/forms/about/
Google Forms Instructions	• https://www.youtube.com/watch?v=ycI6WwOelKo
Scratch	• https://scratch.mit.edu/
Scratch Instructions	• https://www.youtube.com/watch?v=EL6SAq7ND7U
Scratch Tutorials	• https://scratch.mit.edu/help/videos/

Student Worksheet: Plotting and Outlining (1 of 3)

Setting	Place	
	Time	

Main Character	Name	
	Background	
	What do they want?	

Antagonist	Name	
	What is their relationship to main character?	
	Background	
	What do they want?	

Situation	What is happening at the beginning of the story?	

Inciting Event	What is happening at the beginning of the story?	

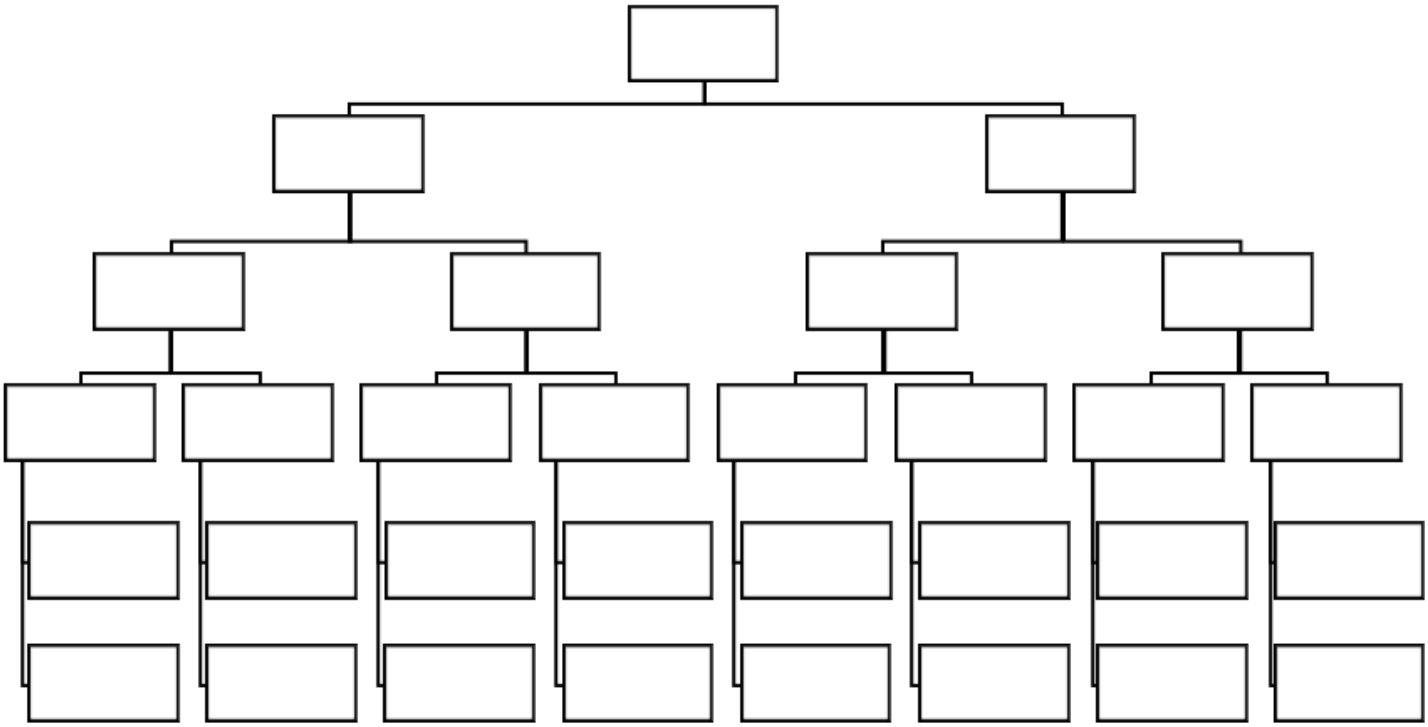
Student Worksheet: Plotting and Outlining (2 of 3)

Conflict	How do the characters react to the conflict?	
	What choices must the main character make?	**1.**
		2.
		3.
		4.
		5.
		6.
		7.
		8.
		9.
		10.
		11.
		12.
		13.
		14.
		15.

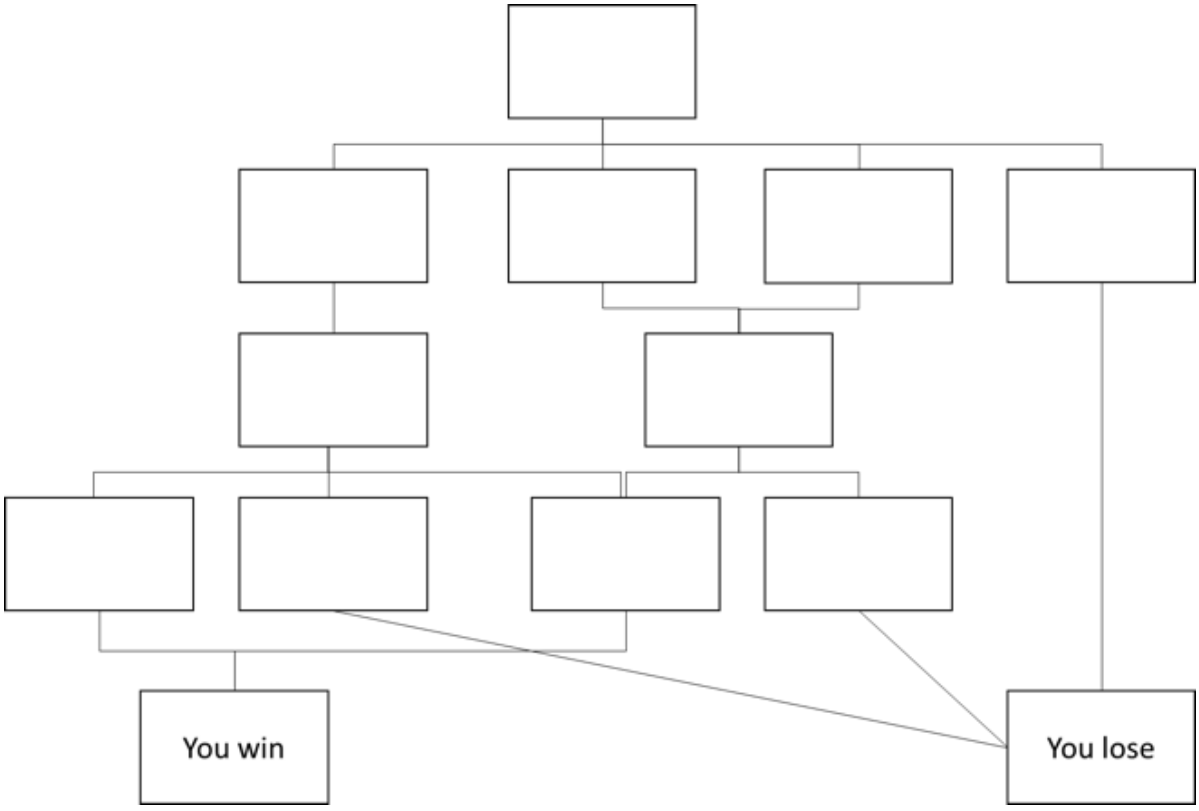
Student Worksheet: Story Map Examples (3 of 3)

