OUR LADY OF THE ROSARY, THE ENTRANCE
SCIENCE & TECHNOLOGY PROGRAM

Stage:	3	Year:	6	Unit Name:	Designing Digital Solutions - Digital Technologies	Term:	3 &4 2020	Duration:	20 Weeks

Unit Description

This unit focuses on understanding the role of individual components of digital systems play in processing and representing data. Students design, modify and follow algorithms involving branching and iteration. This unit further develops students' knowledge and understanding of project management, abstraction and the relationship between models and the real-world systems they represent.

Key Inquiry Questions

- ➔ How do components of digital systems interact with each other to transmit data?
- ➔ How do the components of digital systems connect together to form networks?
- ➔ How do we represent decision-making in an algorithm?

Outcomes & Content

ST3-2DP-T plans and uses materials, tools and equipment to develop solutions for a need or opportunity

ST3-3DP-T defines problems, and designs, modifies and follows algorithms to develop solutions

- design, modify and follow algorithms involving branching and iteration
- define problems, and plan and implement digital solutions, using an appropriate visual programming language involving branching and iteration, and requiring user input

ST3-11DI-T explains how digital systems represent data, connect together to form networks and transmit data

- identify how whole numbers are used to represent all data (binary) in digital systems
- collect, store and interpret different types of data
- use software to interpret and visualise data
- investigate internal and external components of digital systems that perform functions
- explore how the main components of digital systems connect together to form networks that transmit data
- describe how data can be transmitted between two digital components
- identify and explain how existing information systems meet the needs of present and future communities
- explore current ethical, social and technical protocols when communicating using information systems
- design a user interface for a digital system

CROSS CURRICULUM LINKS

Maths

- **MA3-8NA** analyses and creates geometric and number patterns, constructs and completes number sentences, and locates points on the Cartesian plane
- **MA3-16MG** measures and constructs angles, and applies angle relationships to find unknown angles
- **MA3-17MG** locates and describes position on maps using a grid-reference system

English:

- **EN3-1A:** communicates effectively for a variety of audiences and purposes using increasingly challenging topics, ideas, issues and language forms and features

Skills Focus

Working Scientifically → **ST3-1WS-S**

Processing and Analysing Data

- construct and use a range of representations, including tables and graphs, to represent and describe observations, patterns or relationships in data
- employ appropriate technologies to represent data
- compare data with predictions
- present data as evidence in developing explanations

Design & Production → **ST3-2DP-T**

Identifying and Defining

- examine and critique needs, opportunities or modifications using a range of criteria to define a project
- examine and determine functional requirements to define a problem
- identify data required to formulate algorithms to improve a process

Researching and Planning

- develop, record and communicate design ideas, decisions and processes using appropriate technical terms
- manage projects within time constraints
- design, modify and follow simple algorithms
- extend sequences of steps to provide a series of possibilities through branching
- develop solutions through trialling and refining using iterations

Producing & Implementing

- develop project plans that consider resources when producing designed solutions individually and collaboratively
- implement digital solutions as visual programs involving branching, iteration and user input
- work collaboratively to share, appraise and improve ideas to achieve design purposes
- identify, organise and perform strategic roles within a group to solve a problem
- acquire, store, access and validate different types of data, and use a range of software to present, interpret and visualise data

Testing & Evaluating

- evaluate design ideas, processes and solutions according to criteria for success(ACTDEP027)
- explain how students' solutions and existing information systems meet current and future local community needs

Assessment: ***For/ As/ Of*** **Learning → Throughout this unit a range of assessment tasks and types will be used to gauge students' knowledge and understanding.**

- ❑ Binary System & Reflection
- ❑ Digital Compass & Reflection
- ❑ Design and Produce Digital Task (Assessment For and Of Learning) and Evaluation (Assessment As Learning)

Alice Vigors - 2020

THINKING SKILLS (Page 35)

Highlight the thinking skills this unit promotes.

