Computing with Loti-Bot

Loti-Bot is a member of the TTS Bot Family, featuring programmable movement, highly accurate drawing capabilities and a variety of inputs and outputs.

This collection of lessons will take you from getting to know Loti-Bot and understanding the sensors and functionality through to programming Loti-bot using the accompanying block-based coding app.

This unit has been written with the skills of students **aged 8-11** in mind but can easily be adapted for younger or less experienced students or for those who are older or more experienced. For example:

- **For younger students,** you could write the code as a whole class so that everyone can take part but are guided more by the teacher. You may also decide to adapt the sequence of the lessons, or leave some sessions out, depending on their prior learning.
- **For older students** you may want to add in the 'variables' elements for Loti-Bot which include being able to give the robot instructions to follow if their battery drops below a certain point, or to use the light level sensor as a trigger to do certain actions. You could also explore adding random number generation. These can all be explored via the app.

Within the plans, there are also suggestions to make each lesson 'more accessible' or to 'add a challenge' if you wish with your own class.

Resourcing

- It would be ideal to have at least one Loti-Bot for each group of children. However, if this is not always possible, groups can view their output via the app so can practise before testing on a Loti-Bot when one becomes available.
- You will need tablets with the Loti-Bot app installed.
- To model the coding and to show students what the app can do, it is best if you can mirror your tablet to the Interactive Whiteboard, either directly or via a web extension. If not, you can show the tablet under a visualiser or simply go round the groups to demonstrate.

With many thanks to Jodie Lopez, EdTech Consultant, for her support with writing and collating this sequence of lessons.

1. Meet Loti-Bot!

Students will meet Loti-Bot and spend time learning about all the different sensors and functionality of this programable robot.

Skills and Learning	Resources
Students will: - Explore a new robotic device and programming environment. - Explain how a digital, programmable device functions. - Identify output and input devices.	- Loti-Bot (ideally one robot for every 3 to 4 pupils) - Tablet(s) with Loti-Bot app installed. - Large paper and pens

Key Vocabulary and Questions	Assessment Opportunities
robot, input, output, sensor, command - What is a robot? - What are inputs and outputs? - How does Bluetooth work?	Children will present their 'Loti-Bot User Guide' to share what they have learnt. This is also an opportunity to support and develop speaking and listening skills.

Introduce	Explain that today we are going to be learning about and using a new programmable robot. To begin, have a class discussion about the following: - **What is a robot?** *(you may want to discuss that people give robots **commands** to complete, robots have **sensors** to sense or measure things, robots have **hardware** to **process** the information from their sensors, robots have a way to **complete** tasks e.g. some may fly, roll, turn, etc.)* - **What robotic devices do the children use or encounter in their daily lives?** *(you could think about things such as robotic hoovers, heating/air con systems, remote control cars, car washes, vending machines, etc.)* **Loti-Bot** Introduce Loti-Bot and the Loti-Bot app. **Question - Have you ever used any other programmable robots before, for example the Bee-Bot or Blue-Bot?** Reflect on previous learning with robotics and encourage children to think about how they can use and apply these skills and knowledge to support them.

Learn and Explore

Today's challenge is to begin creating a 'Loti-Bot User Guide Poster.' The children will start by gathering information and then adding to it as they move through each of the lessons. This needs to be something that others in the school can use when they first use Loti-Bot, so it needs to be easy to understand. (You could link this to your English lessons, looking at the purpose of User Guides and different examples.)

Time to Explore

Give children time to explore Loti-Bot in small groups to 'tinker' and discover as many functions and features as possible. They should consider things such as turning on and off, setting up the app, Loti's inputs, and outputs, etc. Do they notice any similarities or differences to the robots they have worked with in the past?

Provide large paper and pens for recording everything they discover about Loti-Bot. This could be done independently or collaboratively in small groups.

Children may want to consider how to present their poster. For example, they could draw a picture of Loti-Bot in the middle of the page so they can create their own mind map with everything they discover (this may be a first draft, *with time built into later lessons to plan and create their final design).*

Encourage children to record questions that they have but cannot answer themselves on sticky notes. These can be revisited later as a whole class, for example, if they do not understand one of the sensors.

Check Ins and Questions

Throughout the 'tinker time' session, bring the class back together at intervals and scaffold any discussions or highlight key 'tips' that groups are identifying within their conversations.

Encourage children to ask any questions they have recorded on sticky notes to their peers. Do any of the other groups have an answer to this? If so, ask the children to support their peers by sharing what they have found out. If not, add it to a class list of questions to answer as you move through the next lessons. We will discover the answers together as we learn more about Loti-Bot.

Connectivity and Security

This may be one aspect you wish to highlight specifically within this lesson.
Check whether children have discovered what type of connection Loti-Bot uses to connect to the app.
This is done through transmitting data over **Bluetooth**.

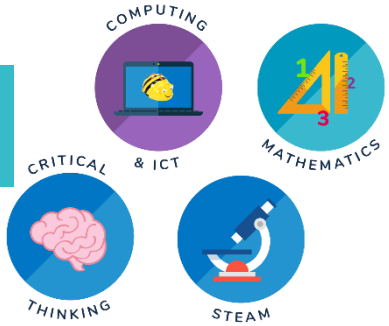
Bluetooth is a type of network. It works by using radio waves to transmit information between devices. It divides the transmitted data into packets and transmits each packet on

	one of the designated Bluetooth channels. Bluetooth devices communicate, pair and form networks. Ask children to consider why the developers of this robot chose to connect using Bluetooth rather than through a different approach, e.g. Wi-Fi. They may discuss elements of security and how information is shared through this network.

Make it accessible	Add a challenge
You may want to create a list of Loti-Bot's main features, functions, inputs and outputs which children can use as a stimulus or for labelling. For example: Obstacle Sensor, Light Sensor, On/Off Switch You could add a definition for each of these too.	If children feel confident, ask them to begin to test some of the inputs and outputs to identify more detailed instructions, such as examples of code that work with each input.

Review and Reflect	Allow each group to present their User Guide Posters on everything they have learned about Loti-Bot so far. Spend time reflecting on what they have learned. - What is your favourite part or feature of Loti-Bot? - Are there any features you did not spot that another group identified? - What helped you most today while 'tinkering' with Loti-Bot? - What new information have you learned today? - Next steps – what would you like to learn about with Loti-Bot in future sessions?

2. Loti-Bot On The Move



During this lesson, children will learn the basic principles of writing algorithms and will use block-based coding to get Loti-Bot on the move!