Plan your non-linear story, showing the paths that the reader could take based on their choices.

Example 1:



Example 2:



Teacher Resource 3 (TR 3)
Debugging

Description

In this activity, students will create and debug an algorithm in a game based on the story of how the rivers Waikato and Rangitaiki raced seaward.

Curriculum Alignment

New Zealand Technologies Curriculum	
Computational thinking for digital technologies: Progress Outcome 4	• In authentic contexts and taking account of end-users, students decompose problems to create simple algorithms using the three building blocks of programming: sequence, selection, and iteration. They implement these algorithms by creating programs that use inputs, outputs, sequence, basic selection using comparative operators, and iteration. They debug simple algorithms and programs by identifying when things go wrong with their instructions and correcting them, and they are able to explain why things went wrong and how they fixed them.

New Zealand Maths Curriculum	
Position and orientation: Level 3	• Communicate and interpret locations and directions, using compass directions, distances, and grid references.
Geometry and measurement: Level 2	• Sort objects by their spatial features, with justification.

TR 3 - Workshop Details

Learning Objectives

Students will be able to:

- Write an algorithm (a set of clear and simple, step-by-step instructions to solve a problem).
- Identify when an algorithm produces an unexpected result (a bug).
- Understand that debugging is how we find and fix a bug in an algorithm.
- Complete the process of debugging:
  a) Start at the beginning of the algorithm.
  b) Follow the algorithm step-by-step until you find a step that produces a result you did not expect.
  c) Correct the step.
  d) Start at the beginning again and repeat these steps until the algorithm does what you were expecting.

Materials

Ensure you have the following material ready:

[ ] Worksheet – Algorithms and debugging (1 per pair of students)

[ ] Paper and pens

Preparation

- Before the lesson, you will need to print at least one copy of Worksheet – Algorithms and debugging, per pair of students.
- Ensure that you are familiar with the definitions of relevant terms (see the glossary provided).

Time Allowance

- 15 minutes

TR 3 - Lesson Plan

Introduction / Learning Hook

1. Ask students if they know the story of How Waikato and Rangitaiki Faced Seaward.
2. Elicit or tell the story: How Waikato and Rangitaiki Raced Seaward. Story can be found on page 15 of this Teacher's Resource
3. Tell students that they are going to debug an algorithm so that Ragitaiki can win the race against Waikato.

Running the Lesson

1. Give each student a copy of Worksheet – Algorithms and debugging.
2. Ask students to complete the Worksheet – Algorithms and debugging. In this activity, students must debug the algorithm so Ragitaiki can reach the ocean, and win the race against Waikato.
3. In pairs, ask the students to run through the process of debugging and circle any incorrect steps in the algorithms. The process of debugging is:
   a) Start at the beginning of the algorithm.
   b) Follow the algorithm step-by-step until you find the step(s) where the algorithm produces a result you did not expect.
   c) Circle the incorrect steps and write down the correct steps in the space provided.
   d) Start at the beginning again and repeat these steps until the algorithm does what you were expecting.
4. After students have completed this activity, have students compare their sheets with a different pair to see if they align.

Conclusion

1. Ask students to discuss what happened when they found a bug in the algorithm.
2. Ask students whether it was helpful to have someone else check their algorithm for them, and if it was, why that might be. Discuss the importance of collaboration in getting to the best possible outcome and problem solving.

Glossary

Decomposition	Breaking a problem into smaller parts.
Algorithm	A set of clear and simple, step-by-step instructions to solve a problem.
A Bug	When an algorithm produces an unexpected result.
Debugging	A process of how to find and fix a bug in an algorithm. This process is: a) Start at the beginning of the algorithm. b) Follow the algorithm step-by-step until you find a step that produces a result you did not expect. c) Correct the step(s). d) Start at the beginning again and repeat these steps until the algorithm does what you were expecting.

How Waikato and Rangitaiki Raced Seaward

A long time ago near Lake Taupo the Waikato and Rangitaiki rivers argued about which would reach their parent Wainui (the ocean) first, and decided to have a race to settle the dispute.

Waikato started from the base of Tongariro, a tall volcanic mountain, and Rangitaiki from the base of Kaimanawa, the main mountain ranges of the North island.

Now Whangaehu, a third river, also flowing from the base of Tongariro, suggested to Waikato that they should flow southward to Wainui (the ocean). Not waiting for Whangaehu, Waikato turned northward and started the race with Rangitaiki. Waikato called out that it would reach Wainui first, and Rangitaiki argued back: "Not so, I will be the first to arrive!"

As Waikato reached Tauwhara mountain it sent out three scouts to find which way it should continue. Rangitaiki also sent out some scouts. These scouts are now the tributary streams running from both rivers.

Listening for any sound of the advance of its rival, Waikato heard the roar of many waters as Rangitaiki flowed into the ocean. Rangitaiki was the first to reach their mother Wainui. Waikato was so disappointed that it swerved westward from south of Paeroa and sought the western ocean.