Computational thinking – ComT
Computational thinking is a process where a problem is analysed and solved so that a human, machine or computer can effectively implement the solution. It involves using strategies to organise data logically, break down problems into parts, interpret patterns and design and implement algorithms to solve problems.

Design thinking – DesT
Design thinking is a process where a need or opportunity is identified and a design solution is developed. The consideration of economic, environmental and social impacts that result from designed solutions are core to design thinking. Design thinking methods can be used when trying to understand a problem, generate ideas and refine a design based on evaluation and testing.

Scientific thinking – SciT
Scientific thinking is purposeful thinking that has the objective to enhance knowledge. A scientific thinker raises questions and problems, observes and gathers data, draws conclusions based on evidence, tests conclusions, thinks with an open mind and communicates research findings appropriately.

Systems thinking – SysT
Systems thinking is an understanding of how related objects or components interact to influence how a system functions. Students are provided with opportunities to recognise the connectedness of, and interactions between phenomena, people, places and events in local and wider contexts and consider the impact of their decisions. Understanding the complexity of systems and the interdependence of components is important for scientific research and for the creation of solutions to technical, economic and social issues.

CROSS CURRICULUM PRIORITIES AND GENERAL CAPABILITIES (Page 38)

Highlight the general capabilities this unit promotes.


Aboriginal and Torres Strait Islander histories and cultures


Asia and Australia's engagement with Asia


Sustainability

Highlight the cross-curriculum priorities this unit promotes.


Critical and creative thinking


Ethical understanding


Information and communication technology capability


Intercultural understanding


Literacy


Numeracy


Personal and social capability


Civics and citizenship


Difference and diversity

Work and enterprise

CONTENT FOCUS	LEARNING & TEACHING SEQUENCE - 1 *Using and Interpreting Data*	EVALUATION	RESOURCES
How do components of digital systems interact with each other to transmit data? Students: • Identify how whole numbers are used to represent all data (binary) in digital systems **Curriculum Links:** **Maths:** • **MA3-8NA** Patterns and Algebra: analyses and creates geometric and number patterns, constructs and completes number sentences, and locates points on the Cartesian plane	**Tuning In:** ❑ Pose the question '*How do you think a digital device stores information?'* and display the image from Appendix One. ❑ Use the **chalk talk** thinking routine to help students share their thinking, build on and elaborate on the thinking of others and pose wonderings. **Shared Inquiry:** ❑ Investigate how the binary system works (**Unplugged Task**) (**LINK: Maths**) ❑ Invite 8 students to stand at the front of the class. ❑ Explain that a computer uses a counting system that uses a series of digits called 'bits' (**bi**nary digi**ts**) to store information. Each 'bit' is part of a sequence of eight and represents a particular value. ❑ Hand the first binary card (1) to the first student. What do you notice so far about the binary counting system? What might come next? ❑ Hand the second binary card (2) to the second student. What do you notice now? How is it similar to our counting system so far? What might come next? ❑ Hand the third binary card (4) to the third student. What do you notice now? Is there a pattern beginning to emerge? What might come next? ❑ Repeat this process and questioning until all 8 students have their binary cards. What do you notice? What pattern do you notice? ❑ Explore how we make particular numbers and what this looks like when we represent it as '1' and '0'. 0 represents 'off' and 1 represents 'on' ❑ When we make particular numbers, letters or symbols in this number system it is like turning switches on and off. ❑ Examine what happens when we make the number 2 → 00000010, number 3, number 5. Ask students to think of a number between 1 and 128 and discuss how we might make that number in binary code. ❑ Pairs experiment with converting numbers into binary code ❑ Experiment with communicating to machines through pattern recognition (unplugged Task) (**LINK: Maths**) ❑ Use the binary character table to create the pattern for students' first names. Students could create this binary pattern using beads or coloured markers. ❑ Support: students use pattern blocks/ unifix cubes and the binary bracelets decoder key to create the pattern that represents their name. ❑ Extension: students use binary code to create an encrypted message that needs to be decoded by a partner. ❑ Reflecting on learning ❑ *What are some reasons why we don't use the binary number system as the language for our written language?* ❑ *What did you find challenging about understanding binary code?* ❑ *How did you overcome these challenges?* (**Assessment ST3-11DI-T,ST3-2DP-T**)		-Example image (Appendix 1) -binary cards -beads -string OR -coloured markers -scissors -glue OR -pattern blocks -binary character table -binary bracelets decoder key