Skills and Learning	**Resources**
Students will: - Understand the basic principles of writing algorithms. - Use block-based coding to program a robot. - Use directional language and knowledge of angles to move and turn Loti-Bot.	- Loti-Bot (ideally one robot for every 3 to 4 pupils) - Tablet(s) with Loti-Bot app installed - Large, clear space to move Loti-Bot - Floor markers or tape to create a simple path

Key Vocabulary and Questions	**Assessment Opportunities**
algorithm, block-based coding, forward, backward, degrees, left, right, angle, debug - What is an algorithm? - How do we program Loti-Bot? - What do we do if something is wrong with our algorithm?	- Observe children as they program Loti-Bot. - Can children program their algorithm? - Can children debug their algorithm?

Introduce	Welcome to the next steps in our exciting world of coding and robotics! Recap on learning from Lesson 1 – what did we learn about Loti-Bot? Review children's user guides to support with their learning today. In this lesson, we will learn how to program Loti-Bot to follow specific instructions and navigate to a destination. We will use block-based coding, which uses visual blocks to create programs, making it easier for us to control the robot's movements. Our robot is capable of moving forward, backward, and turning in different directions.

Learn and Explore	**Activity 1: Understanding Algorithms** • Start by explaining the concept of algorithms in a simple manner. • *An algorithm is a set of step-by-step instructions/rules for completing a task, reaching a goal, or solving a problem.* • Show some real-life examples of algorithms, like a recipe for baking cookies or the steps to tie shoelaces.

- Ask children to work in pairs or small groups to create an algorithm to complete a task, such as moving from their desk to the door. They may have to stand up, turn 90 degrees right, move forward 1 step, turn 90 degrees left, and move forward 5.

- Share their algorithm with the class – did it work?

- Explain that just like these examples, we can use an algorithm (a set of instructions) to program our robot to move.

Activity 2: Block-Based Coding

- Explain that block-based coding is a way of programming by stacking visual blocks together. Each block represents a specific command or action that the robot will perform.

- Show the students the programming app on the tablet and the available coding blocks. We will not cover all of them in today's lesson, but they will have a chance to use most of them by the end of this unit.

- *Optional:* You could ask children to record their algorithm from the first activity into a series of blocks, representing the block-based coding in Loti-Bot's app.

Activity 3: Directional Vocabulary

- Revisit directional vocabulary and knowledge about angles that children will be familiar with from their mathematics learning, such as forward, backward, left, right, angles, and degrees.

- Explain how the directions relate to the robot's movements, including programming the turning angle when moving Loti-Bot. Recap – how many degrees will it be for a right-angle turn?

- Creating a 'crib sheet' on your board of key information, such as 90^0 is a right-angle turn, might be helpful and help to scaffold the children's learning.

- Relate this vocabulary to basic mathematical concepts. For instance, moving "forward" can be represented as a positive change in position, while moving "backward" can be represented as a negative change in position.

Activity 4: Loti-Bot On The Move

- Create a simple path on the floor using markers or tape, consisting of straight lines and a few turns. Ensure that the path is clear and easy to follow.

- In pairs or small groups, let the students take turns to program the robot to move along the path to reach the destination. They may want to take on different roles in the group, such as note taker, program tester, and 'driver'. They may want to switch roles as they try different journeys.

- Ensure students are explaining their programming choices by using the correct directional vocabulary and discussing which coding blocks they have used to complete the task.

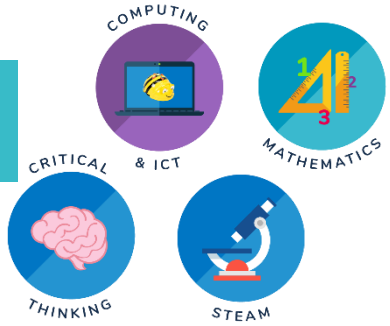
	Debug – Children will need to 'debug' their algorithm when they spot errors, for example if they have programmed Loti-Bot to turn in the wrong direction. Allow time for them to reflect and re-test their algorithm.

Make it accessible	Add a challenge
Provide some more opportunities for physical coding, e.g. with direction and turn cards to map out a route. Children can trial creating algorithms with the cards and physically moving themselves to test the algorithms, before using the block-based environment. Ensure the paths created for Loti-Bot are simple, for example, only containing one turn.	Once the students are comfortable with basic movements, introduce a more complex path or maze for the robot to navigate. You could also give them big sheets of paper and ask them to draw their own maze. Ask them to also plan and write down the algorithm on paper, in note form, before programming the robot. This practice will reinforce the concept of planning before executing the code and may help when debugging.

Review and Reflect	Gather the students and discuss their experiences with the Loti-Bot. - What did you learn about Loti-Bot? - What or who helped you to learn something new today? Review the directional vocabulary and block-based coding concepts. Emphasise the importance of algorithms in coding and problem-solving. Give children 5 minutes to add anything new to their User Guide Posters on Loti-Bot from what they have learnt today.

Homework *(optional)*	Ask the students to create a simple map of their house or classroom and write an algorithm using directional vocabulary to guide Loti-Bot through the map to a specific location. Can they test this by asking a family member or friend to complete the algorithm? Did it work, or did they have to debug?

3. Making Loti-Bot WAIT



Students will learn how to use a WAIT instruction to program Loti-Bot to stop and wait at certain destinations before continuing to the next stop!

Skills and Learning	**Resources**
Students will: - Use block-based coding to program Loti-Bot. - Program using the WAIT instruction to make Loti-Bot stop and wait.	- Loti-Bot (ideally one robot for every 3 to 4 pupils). - Tablet(s) with Loti-Bot app installed. - Prior to the lesson – a large space with markers or tape laid out to create a model town with roads running through to create paths for the robot. In this, layout markers such as small world buildings or wooden blocks, to represent specific locations in the town, such as bakery, library, school, traffic lights, etc. - Aerial map (photograph) of your model town.

Key Vocabulary and Questions	**Assessment Opportunities**
algorithm, block-based coding, directions, debug, WAIT instruction - How do we debug a program? - What is a WAIT instruction?	- Can children program Loti-Bot with a WAIT instruction, so that Loti-Bot can travel, wait, and then restart the journey?

Introduce	Begin by briefly reviewing the key concepts from the previous lesson: -What is an algorithm? (A set of step-by-step instructions) - What is block-based coding? (Using visual blocks to create programs) - What is directional vocabulary? (Words like "forward," "backward," "left," and "right" used to direct the robot's movements)

Learn and Explore	**Introducing the Model Town** • Set up a model town path in the classroom or a large space using different markers (e.g. tape, wooden blocks, or small world buildings) to represent streets, buildings, and specific locations such as a bakery, library, school, etc. • Explain to the students that today, we must help Loti-Bot navigate through the town and make stops at different locations.