Adapted from:
http://nzetc.victoria.ac.nz/tm/scholarly/tei-Bes02Reli-t1-body-d4-d6-d4.html

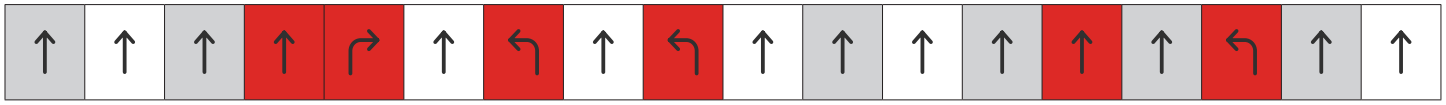
TR 3 - Lesson Resources: Answers

Algorithms and Debugging - Worksheet Answers

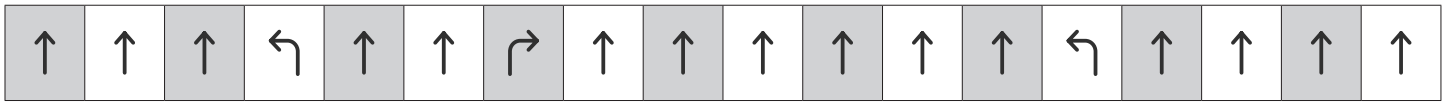
Rangitaiki's Algorithm:

Answer:

Waikato's Algorithm:



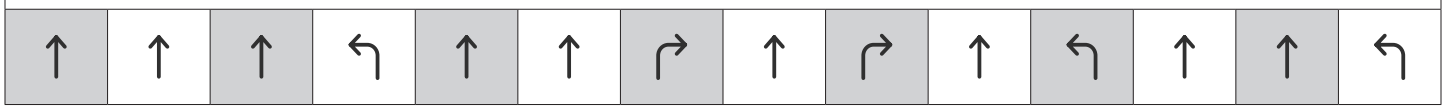
Answer:



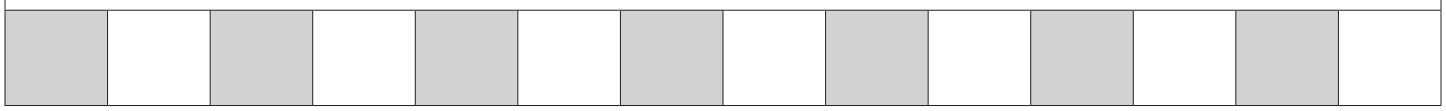
Student Worksheet: Algorithms and debugging (1 of 2)

Debug the algorithm below to help Ragitaiki reach the ocean before Waikato.

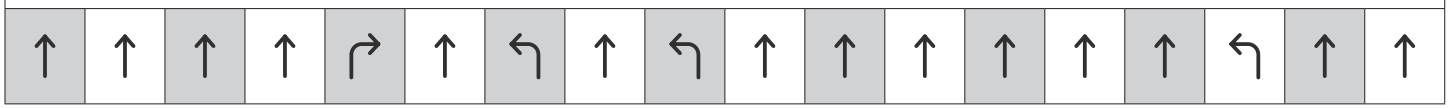
Rangitaiki's Algorithm: Circle the bugs in the algorithm below



Write your correct algorithm below:

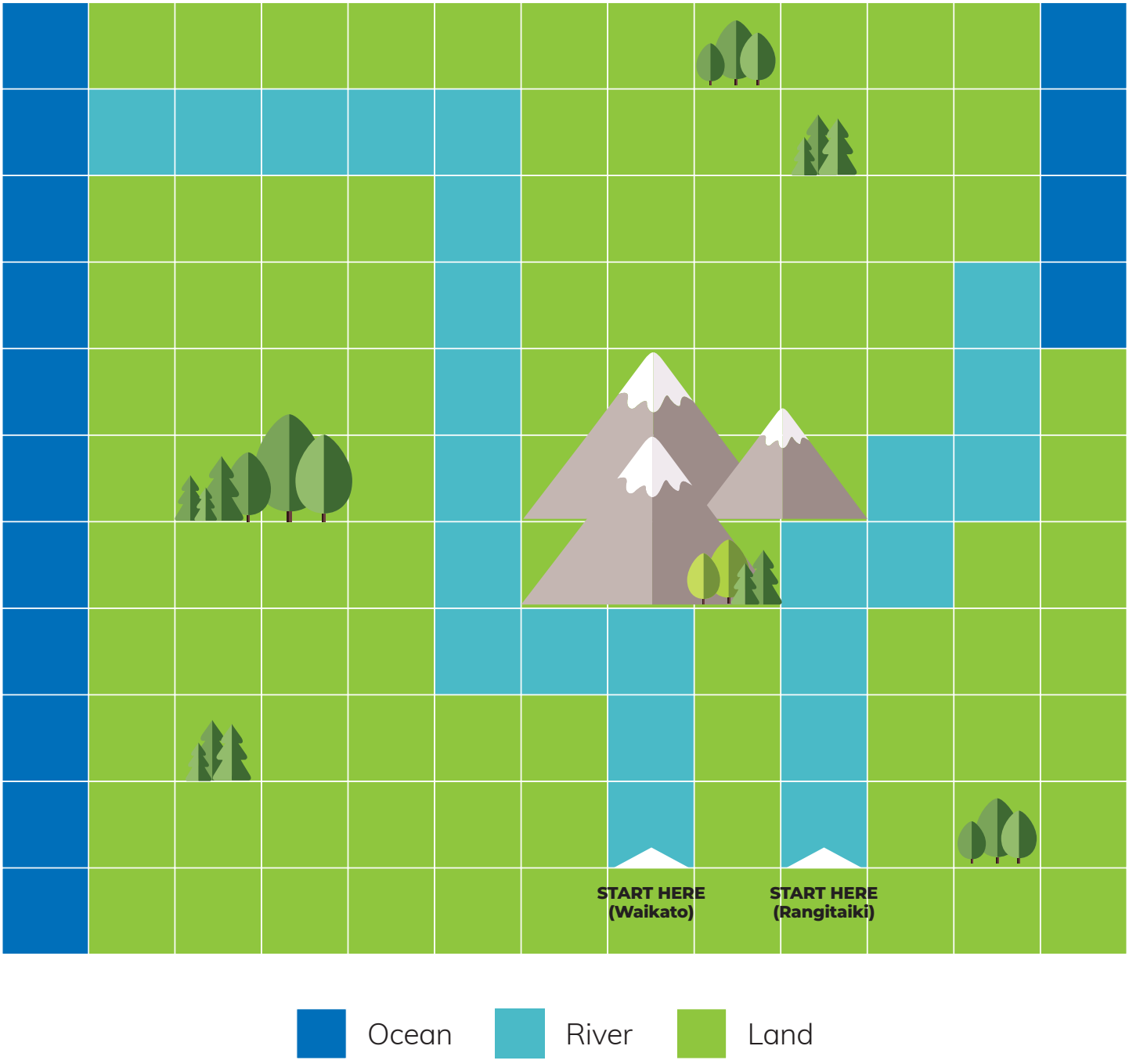


Waikato's Algorithm: Circle the bugs in the algorithm below



Write your correct algorithm below:

Student Worksheet: Algorithms and debugging (2 of 2)



Teacher Resource 4 (TR 4)
Conditionals & Loops

Description

In this activity, students will create an algorithm using conditionals, loops and functions to create a digital solution to a real-world problem.

Curriculum Alignment

New Zealand Digital Technologies Curriculum	
Computational Thinking for Digital Technologies: Progress outcome 5	• In authentic contexts and taking account of end-users, students decompose problems to create simple algorithms using the three building blocks of programming: sequence, selection, and iteration. They implement these algorithms by creating programs that use inputs, outputs, sequence, basic selection. They debug simple algorithms and programs by identifying when things go wrong with their instructions and correcting them, and they are able to explain why things went wrong and how they fixed them.

New Zealand Social Studies Curriculum	
Students will gain knowledge, skills, and experience to: Level 1	• Understand how the past is important to people. • Understand how the cultures of people in New Zealand are expressed in their daily lives.

New Zealand Maths Curriculum	
Position and orientation: Level 3	• Communicate and interpret locations and directions, using compass directions, distances, and grid references.
Geometry and measurement: Level 2	• Sort objects by their spatial features, with justification.

TR 4 - Workshop Details

Learning Objectives

Students will be able to:

- Write an algorithm (a set of clear and simple, step-by-step instructions to solve a problem).
- Identify when an algorithm produces an unexpected result (a bug).
- Understand that debugging is how we find and fix a bug in an algorithm.
- Complete the process of debugging:
  a) Start at the beginning of the algorithm.
  b) Follow the algorithm step-by-step until you find a step that produces a result you did not expect.
  c) Correct the step(s).
  d) Start at the beginning again and repeat these steps until the algorithm does what you were expecting.
- Understand that some algorithms are more efficient than others.
- Understand that conditionals let us run different code in different situations.
- Understand that a function is a group of instructions that has been given a name.
- Understand that loops let us repeat code again and again.

Materials

Ensure you have the following material ready:

[ ] Worksheet – Conditionals and loops 1 (1 per pair of students)

[ ] Pens

[ ] Scissors

[ ] Glue

Time Allowance

- 15 minutes

Preparation

- Before the lesson, you will need to print enough copies of Worksheet – Conditionals and loops (1 & 2) one copy per student.
- Read the links from the Lesson Resources to be used in the Learning Hook to familiarise yourself with the environmental concerns of oil spills, an example of an oil spill in New Zealand and a robot that could help solve the problem.
- Ensure that you are familiar with the definitions of relevant terms (see the glossary provided).
- Optional, print both articles for the Rena oil spill and the robots that are used to clean oil spills, OR, ensure that you have them open and projected for the class to read as a group.

TR 4 - Lesson Plan

Introduction / Learning Hook

1. Share an article and video (either through print and/or projection) with the students on the Rena Oil Spill: https://www.telegraph.co.uk/news/worldnews/australiaandthepacific/newzealand/8819435/Oil-leak-from-container-ship-declared-New-Zealands-worst-maritime-disaster.html.
2. As a class, discuss the environmental impacts of oil spills. Reference if needed: https://www.thoughtco.com/environmental-consequences-of-oil-spills-1204088.
3. Share an article that chronicles the use of robots to help contain oil spills: https://www.roboticstomorrow.com/article/2013/12/using-robots-to-clean-oil-spills/215/.

Running the Lesson - Part 1

1. Give students a copy of Worksheet – Conditionals, loops and functions (1).
2. Give students the instructions that the robot can understand:
   - moveForward (move forward one square)
   - turnRight (turn 90° to the right, but do not move forward)
   - turnLeft (turn 90° to the left, but do not move forward)
   - clean (cleans the oil on the square the robot is on)
3. Ask students to complete the worksheet by writing an algorithm for robot to clean the oil.
4. After students have completed this activity, have students swap algorithms. Once students have swapped worksheets, they must follow the algorithm provided to them step-by-step and determine the path that the algorithm describes. They must determine whether the algorithm will clean up all the oil.
5. If the algorithm does not clean up all the oil, then the student has found a bug! In this case, the student who wrote the algorithm and the student who found the bug must go through the process of debugging together to correct the algorithm. The process of debugging is:
   a) Start at the beginning of the algorithm.
   b) Follow the algorithm step-by-step until you find the step/s where the algorithm produces a result you did not expect.
   c) Correct the step(s).
   d) Start at the beginning again and repeat these steps until the algorithm does what you were expecting.
6. When students have a bug-free algorithm, ask each student to count the number of steps in their algorithms and write the number on their worksheets.