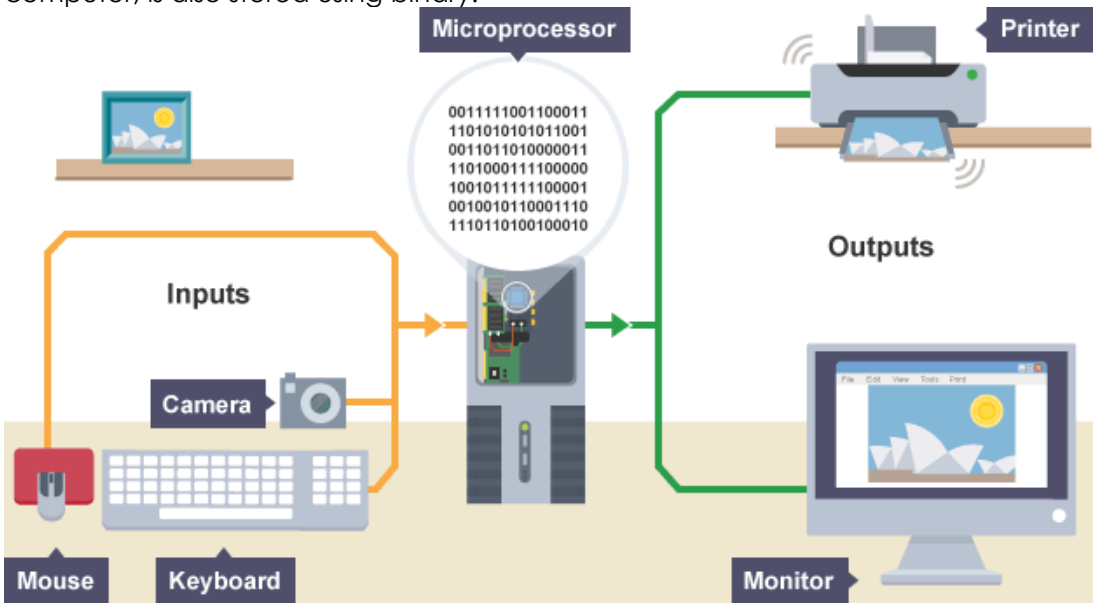
CONTENT FOCUS	LEARNING & TEACHING SEQUENCE - 1 *Using and Interpreting Data*	EVALUATION	RESOURCES
How do components of digital systems interact with each other to transmit data? Students: ● collect, store and interpret different types of data, for example: ○ using sensors to collect data ● Use software to interpret and visualise data **Curriculum Links:** **Maths:** ● **MA3-8NA** Patterns and Algebra: analyses and creates geometric and number patterns, constructs and completes number sentences, and locates points on the Cartesian plane	**Tuning In:** ❏ Small groups use black and white squares to create a 5x5 design. ❏ *How might you get another group to recreate the image without seeing it?* ❏ Pair up groups to trial different strategies to recreate the image of another group ❏ *What strategies worked the best? Why do you think this might be?* **Shared Inquiry:** ❏ Pose the question: *How do computers store and send digital images? How can we represent images in a digital format?* ❏ Introduce the term 'pixels'. Explain that the pattern groups just created used pixels. A computer represents this by using two numbers: 1s and 0s. In the picture, 1 represents the white colour (on) and 0 represents the black colour (off). ❏ Experiment with creating pixel images through a plugged and/or unplugged experience ❏ **Plugged Experience:** ❏ Digital tool: Google Sheets or Google Docs ❏ Create an 8x8 square table and use the fill bucket tool  to create a picture. Fill some squares in black and leave others white. ❏ Develop a code for each line of the picture. Each line of code should have 8 numbers (consisting of 0s and 1s). ❏ Swap code with another person and try to decode each other's code to recreate the image digitally. ❏ Share their work, making comparisons with the original image. Encourage students to discuss and try to debug any problems. Having a debugging mindset is incredibly important when working in programming. ❏ **UnPlugged Experience:** ❏ Draw image on an 8x8 template, colouring some squares black and leaving some white. ❏ Create a code for each line of the image, using 1s and 0s. ❏ Decode a partners code to try and recreate their image, making comparisons to the original image. ❏ Place a pixelated image of a cat Picture to decode on the board for the whole class to see. ❏ Challenge students to write the binary code for this image in their books. Provide students with some time to code this image. ❏ Reflecting on learning using the Learning in Hand tool		-black and white squares -Digital devices -Paper template -Picture to decode -Learning in Hand tool