- Spend some time exploring the model town so that children are familiar with each of the buildings. If needed to build confidence or provide additional support, you could even let children practise travelling through the model town themselves by following algorithms created verbally.

Introducing the WAIT Instruction

- Explain the concept of the WAIT instruction, which allows the robot to pause and wait for a certain amount of time before continuing with the following instructions.

- Discuss scenarios where waiting might be necessary, such as when the robot arrives at a traffic light, a pedestrian crossing, or a busy intersection.

Programming the Robot with WAIT Instructions

- Divide the students into pairs or small groups. Provide each group with a map of the model town and a set of instructions (algorithm) to help program the robot's journey, including the WAIT instructions at specific locations. For example, Loti-Bot will need to go from the school to the library, where Loti-Bot must wait 10 seconds to pick up a book before moving on to the bakery.

- Encourage the students to collaborate and plan the robot's path using directional vocabulary and the new WAIT instruction. Show children how to break down their problem into smaller parts (decompose) to help plan their algorithm. Record these steps on paper before testing on the model town.

- Ask them to take on different roles in the group, such as note taker, program tester, driver, debugger. Children can experience different tasks by switching roles, as they try different scenarios.

Implementing the Program

- Allow each group to take turns programming Loti-Bot to test their algorithms on the model town path. Ask children to explain their program and the choices they made. Observe and assist as needed to ensure the robot follows the instructions accurately.

Troubleshooting and Iteration

- Encourage students to discuss and troubleshoot any issues they encounter while testing the robot's path (debugging).
- Prompt them to make improvements and adjustments to their algorithms if necessary.

Code Journal (optional additional task)

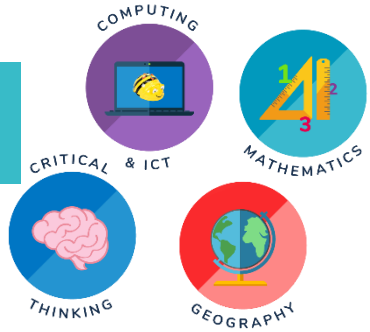
- Throughout the process of learning about Loti-Bot, it may be helpful to set up a ‘code journal’ where children can keep examples of algorithms they have created to complete specific actions/journeys.
- For example, they may want to include an entry from today and record an example of how they programmed the WAIT instruction. They can then draw on this journal throughout the unit as they move on to more complex activities.

Make it accessible	Add a challenge
Give children model sections of code that they can combine to use, such as a pre-built WAIT instruction or code to get from one place to another.	For students who grasp the concepts quickly, challenge them to add more destinations and instructions to their algorithms, incorporating multiple WAIT instructions in different scenarios.

Review and Reflect	Gather the students and have a group discussion about their experiences navigating the model town. Ask questions to reinforce their understanding of algorithms, directional vocabulary, and the new WAIT instruction. Highlight the importance of waiting in real-life scenarios and how it can make the robot's path more efficient and safer. **User Guide Posters** Give children 5 minutes to add anything new to their User Guide Posters after what they have learnt today about Loti-Bot.

Homework *(optional)*	Ask the students to create a new model town map (based on a real example or fictional town) with different locations. Can they plan an algorithm using block-based coding, including the WAIT instruction for specific stops?

4. Loti-Bot Around The World



Explore and learn about different countries, continents, and oceans around the world by programming Loti-Bot to take a worldwide trip!

Skills and Learning	**Resources**
Students will: - Learn about and use Loti-Bot's different sensors. - Work with various forms of input and output. - Design, write and debug programs. - Estimate, measure and record lengths. - Use world maps to name and locate countries, continents, and oceans. - Work collaboratively with others.	- Loti-Bot (ideally one robot for every 3 to 4 pupils) - Tablet(s) with Loti-Bot app installed - World Map (e.g. Bee-Bot World Map Mat) - Flag cards from countries around the world (you can choose which countries you wish to focus on)

Key Vocabulary and Questions	**Assessment Opportunities**
program, algorithm, debug, sensors, modify - How do we debug a program?	- Can children program Loti-Bot to travel in different directions? - Can children debug their programs when they identify problems? - Can children add to and modify their existing programs?

Introduce	• Recap prior learning with Loti-Bot, including how to program Loti within the app. • As a quick reminder, review your User Guide Posters – what have we learnt about Loti-Bot so far and what are we still waiting to explore? • Explain that today, we will be helping to take Loti-Bot on their first holiday around the world! • Share and introduce the large world map, looking closely at the countries they may be visiting with Loti-Bot, based on the flag cards you have chosen.

Learn and Explore	• Split the class into small groups, ideally with each group having their own Loti-Bot. • The challenge is to program Loti-Bot to travel between countries on the world map, with some added challenges along the way. • Each group should start by choosing two (or more) flag cards and locating these countries on the world map. • They will need to choose the country where Loti-Bot will start and then measure the distances and angles to plan their journey from the first country to the second. • As in previous lessons, encourage children to take on different roles in their group, such as note taker, program tester, driver and/or debugger. They can switch roles as they try different scenarios.

	• Children can plan and write out their algorithm on paper and, when ready, test it with Loti-Bot and the World Map. • Support and help children debug their program if their Loti-Bot journey does not go as planned. **Add to your Program** • When each group has successfully completed their journey, they can move onto the next challenge which involves modifying and adding to their existing program. Each time they complete a challenge (see examples below), they can move onto the next or experiment with making their program more complex by exploring and programming more of Loti-Bot's sensors. This could be completed in one lesson or could extend learning across more than one session. • As they move through the next series of challenges, children will need to add, edit, and improve their existing program. Each time, introduce the new sensor/input to be used and model to children if needed. • After each stage, when they think they are ready, test this on the large World Map and debug and amend if needed. Here are some suggested challenges, but children could also set their own: 1. Each group must amend their code so that Loti-Bot's lights change colour to match the colours of the country's flag as they cross the border. 2. Add an additional destination for Loti-Bot to visit. When is it best to visit this country on their journey? 3. Place landmarks around the world map and ask children to be sure that they do not knock any over during their route (Loti-Bot's bumper sensors may be helpful here!).

Make it accessible	Add a challenge
Give children more time to plan their initial routes. It may be helpful to provide some physical cards that represent the individual coding blocks so they can physically create an algorithm first, before creating the algorithm on the app.	*Time trials:* Children should measure the distance of their alternative routes and measure the time it takes for Loti-Bot to complete the different journeys. They can then experiment with changing Loti-Bot's speed within their program.