Running the Lesson - Part 2

1. Remind students that the conditionals block (IF/THEN/ELSE) lets us run different code in different situations and the loop block lets us repeat code again and again. These blocks can help us write more efficient algorithms.
2. Give each student a copy of Worksheet – Conditionals, loops and functions (2).
3. Ask students to cut out the blocks on the worksheet.
4. Ask students to create an algorithm that uses fewer blocks than their first algorithm that will get the robot to clean the oil. Remind them that they can use loops and conditionals to achieve this. Explain that in block programming, using less blocks often creates more efficient algorithms.
5. Get students to glue their new, shorter algorithms next to their original algorithms, and write the number of blocks they used to create that algorithm (see below for possible solutions).
6. After students have completed this activity, have them swap algorithms with each other. They must follow the algorithm provided to them and determine the path that the algorithm describes. It may help them to draw the path on the worksheet as they follow each step of the algorithm. They must determine whether the algorithm successfully cleans the spill.
7. If the algorithm does not clean up all the oil, then the student has found a bug! In this case, the student who wrote the algorithm and the student who found the bug must go through the process of debugging together to correct the algorithm. The process of debugging is:
   a) Start at the beginning of the algorithm.
   b) Follow the algorithm step-by-step until you find the step/s where the algorithm produces a result you did not expect.
   c) Correct the step(s).
   d) Start at the beginning again and repeat these steps until the algorithm does what you were expecting.
8. Ask students to count the number of blocks in their debugged algorithm.

Conclusion

1. Ask students which of their algorithms would clean the oil the fastest, and which algorithm had fewer blocks or steps in it. While in some cases an algorithm that has fewer steps is considered more efficient, another way to consider algorithm efficiency is how long it would take to solve a problem.
2. Discuss which algorithm would be the most suitable to program a robot to clean an oil spill in real life. Mention that, unlike on a worksheet, we might not know where all the oil is in an oil spill as it would likely move and spread over time, and discuss why an algorithm containing conditionals and loops might be more effective in that circumstance.
3. Have a discussion with students around algorithm efficiency. Highlight that some algorithms with many steps can be written more efficiently if the coder uses conditionals, functions and loops. However, an algorithm that is short to write does not necessarily take less time for a computer or other digital device to execute. Ask students to identify which way they preferred to write the algorithm and why. Ask students which way would be more practical if they had to write a very long algorithm.

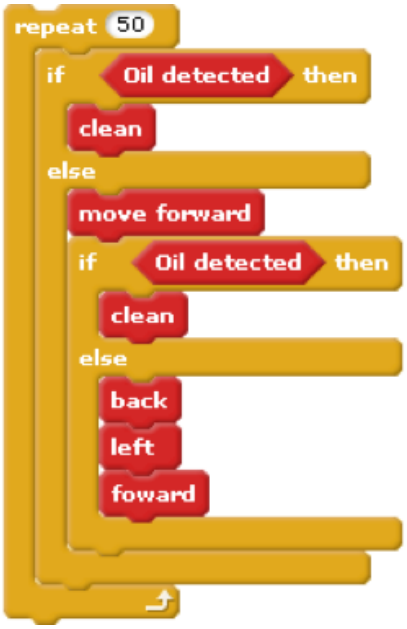
4. Explain that conditionals can help when you want to do different things in different situations – if you did n'ot know exactly where the oil was going to be, conditionals could help the robot clean only when it found oil. Ask students to come up with other situations in their lives where they need a conditional, rather than a single rule they follow all the time. (For instance, when crossing the rode, IF there are no vehicles approaching, THEN they should cross ELSE they should wait until it is safe).
5. If students found a bug in the algorithm, ask them to discuss how they found it and fixed it.
6. Ask students whether it was helpful to have someone else check their algorithm for them, and if it was, why that might be. Discuss the importance of collaboration in getting to the best possible outcome and problem solving.

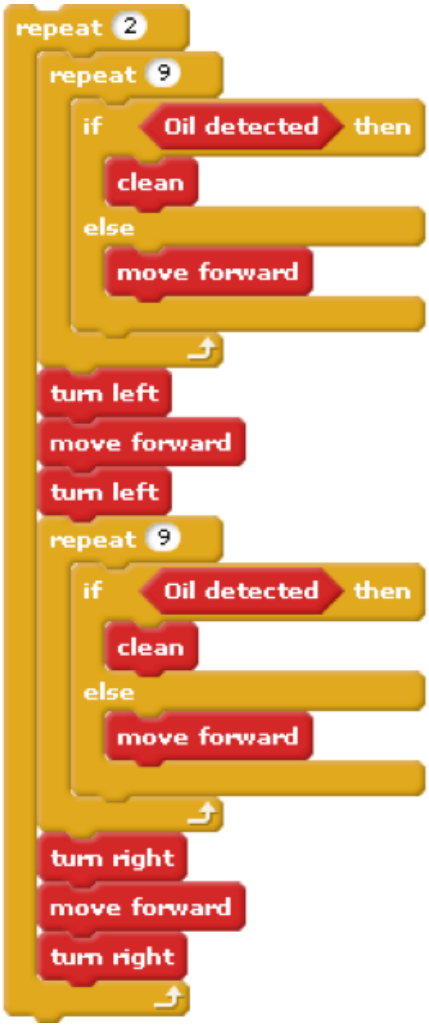
Glossary	
Algorithm	A set of clear and simple, step-by-step instructions to solve a problem.
A Bug	When an algorithm produces an unexpected result.
Debugging	A process of how to find and fix a bug in an algorithm. This process is: a) Start at the beginning of the algorithm. b) Follow the algorithm step-by-step until you find a step that produces a result you did not expect. c) Correct the step(s). d) Start at the beginning again and repeat these steps until the algorithm does what you were expecting.
Conditionals	Lets us run different code in different situations.
Function	A group of instructions that has been given a name.
Loops	Let us repeat code again and again

TR 4 - Lesson Resources: Relevant Links & Answers

Useful Links	
Rena Oil Spill	• https://www.telegraph.co.uk/news/worldnews/australiaandthepacific/newzealand/8819435/Oil-leak-from-container-ship-declared-New-Zealands-worst-maritime-disaster.html
The environmental impacts of oil spills	• https://www.thoughtco.com/environmental-consequences-of-oil-spills-1204088
Robots to help contain oil spills	• https://www.roboticstomorrow.com/article/2013/12/using-robots-to-clean-oil-spills/215/