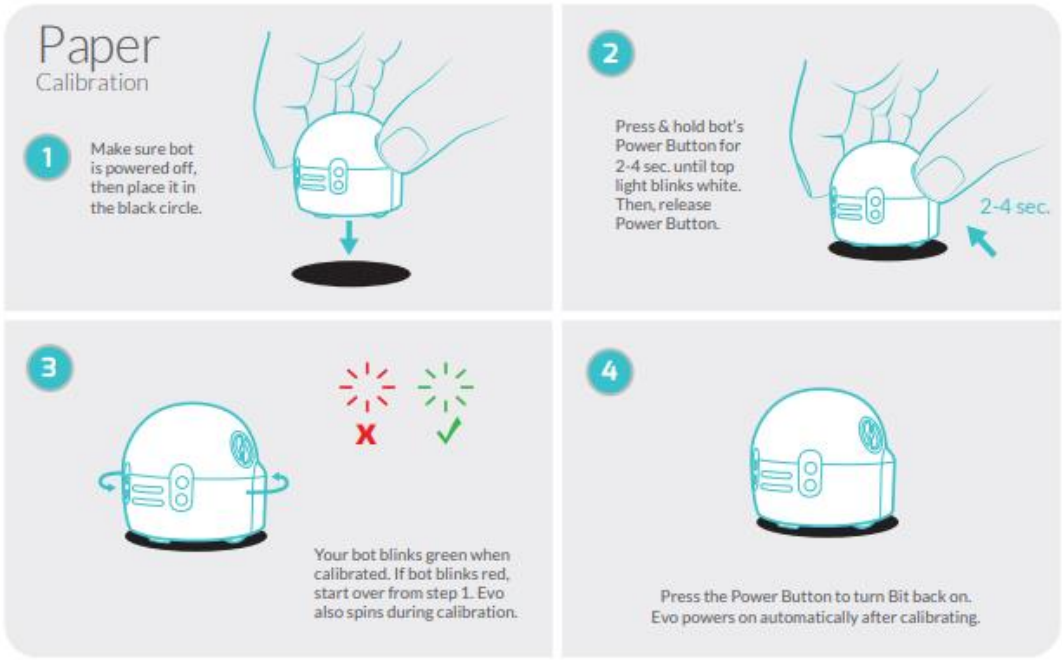
CONTENT FOCUS	LEARNING & TEACHING SEQUENCE - 2 *Digital Systems and Networks*	EVALUATION	RESOURCES
How do the components of digital systems connect together to form networks? Students: • Investigate internal and external components of digital systems that perform functions • explore how the main components of digital systems connect together to form networks that transmit data • describe how data can be transmitted between two digital components **Curriculum Links:** **English**: • **EN3-1A:** communicates effectively for a variety of audiences and purposes using increasingly challenging topics, ideas, issues and language forms and features	**Tuning In:** ❑ Display a device, such as a laptop, Chromebook or iPad. Engage in a discussion using the thinking routine Think, Puzzle, Explore to help scaffold student thinking. ❑ *What do you think you know about how devices work and uses the network?* ❑ *What questions or puzzles do you have?* ❑ *How might we explore the digital systems and networks at our school?* **Shared Inquiry:** ❑ Pose the question: *How is data input into a digital system, and how might it be output?* ❑ Watch the TedEd video Inside Your Computer. ❑ Use the thinking routine Plus One to help students take notes of key ideas and important information in the video. (LINK: English) ❑ Engage in a discussion about the critical components of a computer - peripherals (e.g. mouse), input/output subsystem (controls what and how much information comes in and out), and the central processing unit (the brain), as well as human-written programs and memory. ❑ Create a visual representation such as a labelled diagram to show how a digital system of interest works, showing inputs, how data is processed and the output. They may include specific software that is required as part of the system. ❑ Share completed representations to help answer the supporting question. ❑ Pose the question: *How do our digital systems connect to our school network?* ❑ Discuss the term 'school network' and explore what this might mean. *What other networks can they think of?* ❑ Guide a discussion to explain that the computers in the school are all connected together, creating a 'school computer network'. Add that this network also contains other devices, such as printers, wireless access points (WAPs). ❑ School Tour - engage in an exploration and mapping of the school's computer network on a blank piece of paper or map of the school. ❑ Before: Identify and name the devices students will find using images. Students will then use this to help them locate and identify devices around the school. ❑ Small groups given a set time frame (e.g. 20 mins) to locate and identify key components of the schools computer network, amd sketch them on a map of the school. ❑ Engage in a discussion about what they found on their school tour and make some predictions as to its purpose and function. ❑ Investigate the role of each device on the schools computer network to help develop student understanding ❑ Support: Use additional targeted questions to check basic understanding of computers being connected together and the key devices on the network ❑ Extension: Challenge students to explain how each of the devices they have learnt about would play a role in enabling them to conduct web-based research into the devices, e.g. They have logged in to the network using a client computer. They have accessed the internet via the server – the switches would have let the computers 'talk' to each other to achieve this etc.		- Think, Puzzle, Explore -TedEd video Inside Your Computer -Plus One -Teacher Information (see appendix) -School network images