Review and Reflect	Take time to review learning from today's lesson. - What have we learnt about Loti-Bot today? - What are the benefits of modifying a program rather than starting from the beginning each time? - What do you think are your next steps for learning? **User Guide Posters** Give children 5 minutes to add anything new to their User Guide Posters based on what they have learnt today about Loti-Bot. **Code Journal (optional)** If you are using a code journal – give children some time to write down and record any of their code from today's lesson.

5. Shape Up With Loti-Bot

In this lesson, children will explore and discover Loti-Bot's drawing capability by programming Loti-Bot to draw a range of different 2D shapes.

Skills and Learning	**Resources**
Students will: - Learn to use pre-built block code for drawing shapes and understand the algorithm behind it. - Create and draw different shapes by programming Loti-Bot.	- Loti-Bot (ideally one robot for every 3 to 4 pupils) - Tablet(s) with Loti-Bot app - Selection of 2D shapes - Large pieces of paper or individual tables (if using erasable markers) - Markers or pens for the robot's drawing

Key Vocabulary and Questions	**Assessment Opportunities**
algorithm, program, problem, decompose, debug, loops Shape Vocabulary – properties, tessellation, shape, square, triangle, hexagon, etc.	- Can children create the code and then program Loti-Bot to draw a 2D shape? - Can children decompose a problem to help them create their tessellating pattern? - Quick debugging assessment activity

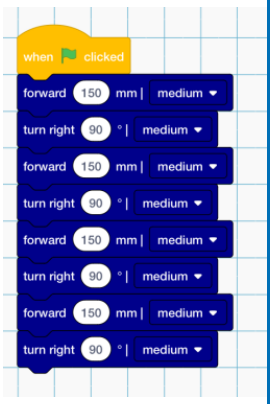
Introduce	Recap the previous lessons briefly, reminding the students of the concepts of algorithms, block-based coding, directional vocabulary, and WAIT instructions. Introduce the next new capability of Loti-Bot - drawing using the pen holder. Think about: - What might be some uses of a robot being able to draw? *E.g. drawing shapes, mapping routes, creating plans, etc.* Discuss the importance of combining creativity and problem-solving in coding and robotics. Explain that even though the robot has the 'creative output' of drawing shapes, it still requires a creative person to program the robot. Therefore, these skills are **very important for the future.**

Learn and Explore	Today, we will use Loti-Bot to help us with our mathematics learning and draw different 2D shapes. Review the children's prior learning of 2D shapes (you may want to tailor the shapes used in today's lesson based on previous learning). **Exploring the Square Drawing Block** • Begin by showing the students the prebuilt block for drawing a square in the programming app. What are the properties of a square?

- Discuss the algorithm behind the square: moving forward, turning 90 degrees, and repeating this process four times. Children may want to physically demonstrate this algorithm before moving on to coding.

Drawing a Square

- Demonstrate how to use the square drawing block to make the robot draw a square on a large piece of paper or on the table. (NB This is a good opportunity to remind children (or introduce) that Loti-Bot has a handy 'cliff-edge' sensor to stop it falling off tables!)



- Let the students take turns to program the robot to draw squares and observe the shapes they create. Are they squares? How do we know?
- Children can click the green flag at any stage and view the simulator on the right-hand side of the screen to check they have programmed correctly to make a square and debug if necessary.

Understanding the Algorithm

- Engage the students in a discussion about the algorithm for drawing a square. Encourage them to think step-by-step, considering the direction and number of movements required.
- Does this match with the properties of a square? *i.e. that the algorithm repeats 4 times, as a square has 4 sides, all the same length and four right-angles.*
- The algorithm for drawing a shape will be created using what we know about its properties.

Challenge: Drawing Different Shapes

- Present the students with a selection of new challenges to draw different shapes, such as triangles, rectangles, pentagons, or hexagons.
- Ask the students to work in groups to plan and write down the algorithms on paper before programming the robot. They will need to test and debug their algorithm to ensure it runs as intended.
- Ensure children can describe the choices they made for their program development, explaining how they ensured Loti-Bot drew an accurate shape, for example, considering angles, loops, etc.
- Bring the class back together and **discuss**.
- Compare the different algorithms that each group have created/used to draw the same regular polygons. For example, how many different algorithms have been written to create a rectangle? Consider which of these would be the easiest to modify or repurpose for creating other shapes.

Second Part of Lesson - this could form part of this lesson, or be used as a separate session)

Introduction to Tessellation

- Explain the concept of tessellation:

- *when one or more shapes fit together in a pattern with no gaps or overlaps.*

- Show examples of tessellating patterns found in art and architecture.

Challenge: Tessellating Shapes

- Challenge students to create tessellating patterns using Loti-Bot's drawing capabilities. They can experiment with different shapes and orientations to achieve tessellation.

Decompose

- Revisit the skill of decomposing problems to help program development.
- It may be helpful for students to **decompose (break down)** this challenge into smaller, manageable subproblems to help support the program development. This may involve creating an algorithm for each shape in their pattern before working to combine them to create the tessellating pattern.

Showcasing and Sharing

- Allow time for each group to showcase their drawn shapes and tessellating patterns to the class. Encourage them to explain their algorithms, the choices they made and how they approached the challenges.

Make it accessible	Add a challenge
• Provide the children with more examples of pre-built code for shapes to explore initially. • You may not want to move onto tessellating patterns, and instead focus on drawing shapes accurately.	For those who need an additional challenge, encourage them to experiment with creating more intricate shapes and complex tessellating patterns.

Review and Reflect

Recap the key concepts covered in the lesson: using the pen holder to draw shapes, understanding algorithms for different shapes, and exploring tessellation.

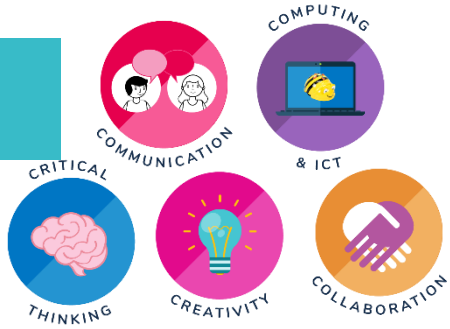
Quick debugging assessment – show children an algorithm for a triangle with some mistakes in the code. Can children spot the mistake and suggest how to fix it? What is it called if we fix part of a code?

User Guide Posters and Code Journal
Give children 5 minutes to add anything new to their User Guide Posters and code journals (if using them) based on what they have learnt today about Loti-Bot.

Homework *(optional)*

Students may like to create a design on paper using the concept of tessellation. Could they then write the code they think would be needed to create this pattern?