Condtional & Loops - Worksheet Answers

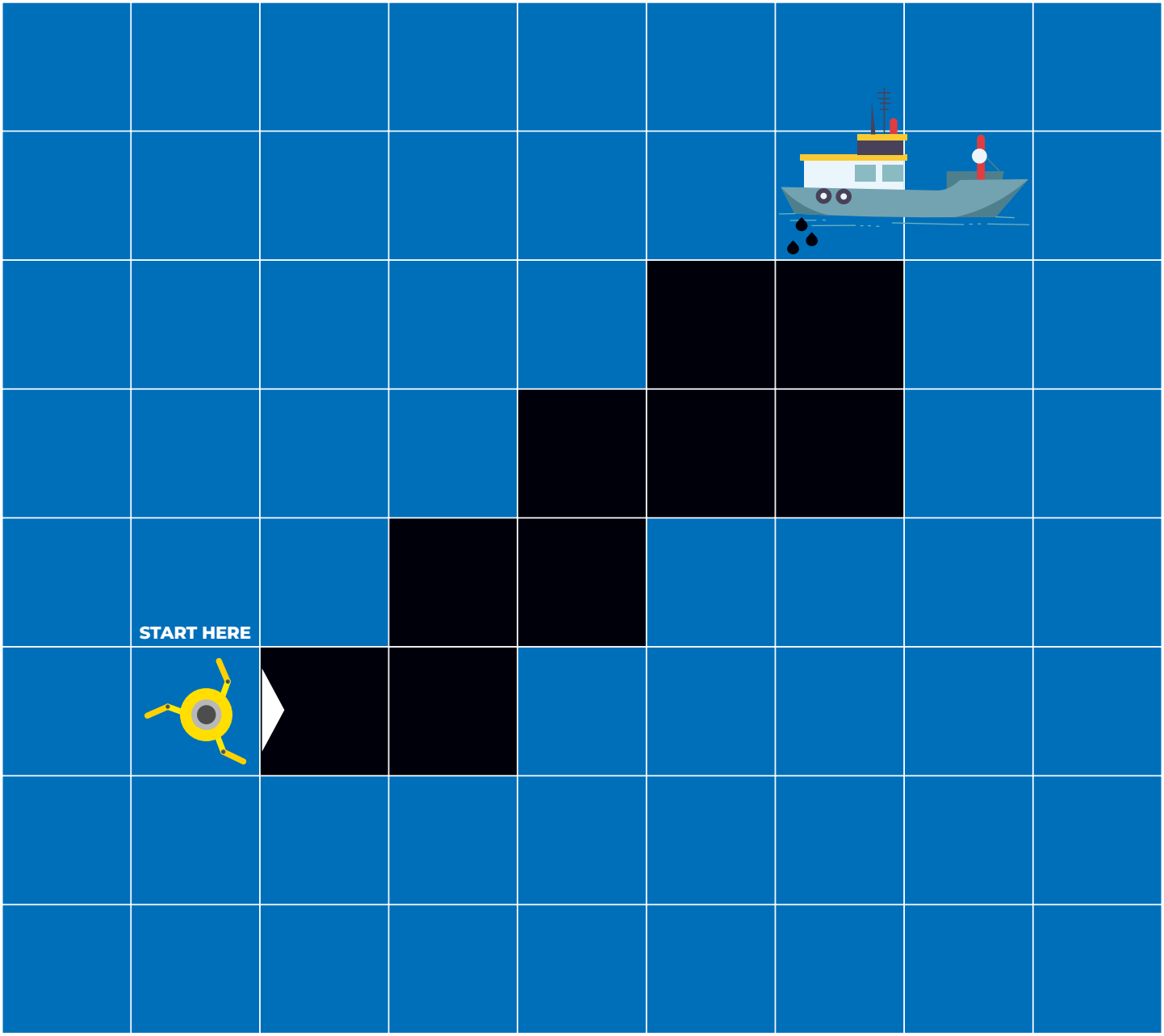
Write your algorithm below:	Paste your blocks below:
• clean • moveForward • clean • moveForward • turnLeft • clean • moveForward • turnRight • clean • moveForward • turnLeft • clean • moveForward • turnRight • clean • moveForward • turnLeft • clean	• Possible solution 1: 
Number of steps: 18	**Number of blocks: 11**

	Paste your blocks below:
	• Possible solution 2: 
	Number of blocks: 17

Student Worksheet: Contionals & loops (1 of 5)

Clean up the oil spill!

Direct the robot to find and clean up all of the oil. Don't forget to debug your code when you have finished.



Ocean

Oil spill

Oil spill cleaning robot

Ship

Oil leak

Student Worksheet: Contionals & loops (2 of 5)

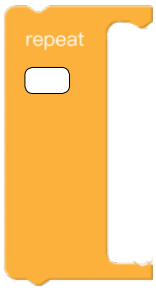
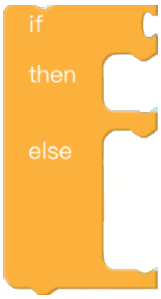
Write your algorithm below:	Paste your blocks below:
Number of steps:	**Number of blocks:**

Student Worksheet: Contionals & loops (3 of 5)

We want to write a really efficient algorithm to clean up the oil.