CONTENT FOCUS	LEARNING & TEACHING SEQUENCE - 2 *Digital Systems and Networks*	EVALUATION	RESOURCES
How do the components of digital systems connect together to form networks? Students: • describe how data can be transmitted between two digital components • explore how the main components of digital systems connect together to form networks that transmit data • explore current ethical, social and technical protocols when communicating using information systems **Curriculum Links:** **Maths:** • **MA3-16MG** measures and constructs angles, and applies angle relationships to find unknown angles • **MA3-17MG** locates and describes position on maps using a grid-reference system	**Shared Inquiry: (cont.)** ❑ Pose the question: *How can I apply what I know about digital systems?* ❑ Design a digital solution that incorporates data being transmitted via an input device or network for a particular purpose or to meet a particular need. ❑ Students plan their design and identify the data and functional requirements. If time permits, students create a digital solution by implementing their design. ❑ Task: (LINK: Maths) ❑ Design a maze for a robotic device to navigate → controlled via bluetooth and connected via an app. ❑ Support: draw a path on the screen of the device for the robot to follow ❑ Extension: push a ping pong type ball through the maze and use the blocks to code the robots movements.   ❑ Pose the question: *What does it mean to be digital citizen?* ❑ Engage in a discussion about digital citizenship using guiding prompts: ❑ How do you interact with technology each day? ❑ What are some impacts of using technology (both positive and negative)? ❑ How do rules aim to protect us online? ❑ What does it mean to be responsible online? ❑ Provide students with the opportunity to engage with the interactive platform Digital Compass to help students explore the impact different choices have in the online environment. ❑ Find facts and gather data for conscientious decisions ❑ Synthesize information and evaluate options ❑ Assess situations in order to make informed judgments ❑ Reflect on decisions and determine alternative choices ❑ Build interpersonal empathy by role-playing and taking the ❑ perspective of others ❑ Develop skill-based competencies through game-based learning ❑ Apply learnings to real-world situations ❑ Extension: engage in a reflective creative writing exercise so that they are able to reflect or elaborate on the current issues raised in the eight stories. (Link: English) **ASSESSMENT** ❑ How does playing with negative outcomes, even the fantastical ones, help you apply new thinking to your real world? ❑ Why is the digital world filled with so many ups and downs? What do you think are the best opportunities? What are the pitfalls that you and your peers need to watch out for? ❑ Which character do you most relate to? Why? How are you similar? In what ways are you different?		-Spero robots -iPad devices -straws -ping pong type balls - interactive platform Digital Compass