6. Let's Dance with Loti-Bot



Students will use and apply their programming skills to design and choreograph a new dance trend with Loti-Bot!

This lesson could be simplified and taught over one session or stretched over a number of lessons as a project (alongside Lesson 7) to allow children to polish and refine their programming for a marvellous Loti-Bot Dance Performance!

Skills and Learning	**Resources**
Students will: - Use and apply the concepts of using WAIT and directional instructions in programs. - Create programs that include sequences and loops. - Decompose problems into smaller manageable parts. - Test and debug a program.	- Loti-Bot (ideally one robot for every 3 to 4 pupils) - Tablet(s) with Loti-Bot app - A large and clear space for the Loti-Bots to dance!

Key Vocabulary and Questions	**Assessment Opportunities**
algorithm, program, WAIT instruction, loop (iteration), choreograph	Through children programming their dance routine, you can assess if children can: - Include loops in their algorithm. - Work together and seek and respond to different perspectives. - Test and debug a program. - Modify, remix, or incorporate portions of an existing program into their own. - Use an iterative process (repetition or looping) to plan their program.

Introduce	• Recap the key concepts from the previous lessons, including the WAIT instruction and directional vocabulary, including forward, backward, left, right, etc. • Emphasise that coding and robotics can be creative and fun. In this lesson, students will explore more imaginative ways to program the robot's movements.

Learn and Explore	**Set the Scene** • Explain to children that their challenge over the course of this lesson and the next will be to plan and choreograph a new dance trend with Loti-Bot. • You can choose the purpose for this, but it could be used for children to perform a dance alongside their Loti-Bots or to set up a Loti-Bot Flash Mob and get as many robots dancing together as possible!

Dance Moves

- Children will need to work in small groups, ideally with one Loti-Bot per group.
- Start by giving students some time to experiment with programming different dance moves, for example making Loti spin and twirl, move forward and backward, shimmy and shake, etc.
- It may be helpful to watch some clips of different dance moves to offer some inspiration!
- Try to encourage children to think beyond simple movements, shapes, and paths.
- Share the algorithms children have planned for specific moves; for example, how have you programmed Loti to make it spin?
- Share how different groups have done this and compare the different algorithms.
- *Is one simpler than the other? What are the benefits of programming this move in different ways?*
- Look at the most effective/efficient ways to program certain moves to refine a selection of dance move algorithms.
- When children have planned/written some code for different individual moves, model on the interactive whiteboard how to **combine** the different movements together, e.g., with a pause (WAIT instruction), to begin building more complex sequences.

Understanding Loops

- Question – does every dance move in a routine have to be completely individual?
- *Discuss with the class that dance routines are normally built up of a certain number of moves that are then repeated in a 'loop' – you could watch some videos to demonstrate this.*
- Introduce and explain that we can use loops (iteration) in our robot dance programming to repeat a sequence of instructions multiple times. This would ensure that Loti-Bot can repeat specific dance movements, helping to create patterns in their routines.
- Show examples of how loops can be represented as blocks in the programming app.

Model - Select a dance move that one of the groups have planned and demonstrate how to use a loop to repeat this movement.

Try it Out - Encourage the groups to try out including a loop for one of their dance movements. Visit each group and ensure they are confident in building loops into their block-based code.

Choreographing Your Robot Dance

- Students will have a 'bank' of code for individual dance routines, which they can now combine to create a whole dance routine.
- Provide time for each group to plan out their dance routines.
- During the planning stage, stop the groups at intervals and encourage them to share a 'Loti-Bot dance move' they have perfected. This provides the opportunity to share smaller pieces of their program which others may want to incorporate into their own work to develop something more advanced.

Dance Showcase

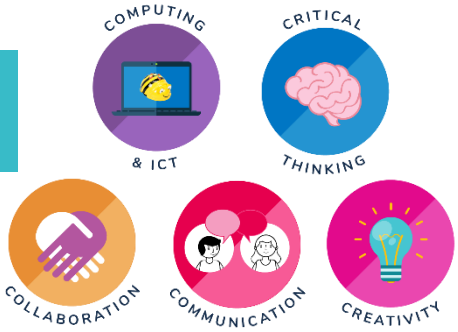
	• When groups have a section of their dance perfected, let them showcase their robot routine to the class. • Encourage each group to explain the different movements programmed and the inspiration behind their dance. • After each performance, encourage the other students to provide positive feedback and ask questions about the choreography. Which dance moves were the easiest to program? • Facilitate a brief reflection session where each group discusses their creative process and what they learned. • *If continuing this lesson – encourage children to share the coding for specific dance moves they would like to incorporate into their own routines and provide time for redrafting and editing.* **Dance Collaboration (optional):** As an optional activity, allow the groups to collaborate and combine their robot dance routines into a larger performance. For example, you could have multiple Loti-Bot's perform the same routine in unison. This can be a fun way to promote teamwork and creativity among the students.

Make it accessible	Add a challenge
Provide some pre-built block-based examples of algorithms for specific moves and model how to combine (or loop) these to create a routine.	Can children alter the tempo of the dance to match a specific tune? For example, they may experiment with changing Loti-Bot's movement speed to include some quick and slow dance moves.

Review and Reflect	• Recap the key points from the lesson, emphasising the creative possibilities of coding and robotics. • Celebrate the students' creativity and efforts in choreographing their robot dances. Ask the students to reflect on their experience of choreographing the robot dance and either write a short reflection or discuss with a partner: - What did you enjoy the most? - What challenges did you face? - How did you overcome these challenges? - What were you most proud of? - What would you improve/do differently next time? **User Guide Posters and Code Journal** Give children 5 minutes to add anything new to their User Guide Posters and code journals (if using them) based on what they have learnt today about Loti-Bot.

Homework *(optional)*	Ask students to watch a short clip of a dance routine (from a music artist they like or a TV programme they enjoy). Can they create the algorithm that would be needed for Loti-Bot to recreate that dance move?

7. Light Up Loti-Bot's Dancing



In this lesson, children will continue to build on and improve the dance routines they started in Lesson 6 by adding in messages to control Loti-Bot's lights.

Skills and Learning	**Resources**
Students will: - Use message in code to program other functions of a robot. - Create programs that include sequences, loops, instructions, and messages. - Decompose problems into smaller manageable parts. - Test and debug a program.	- Loti-Bot (ideally one robot for every 3 to 4 pupils) - Tablet(s) with Loti-Bot app - A large and clear space for the Loti-Bots to dance!