Blocks

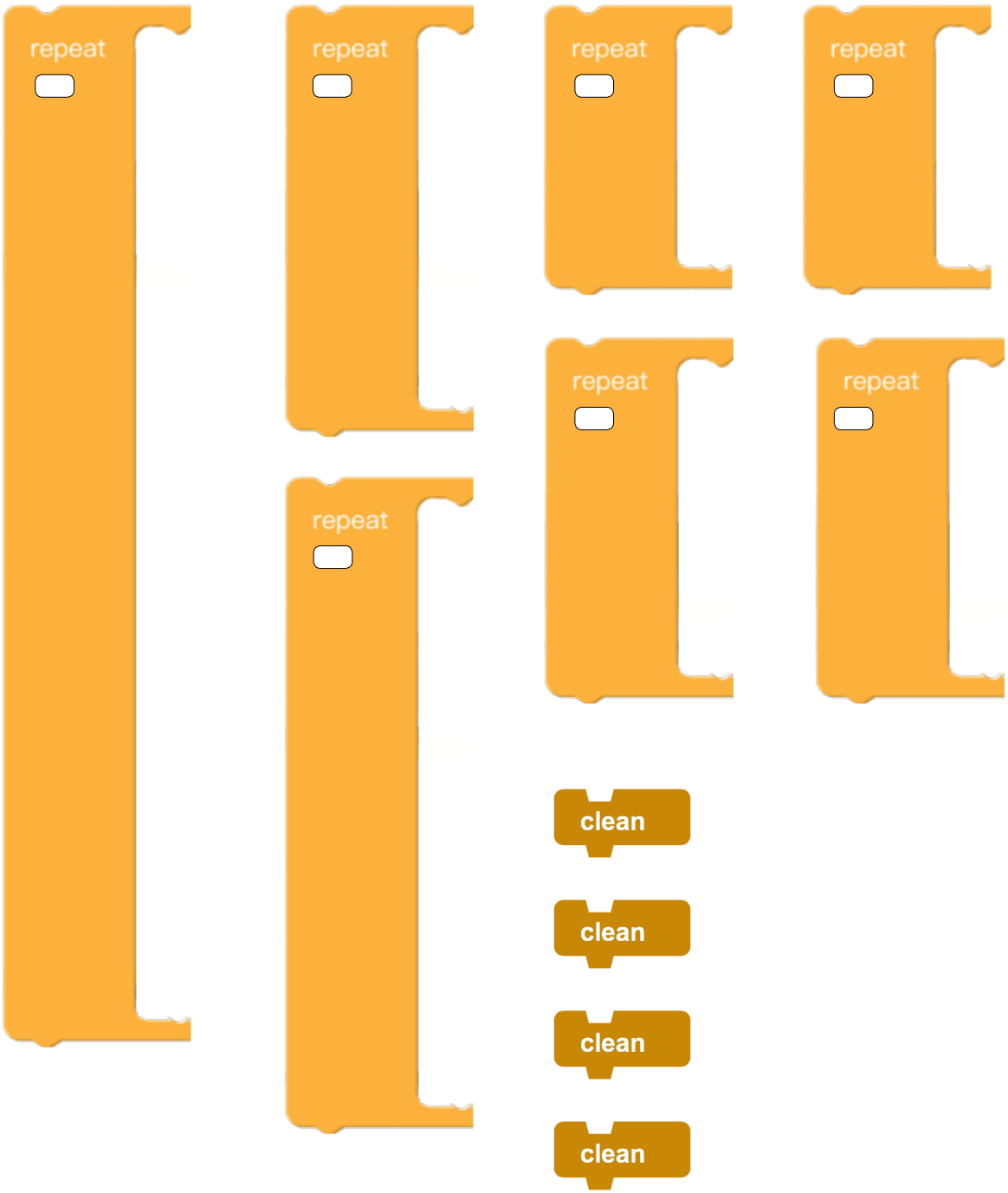
You may use the following **blocks**:

	Moves the robot forward one square.
	Turns the robot to the left.
	Turns the robot to the right.
	The robot cleans the oil from one square.
	The robot detects oil in the square it is on.
	The loop block repeats the code inside it. You must specify the number of times you want to repeat.
	The conditional block lets you use different code in different situations.

Student Worksheet : Conditionals and loops (4 of 5)

Cut out the blocks and put them in the right order to get the robot to clean up all the oil. Don't forget to write in how many times you want to repeat when you include a repeat block.

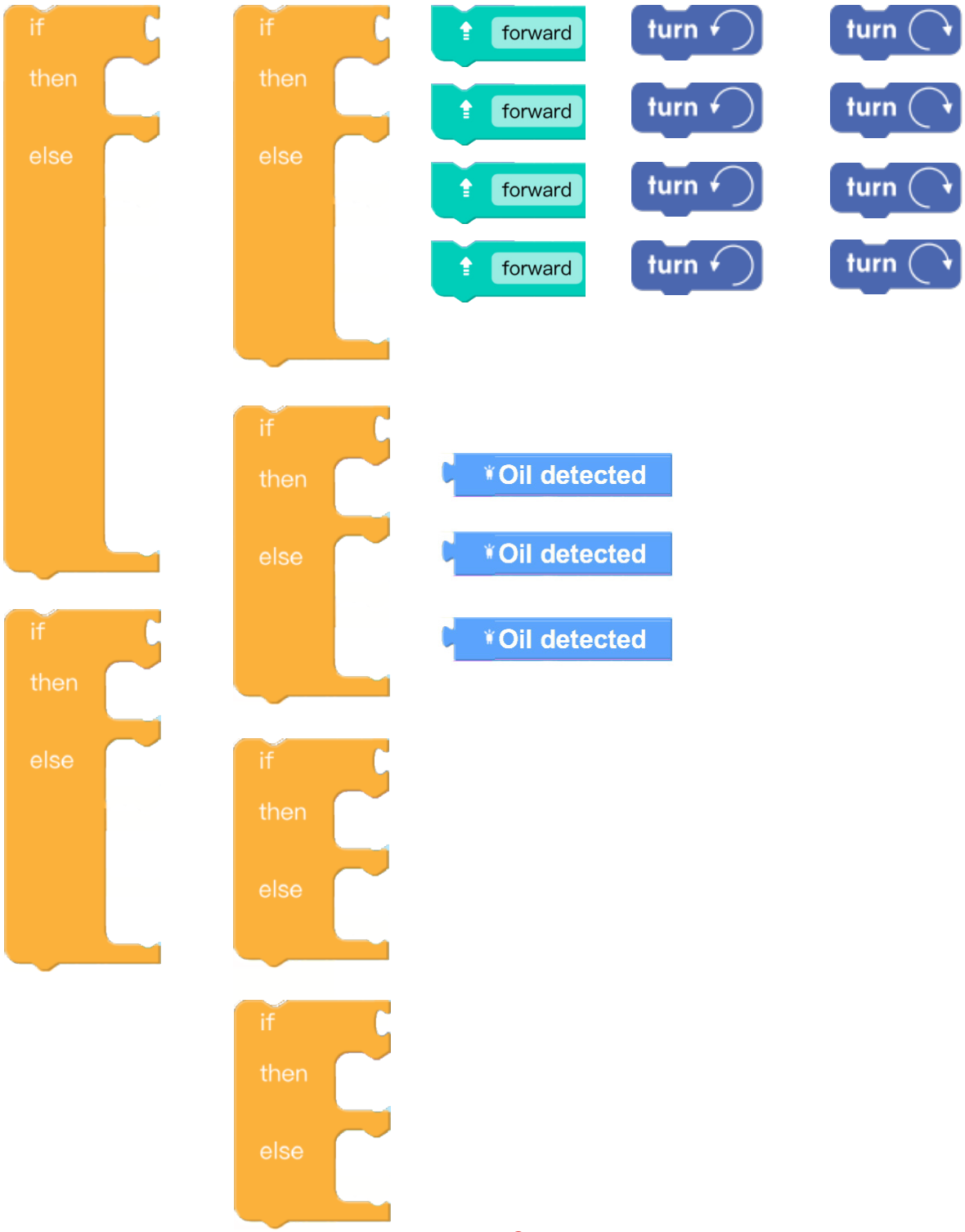
*Note: You may not need all the blocks for your algorithm.
*Note: You can draw your own blocks if the ones provided don't match your algorithm.



Student Worksheet : Conditionals and loops (5 of 5)

Cut out the blocks and put them in the right order to get the robot to clean up all the oil. Don't forget to write in how many times you want to repeat when you include a repeat block.

*Note: You may not need all the blocks for your algorithm.
*Note: You can draw your own blocks if the ones provided don't match your algorithm.



Additional Resources

Resource & Link	Description
Digital Technologies Hub **Think Like an Inventor Lesson Plan** https://www.digitaltechnologieshub.edu.au/teachers/lesson-ideas/think-like-an-inventor/design-thinking-process---ideation	The aim of this specific lesson is to understand how the design process works and to generate different ideas for solving the problem of child obesity. We will use design thinking activities and compare which one was most effective in generating different ideas.
What Makes a Good Game Lesson Plan https://www.digitaltechnologieshub.edu.au/page-not-found?aspxerrorpath=/teachers/lesson-ideas/what-makes-a-good-game%3E	This lesson allows students to use a game design process to create a game. They will empathise with the audience and use text and diagrams to develop their design. They will prototype and test their game just like game designers do.
Design Thinking – Empathising Lesson Plan https://www.digitaltechnologieshub.edu.au/teachers/lesson-ideas/think-like-an-inventor/design-thinking-process---empathy	The aim of this lesson is to understand how the design thinking process works and to understand end users to design a digital solution to reduce the amount of litter in the schoolyard.
Create a Branching Game https://www.digitaltechnologieshub.edu.au/teachers/lesson-ideas/integrating-digital-technologies/create-a-board-game-that-uses-an-ozobot	Students create a game board where the player is provided with a number of decisions. Using Scratch and Makey Makey, students add multimodal elements to the story. These elements are activated using an Ozobot.

Resource & Link	Description
Make a Maths Quiz 1 and Make a Maths Quiz 2 https://www.digitaltechnologieshub.edu.au/teachers/lesson-ideas/making-maths-quizzes-2	In these lessons students will design a maths quiz program that asks maths questions that are harder or easier depending on how well you are going.
Design a Game or Quiz https://www.digitaltechnologieshub.edu.au/teachers/lesson-ideas/integrating-digital-technologies/storm-survivor-input-decision-making-and-loops	Working collaboratively, students design and create a game or quiz to help others prepare for a severe weather event. Students must include algorithms involving user input, decision-making statements and loops, and must use data such as images and sound.
Curriculum Exemplars **Computational thinking** http://technology.tki.org.nz/Technology-in-the-NZC/CT-Progress-outcomes-exemplars-and-snapshots **Designing and developing digital outcomes** http://technology.tki.org.nz/Technology-in-the-NZC/DDDO-Progress-outcomes-exemplars-and-snapshots	The Ministry of Education (Te tahuhu o te Matauranga) provides exemplars of work in areas of technology for both computational thinking and designing and developing digital outcomes. Case studies, teaching snapshots and student showcases available to exemplify current technology teaching are available on the Technology Online website.
GameFroot **Mihi Maker** http://make.gamefroot.com/#/activity/mihi-maker	Mihi Maker is a fun easy to use activity that combines coding, social studies and indigenous culture. Students can code their own mini-game and learn how to introduce themselves in Te Reo Māori.
Go Animate https://goanimate.com/	Go Animate is a free animation program that students can use to animate their own stories or educational information. Note, the free version has restrictions and branding.

Resource & Link	Description
Code.org: Unplugged https://code.org/curriculum/unplugged	Code.org has compiled a list of lessons that teach the fundamentals of computer science, with or without access to computers. These lessons can be used as a stand-alone course or as complementary lessons for any computer science course.
Courses https://studio.code.org/courses?view=teacher	Code.org offers courses for students in grades K-12 and professional learning for teachers. You can sign up for free and complete the courses at your own pace. It also includes online Teacher Communities so that you can take the journey with like-minded teachers.
For Students https://studio.code.org/projects/public	The projects tab of the Code.org site allows students to write a new game for others to play, or to play games made by students all over the world.
BBC **Bitesize Computing** https://www.bbc.com/education/subjects/z34k7ty	The BBC Bitsize Computing website provides lessons in computers in society, binary and data representation, hardware, software, networks, databases and programming.
ScratchJr **Website & Free App** https://www.scratchjr.org/	ScratchJr is a free app on both Apple and Android tablets. It includes many pre-programmed lessons that allows children to program their own interactive stories and games. By snapping together graphical programming blocks, children can make characters move, jump, dance, and sing. In the process, children learn to solve problems, design projects, and express themselves creatively on the computer. They also use math and language in a meaningful and motivating context, supporting the development of early-childhood numeracy and literacy. If your class does not have access to tablets, you can still access free resources through the Scratch Website (below), however, it is a more advanced version.
Tutorials https://www.scratchjr.org/teach	The ScratchJr website offers a range of activities that gives you and students a quick way to learn how to do new things with ScratchJr.
Teacher Resources https://www.scratchjr.org/teach/curricula/animated-genres	ScratchJr offers curricula that introduces computer science concepts to children, while allowing them to practice critical thinking and problem-solving skills. Lessons cover topics like programming, expressing through technology, and user-centered design.

Resource & Link	Description
Scratch Video Tutorials https://scratch.mit.edu/help/videos/	The Scratch website has a series of video tutorials that take you through a full range of skills needed to use Scratch.
Usage Tutorials http://scratch.redware.com/videos	The Scratch website offers a range of tutorials created by users.