CONTENT FOCUS	LEARNING & TEACHING SEQUENCE - 3 *Designing Digital Solutions*	EVALUATION	RESOURCES
How do we represent decision-making in an algorithm? Students: • design a user interface for a digital system • design, modify and follow algorithms branching and iteration • define problems and plan and implement digital solutions, suing an appropriate visual programming language involving branching and iteration, and requiring user input **Curriculum Links:** **Maths**: • **MA3-18SP** uses appropriate methods to collect data	**Tuning In:** ❑ Engage in a discussion about 'games', using prompting questions, such as: ❑ *What games do you play? How are games made? What are the different types of games? What games do you like or dislike? What is your favourite game and why? What do you think when you hear the word 'gaming'? What do you think makes a good game? How do you make a game?* ❑ Explain to the students that they are going to make a digital game; that is, a game that can be played online. To create their own games they will first need to explore some other games. **Shared Inquiry:** ❑ Design and Produce Digital Task: Use the design thinking process to create a game that meets a design brief or audience. **ASSESSMENT** ❑ Empathising: ❑ Provide an opportunity for students to explore a range of new and old digital games and identify what they like or dislike about them using a game review template. ❑ Engage in a class discussion about what students enjoyed or disliked about the games they played. Use the following questions as prompts: ❑ *Which game was your favourite and why?* ❑ *Were there elements of your favourite game that you enjoyed more than others?* ❑ *What were the different elements of the games you played (characters, music, challenge, storyline)?* ❑ *What do you think is the most important element to get right in a game?* ❑ Survey others to find out what they like about games and which ones are popular/ frustrating etc. (LINK: Maths) ❑ Ideation: ❑ Generate a list of ideas for possible games, e.g 50 ideas in 10 minutes. ❑ Engage in a discussion about the possible ideas and groups choose 1 idea to develop further and prototype. ❑ Design: ❑ Use poster paper to design their games and to show how a user will step through the different stages or user input scenarios. This can be achieved through ❑ storyboard - good for story-based games where each box will show how a user will step through a game. ❑ branching diagram/ flow chart - used for games with decision-making to show 'if this, then that' occurrences. ❑ Encourage students to include as much detail as possible to show how the game will work and what the user will do at each stage. This will help when they are trying to build the game. Students should ask themselves the question 'Could someone make this game using just my design?'		-Teacher Resource: What makes a good game? -Teacher notes - design process (see appendix)