Key Vocabulary and Questions	**Assessment Opportunities**
algorithm, program, WAIT instruction, loop (iteration), messages, choreograph, LED lights	Through children programming their dance routine, you can assess if children can: - Include loops in their algorithm. - Include messages within their coded programs. - Work together and seek and respond to different perspectives. - Test and debug a program. - Modify, remix, or incorporate portions of an existing program into their own. - Use an iterative process to plan their program.

Introduce	• Begin by recapping the creative robot dance choreography from the previous lesson. • Explain to the students that in this lesson, they will revisit their dance routines and learn how to make them more dynamic by adding messages to control the robot's side lights.

Learn and Explore	**Introducing Messages** • Explain the concept of messages in programming - a way to send commands or signals to the robot during the dance routine. • Show examples within the block-based environment of how messages can control the robot's side lights and change their colours. • Model how to build this into part of the dance routine from the previous lesson. Encourage children to contribute their ideas.

	Dynamic Robot Dance with Lights • Give each group time to revisit their dance routines or specific dance moves and add messages into their program to control the robot's side lights. • Encourage them to experiment with different colours and timings to match the dance movements. • What impact does it have on the dance to change the lights before, after, or during a routine? **Group Practice and Improvement** • Allow the students to continue to develop, practise and fine-tune their dance routines, incorporating loops and messages as needed. • Offer support and guidance to help them debug their programs and overcome any challenges. **Robot Dance Performance** • Each group will perform their dynamic robot dance routines with changing side lights for the class. **Peer Feedback and Reflection** • After each performance, ask the other students to share positive feedback and ask questions about the loops and messages used. • Facilitate a short reflection session where each group discusses with each other and shares their experiences and what they learned from using loops and messages.

Make it accessible	Add a challenge
Encourage children to focus on including a message within one dance move rather than within the whole dance routine.	Children can be challenged to add more complex loops or to use conditional statements in their dance routines.

Review and Reflect	• Recap the key concepts of loops and messages and how they were applied to the robot dance routines. • Celebrate the students' achievements in creating dynamic and colourful robot dance performances. Ask the students to record (verbally or written) a brief reflection on how using loops and messages enhanced their robot dance routines. - What did you think worked well? - What challenges did you face? - How did you overcome these challenges? - What were you most proud of? - What would you improve/do differently next time? **Code Journal** Give children 5 minutes to add anything new to their code journals (if using them) based on what they have learnt today about messages

8. Play a Game with Loti-Bot

In this lesson, children will use and apply their learning to program and play a game with Loti-Bot.

This lesson can be simplified and taught over one session with the first activity or taught over several lessons as part of a cross-curricular project.

Skills and Learning	**Resources**
Students will: – Design, write and debug programs that accomplish specific goals. – Solve problems by decomposing them into smaller parts. – Use sequence, selection, and repetition in programs. – Use logical reasoning to explain how some simple algorithms work and to detect and correct errors in algorithms and programs.	- Loti-Bot (ideally one robot for every 3 to 4 pupils) – enough to play a small group game - Tablet(s) with Loti-Bot app - Large Snakes and Ladders floor mat (either TTS mat or one created by the students) 

Key Vocabulary and Questions	**Assessment Opportunities**
sequence, repeat/loop, debugging, input, output, program, algorithm, features, programmable	- Can children program Loti-Bot to make the correct moves? - Can children program additional features, such as sounds and lights alongside movement?

Introduce	Recap all prior learning with Loti-Bot. -What have we learnt that Loti-Bot can do? Discuss and agree on the features/success criteria of a good algorithm. - What do we need to include and consider? *Answers may include for example, accurate measurement of distances for movement, angles for turns, importance of the order of blocks in program, etc.*

Learn and Explore

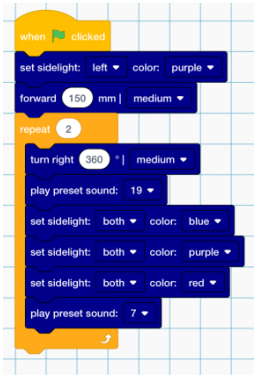
Play a Game

The challenge today is for children to play a game of snakes and ladders using Loti-Bot's as their counters.

Use a game mat, such as a large Snakes and Ladders Mat to set up the game. Children can experiment with coding Loti-Bot, changing colour and sound as their Loti-Bot moves through the game.

Below are some examples of the programming they may include in their gameplay.
You can choose how many elements to include, based on your students' confidence and skill level. This will be an iterative process to plan the development of their program based on their own user preferences. They may also need to test and debug along the way.

- They could set one of Loti-Bot's sidelights to be the colour of their counter.
- They will need to program the correct movements for the number of spaces as they roll the dice.
- They will need to program Loti-Bot to move up and down the snakes and ladders.
- To add an extra challenge, ask the groups to decide on additional programmable features to include when they move on the snakes and ladders. For example, changing the lights red and playing a sound to move down a snake, or changing green and playing a different sound when moving up a ladder. They may even choose that Loti-Bot can only reverse and move backwards when travelling down the snakes.
- Why not finish by including a 'winners celebration dance' for the winning Loti-Bot, for example turning, flashing lights, and playing happy sounds (such as the code written here).



Give children time to experiment and play their game.

Extended Project (optional) – Applying to a real-life situation

To extend and challenge children's learning, move on to setting this additional challenge.

In groups, children will design and create their own interactive, inclusive game to play with Loti-Bot, for example it may be an escape room maze, battleships, or monopoly.

Research

Begin by giving the children time to research different games they could create. They will need to consider which ones would be adaptable to include Loti-Bot.

Design and Create

Once decided, children then need to plan, design and create their game board.
Give children a selection of questions and prompts to consider which will help shape their games, such as:

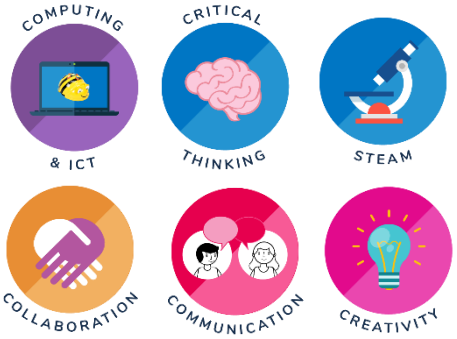
- How many players will the game involve?
- Will there be any obstacles, clues, questions, quizzes?
- How can the game be adapted to be inclusive for all, e.g. younger children, or someone who is maybe visually or hearing impaired?
- What inputs and outputs will you build into your game?

	Test, Trial and Debug Within their groups, encourage children to play their game and have a test run to identify any aspects that need to be 'debugged' and improved. They may want to create some 'rules' for their game to help. **Play** Play the game as a group then play another group's game. Each group will need to explain the rules of the game to the other players as these will be different for each game. **Evaluate** Spend time reviewing the games that have been played. Children can either reflect on their own game or one that they have played. For example: - What did you like about and enjoy most about the game? - How effective was the game? - What worked well? - Are there any tweaks/next steps you think would make the game even better?

Make it accessible	Add a challenge
For the first activity - include fewer programmable requirements when working with Loti-Bot, such as focusing on the programming for movement and gradually including additional elements such as changing light colour or sound as confidence increases.	Include more requirements to the game, such as when you land on an odd number, you must make Loti-Bot sing a short song (made up of the pre-recorded sounds)!

Review and Reflect	Ask children to evaluate the effectiveness and use of the different features when included in the game, for example: - Do the additional programmable elements enhance the game and make it more interactive? If so, why? - What was your favourite aspect to include? - Can you think of other games we could adapt using Loti-Bot and your programming skills? - If so, what features could you use and why? **User Guide Posters and Code Journal** Revisit children's posters and code journals (if using them) and add anything new hfollowing their learning in this lesson.

9. Debugging Loti-Bot



Technology is great but sometimes we must use our knowledge to work out what to do if things do not go to plan. This is no different from when we use programable devices.

In this lesson, children will use their knowledge to work out how to solve any issues that may arise when using Loti-Bot.

Skills and Learning	**Resources**
Students will: - Consider common issues that might arise with technology. - Suggest ways to 'troubleshoot' Loti-Bot. - Communicate suggestions in a way that would support a potential user or customer of Loti-Bot. - Work collaboratively and creatively with others.	- Loti-Bot (ideally one robot for every 3 to 4 pupils) - Tablet(s) with Loti-Bot app - Customer questions with different scenarios and queries.

Key Vocabulary and Questions	**Assessment Opportunities**
program, apps, Bluetooth, features, troubleshooting	- Can children use and apply their knowledge of a programable device (Loti-Bot) to give answers to question? - Have the children remembered what they have learnt in previous lessons?

Introduce	We are surrounded by technology in the modern world. It can be found in our homes, outside and in places we visit. There are many devices and everyday items that we use that rely on technology or programming. However, sometimes we encounter errors that need troubleshooting. Can you think of any situations where technology has needed fixing? E.g. when your computer won't switch on. Sometimes there is a simple solution where we can follow a set of instructions (algorithm) to solve the problem. Sometimes it is more technical. If so, what can we do to help solve the problem? Discuss different solutions e.g. user manuals or information online, a troubleshooting helpline, a service engineer, or a video that we can watch. Consider - how has technology helped us to find solutions e.g. internet?

Learn and Explore	Today we are going to 'debug' Loti-Bot – we are going to consider some scenarios when things may go wrong with Loti-Bot and make suggestions of how to troubleshoot. **Model** Share a model scenario of a Loti-Bot problem (you could set this up as 'Loti-Bot Symptoms' and the children will need to identify a treatment plan). For example: *Loti-Bot is moving round and round in circles and will not respond to any programming on the app.* Ask children to think about ways they might suggest to 'treat' Loti-Bot. - *For example, turn Loti-Bot off with the main switch underneath, wait 3 seconds and turn the robot back on again.* **'Debug Loti-Bot'** Ask children to work in groups. Share a selection of scenarios or queries (symptom cards) that could either 'go wrong' with Loti-Bot or that customers may need to know about when they buy Loti-Bot, such as: - I can't get Loti-Bot to turn on - How do I link Loti-Bot to the app? - I don't know how to charge my Loti-Bot - How many Loti-Bots can I control at one time? - I don't know how to program the lights on Loti-Bot. - I can't hear Loti-Bot's sounds play. Children will need to look at each 'symptom' card and suggest a solution or answer (treatment plan) for Loti-Bot. They will need to draw on their knowledge about how the different parts of Loti-Bot work together as a robotic device and how Loti-Bot's hardware and software work together in order to suggest solutions. Ask children to record their suggested responses for each scenario. **TTS Tech Team** It is now the job of each group to become the 'Tech Team' at TTS (the developer and creator of the robot) to create some helpful advice to share with the customer. Discuss and remind children about the different ways that Frequently Asked Questions or Troubleshooting is often shared with a customer (e.g. document, video, multimedia presentation). Bring in literacy learning here to explore the way in which this information is presented. Children in their groups must choose how they want to present their answers and work together to create their presentation. Each group to then share their presentation with the rest of the class.

Make it accessible	Add a challenge
Simplify the number of scenarios or work more collaboratively with different groupings.	Increase the complexity of the issues contained within the scenarios and include queries regarding the app functionality, for example Loti-Bot is not connecting to the app to bring learning around Bluetooth connectivity.

Review and Reflect	Ask children to reflect on their own learning and group presentation: - What did you think worked well in your presentation? - Why did you choose to present your troubleshooting in this way? - What are you most proud of? - What would you do differently next time? **User Guide Poster** Encourage children to include the information from today's lesson within their Loti-Bot User Guide – they may just want to create a 'link/reference' to the presentation they have produced today.

10. Loti-Bot in the Real World

In this final lesson, students will use and apply their learning to engage in a creative project, showcasing the various functions of Loti-Bot within a real-world idea.

This lesson could be simplified and taught within one lesson or extended through a wider project scope across a number of lessons.

Skills and Learning	**Resources**
Students will: - Use and apply all of their learning throughout this sequence of lessons. - Explore real-world applications of programmable robots. - Work collaboratively to complete a project.	- Loti-Bot (ideally one robot for every 3 to 4 pupils) - Tablet(s) with Loti-Bot app installed - A large and clear space to move Loti-Bot - Art materials for their creative project

Key Vocabulary and Questions	**Assessment Opportunities**
robot, real-world application, functions, features, inputs, outputs, program, programmable - How do we use and work with robots in our lives?	- Can children use and apply all of their learning about Loti-Bot to explore a real-world use of robotics?

Introduce	Begin by recapping all the key concepts, skills, and activities from the previous lessons. Example questions to lead the conversation may include: - What have we learnt about Loti-Bot? - How would you describe Loti-Bot to others? - What is your favourite Loti-Bot feature? - What has most surprised you about Loti-Bot? - Have you discovered any new coding blocks or creative ways that you have tinkered with the robot's capabilities? Encourage them to explain how these different additions, features, etc. help to enhance Loti-Bot's movements or usability. Explain that today we are going to be considering how a robot such as Loti-Bot could be used in the 'real world' for different purposes.

Learn and Explore	**Real-World Applications** Facilitate a discussion about real-world applications of programmable robots, especially those with similar functionalities to the Loti-Bot they have been using. Discuss examples like delivery robots in cities, warehouse robots (such as for picking items to send to customers), or robots used in exploration and research. Consider the different ways we have chosen to use robots within the wider society. You could give the children time to research these robots and identify what features of Loti-Bot (maybe in a more advanced version) allow these robots to work. For example, the programmable movement to locate items in a warehouse, or a cliff edge sensor in a delivery robot so they don't fall off a kerb. **Creative Project Planning** Explain the creative project assignment to the students. You may ask them to work individually, in pairs or in small groups (depending on the age and stage of your learners). The challenge is to create and showcase a real-world idea for using and applying Loti-Bot's capabilities. They will need to plan and design their project so that they can showcase how Loti-Bot's functions will be used and create a model example to demonstrate this. For example, Loti-Bot could be used to deliver messages throughout the school to different classrooms, or why not think wider and consider a use for Loti-Bot beyond the school building? **Project Execution** Give the children ample time to work on their creative projects. They may want to use a range of art supplies and materials to bring their ideas to life and create their model example for how the functionality will be used. They may consider things such as creating: - An outfit/shell for Loti-Bot - A model setup for the 'real-life' scenario Loti-Bot would be working in. - A short presentation to explain the scenario and functions/features used. Encourage students to think creatively about how to incorporate all of the different ways Lot-Bot works (hardware and software) and the different features, such as the robot's movements, pen drawing, sounds, temperature sensor, side lights, etc. into their projects. Ensure that children consider the inclusivity of their planned use – how can they use Loti-Bot's programmable elements to support everyone in our community? Spend some time with the students considering the cyber security aspect of their real-world application – what do they need to consider to reduce the chance of a cyber security threat? **Project Presentation:** Each student/group will present their creative project to the class. They should explain their real-world idea and demonstrate the robot's functions in action. Allow time for questions and feedback from their peers.

	Discuss and Evaluate Facilitate a group discussion after the presentations, allowing the children to share their thoughts on each other's projects and provide positive feedback. Encourage children to engage in self-reflection on their own presentation also.

Make it accessible	Add a challenge
Support children through working in groups of mixed ability levels.	Children may want to explore additional features for an updated version of Loti-Bot that would enable more opportunities in the real-world.

Review and Reflect	Recap all the key concepts and skills learned throughout the series of lessons. Have the students reflect on their journey, what they enjoyed the most, and what they have learned about coding and robotics. **User Guides** Share and review their completed user guides for Loti-Bot. You may want to present these to summarise the unit or take into English lessons and explore drafting them into a final document. **Appreciation and Celebration** Express appreciation for everyone's hard work, creativity, and enthusiasm throughout the series of lessons. Celebrate the class achievements and growth in coding and robotics. For the future – looking ahead, what would you like to learn about next?

Lesson Overview

Lesson	Title	Overview	Skills and Learning
1	Meet Loti-Bot	Students will meet Loti-Bot and spend time learning about all the different sensors and functionality of this programable robot.	**Students will:** - Explore a new robotic device and programming environment. - Explain how a digital, programmable device functions. - Identify output and input devices.
2	Loti-Bot on the Move	During this lesson, children will learn the basic principles of writing algorithms and will use block-based coding to get Loti-Bot on the move!	**Students will:** - Understand the basic principles of writing algorithms - Use block-based coding to program a robot - Use directional language and knowledge of angles to move and turn Loti-Bot.
3	Making Loti-Bot WAIT	Students will be introduced to the WAIT instruction and will use this to program Loti-Bot to stop and wait at certain destinations. They will also discuss real life applications of a WAIT instructions, such as at traffic lights.	**Students will:** - Use block-based coding to program Loti-Bot. - Program using the WAIT instruction to make Loti-Bot stop and wait.
4	Loti-Bot Around the World	Students will take Loti-Bot on a worldwide adventure, building their confidence in programming different routes and exploring how to program and change Loti-Bot's LED lights.	**Students will:** - Learn about and use Loti-Bot's different sensors. - Work with various forms of input and output. - Design, write and debug programs. - Estimate, measure and record lengths. - Use world maps to name and locate countries, continents and oceans. - Work collaboratively with others.
5	Shape Up with Loti-Bot	In this lesson, children will explore and discover Loti-Bot's drawing capability by programming Loti-Bot to draw a range of different 2d shapes.	**Students will:** - Learn to use pre-built block code for drawing shapes and understand the algorithm behind it. - Create and draw different shapes by programming Loti-Bot.

6	Let's Dance with Loti-Bot	Students will use and apply their programming skills to design and choreograph a new dance trend with Loti-Bot! This lesson could be simplified and taught over one session or stretched over a number of lessons to allow children to polish and refine their programming for a marvellous Loti-Bot Dance Performance!	**Students will:** - Use and apply the concepts of using WAIT and directional instructions in programs. - Create programs that include sequences and loops. - Decompose problems into smaller manageable parts. - Test and debug a program.
7	Light Up Loti-Bot's Dancing	In this lesson, children will continue to build on and improve the dance routines they started in Lesson 6 by adding in messages to control Loti-Bot's lights.	**Students will:** - Use message in code to program other functions of a robot. - Create programs that include sequences, loops, instructions and messages. - Decompose problems into smaller manageable parts. - Test and debug a program.
8	Play a Game with Loti-Bot	In this lesson, children will use and apply their learning to program and play a game with Loti-Bot. This lesson can be simplified and taught over one session with the first activity or taught over several lessons as part of a cross-curricular project.	**Students will:** - Design, write and debug programs that accomplish specific goals. - Solve problems by decomposing them into smaller parts. - Use sequence, selection, and repetition in programs. - Use logical reasoning to explain how some simple algorithms work and to detect and correct errors in algorithms and programs.
9	Debugging Loti-Bot	Technology is great but sometimes we must use our knowledge to work out what to do if things do not go to plan. This is no different from when we use programable devices. In this lesson, children will use their knowledge to work out how to solve any issues that may arise when using Loti-Bot.	**Students will:** - Consider common issues that might arise with technology. - Suggest ways to 'troubleshoot' Loti-Bot. - Communicate suggestions in a way that would support a potential user or customer of Loti-Bot. - Work collaboratively and creatively with others.
10	Loti-Bot in the Real World	In this final lesson, students will use and apply their learning to engage in a creative project, showcasing the various functions of Loti-Bot within a real-world idea. This lesson could be simplified and taught within one lesson or extended through a wider project scope across a number of lessons.	**Students will:** - Use and apply all of their learning throughout this sequence of lessons. - Explore real-world applications of programmable robots. - Work collaboratively to complete a project.