CONTENT FOCUS	LEARNING & TEACHING SEQUENCE - 3 *Designing Digital Solutions*	EVALUATION	RESOURCES
How do we represent decision-making in an algorithm? Students: • design a user interface for a digital system • design, modify and follow algorithms branching and iteration • define problems and plan and implement digital solutions, suing an appropriate visual programming language involving branching and iteration, and requiring user input **Curriculum Links:** **Maths**: • **MA3-18SP** uses appropriate methods to collect data	**Shared Inquiry:** ❑ Design and Produce Digital Task: Use the design thinking process to create a game that meets a design brief or audience. **ASSESSMENT** ❑ Prototyping: ❑ Experiment with the Scratch Coding platform using a range of resources to investigate different ways to code a game. ❑ Use the Scratch platform to build a prototype of the game ❑ Testing: ❑ Develop a feedback form groups could distribute to testers of their game. Questions should be developed with the class and could include the following areas: ❑ enjoyment of the game, music, characters, storyline ❑ accessibility of the instructions ❑ game difficulty ❑ length of the game ❑ what they didn't like ❑ parts that didn't make sense. ❑ Showcase games with others beyond class/grade ❑ Evaluation: **Assessment As Learning** ❑ Reflect on the experience of designing and developing a game: ❑ What was your initial idea and how did this change over the development of your game? ❑ What challenges did you have during the making of your game and how did you overcome them? ❑ What worked well in your team? ❑ What changes did you make after testing? ❑ What changes would you make if you did this again? ❑ What are you most proud of about your game?		-Scratch coding resources

Focus Area	Key Information and Resources for Teachers	Resource Links
Binary Code	All computer data is represented using binary, a number system that uses 0s and 1s. Binary digits can be grouped together into bytes. Computers use binary - the digits 0 and 1 - to store data. A binary digit, or bit, is the smallest unit of data in computing. It is represented by a 0 or a 1. Binary numbers are made up of binary digits (bits), eg the binary number 1001. The circuits in a computer's processor are made up of billions of transistors. A transistor is a tiny switch that is activated by the electronic signals it receives. The digits 1 and 0 used in binary reflect the on and off states of a transistor. Computer programs are sets of instructions. Each instruction is translated into machine code - simple binary codes that activate the CPU. Programmers write computer code and this is converted by a translator into binary instructions that the processor can execute. All software, music, documents, and any other information that is processed by a computer, is also stored using binary.  ❑ Counting in Binary - Part One Explained (Computer Science Unplugged) ❑ Binary Numbers for Kids ❑ Binary digits sample classroom lesson	❑ https://www.bbc.co.uk/bitesize/guides/zwsbwmn/revision/1 ❑ **Link:** https://youtu.be/b6vHZ95XDwU ❑ **Link:** https://www.youtube.com/watch?v=hvteVokzZjE ❑ **Link:** https://youtu.be/Wy6-FXtLMV8

Ozobots	❑ Calibrating an Ozobot  	
INPUT/OUTPUT SYSTEMS	❑ INPUT/OUTPUT SYSTEMS ❑ Input devices allow us to enter raw data into a computer. A digital system, such as a tablet or desktop computer, processes the data. It then produces outputs that are communicated using an output device. Input devices can be manual or automatic. ❑ Data such as text, images, sound and numbers are input into a digital system using a range of digital devices. The output is communicated using different components; for example, a speaker for sound. ❑ To enable data input, specific software may be required; for example, to gain audio and video input from a webcam the digital system requires suitable software. This software is also used to output the webcam data to a screen.	
DESIGN PROCESS	❑ The process involves understanding user design needs, generating innovative and creative ideas, planning and evaluating. ❑ **Empathising:** In this part of the process, students explore what people like about games, why people play them and what games interest the audience.	

	❑ **Ideation:** Students come up with the ideas and concepts that they will develop through the game. ❑ **Design:** Students draw out their ideas and how they will piece together the game. They show the connections between what the user wants and how the game will work. ❑ **Prototyping**: Students create a working model of what the game will look like. ❑ **Testing:** Students test their prototype with users (user testing) by asking the audience to play their game. By observing what users do and asking them for feedback students can learn about some of the problems that the game may have. ❑ **Evaluation:** When students think their game is ready to share to a wider audience, they will want to know if they were able to meet the expectations of the users. This will help them if they want to make another game or make further improvements and updates to their game.	

Appendix 1: