

Alarmed! An alarm system to protect treasure

COMPUTER SCIENCE DESIGN & TECHNOLOGY

LABS

education@samlabs.com www.samlabs.com

Key information



SUBJECTS

Computing, Science, Design & Technology.



RECOMMENDED PRIOR KNOWLEDGE

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Basic understanding of SAM, and the SAM Blocks used in the project.

An understanding of sensors and how they are used in real-life alarm systems.



GROUP SIZE

2-3 students



OUTCOMES

KEY STAGE

Key Stage 2

- To use technology to secure an object against theft.
- To make it impossible to remove an object undetected.

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- To build and program an alarm system using multiple inputs and outputs.
- Practise teamwork and collaborate to navigate through problems.
- Reflect on and review the process, the product and that of their peers.

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LEARNING OBJECTIVES

See Curriculum Alignment (next page).

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MATERIALS REQUIRED

- Computer or Tablet
- SAM Space Education app
- 1 SAM Tray
- Additional (optional) blocks: tilt sensor, proximity sensor, button, buzzer
- Precious object (eg. can of Coke)

Note that some of the blocks mentioned in this lesson plan are only available in the larger SAM kits. The lesson can still be conducted using only the SAM Trays, however.

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TIME REQUIRED

NB: This project may go over two sessions, depending on the time needed to be given to each stage, and the experience of the students.

Suggestion for a 1 hour session:

Introduction to concept - 5 minutes. Activity Stages - 40-50 minutes. Extension activity - 10 minutes. Reflection and Plenary - 5 minutes.

Curriculum alignment

NATIONAL CURRICULUM STANDARDS

Computing - Key Stage 2

- Design, write and debug programs that accomplish specific goals, including controlling or simulating physical systems; solve problems by decomposing them into smaller parts.
- Use sequence, selection, and repetition in programs; work with variables and various forms of input and output.
- Use technology safely, respectfully and responsibly; recognise acceptable/ unacceptable behaviour; identify a range of ways to report concerns about content and contact.

https://www.gov.uk/government/ publications/national-curriculum-in-englandcomputing-programmes-of-study

Design & Technology - Key Stage 2

Design

- Use research and develop design criteria to inform the design of innovative, functional, appealing products that are fit for purpose, aimed at particular individuals or groups.

Technical Knowledge

- Understand and use electrical systems in their products (for example, series circuits incorporating switches, bulbs, buzzers and motors).
- Apply their understanding of computing to program, monitor and control their products.

https://www.gov.uk/government/englanddesign-and-technology-programmesof-study

PROGRESSION PATHWAYS / COMPUTATIONAL THINKING CONCEPT

Programing and development

- Creates programs that implement algorithms to achieve given goals. (AL)
- Uses post-tested loop e.g. 'until', and a sequence of selection statements in programs, including an if, then and else statement. (AL)

Hardware and Processing

- Knows that computers collect data from various input devices, including sensors and application software (AB).

Computational Thinking Concept: AB = Abstraction; DE = Decomposition; AL = Algorithmic Thinking; EV = Evaluation; GE = Generalisation

https://community.computingatschool.org. uk/resources/2324

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BEFORE THE CLASS

During this project, students will examine the basic functionality of alarm systems and how to build a system that can detect nefarious activity and sound an alarm.

Students will explore the features of the SAM Blocks in their trays to create and program a working alarm system.

They will work together to discover how best to configure and program the blocks, building their own system to protect their valuable object!

Below is an example solution to the main activity challenge.





02 BEFORE THE CLASS Final checklist

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DOWNLOAD THE APP

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SAM LOG IN

Create a SAM account if you don't already have one. SAM accounts are free and allow you to save your inventions to the cloud and download and modify them later, you can even share them with others.

CHARGE YOUR SAM BLOCKS

Even though the blocks can be used while tethered, they were designed as rechargeable devices that can be used a fair way away from your system or where they can't be plugged in. You can tell they are fully charged when they change colour from red to green.

Handy Tip: you can click on a block in the SAM space to see how much charge is left.

ADDITIONAL RESOURCES

For SAM support https://www.samlabs.com/support.

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during the class Activity stages

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Q: Can you think of some examples of alarms, and why you would use them?

Draw out their knowledge of burglar alarms, car alarms, etc. Ask them why alarm systems might be used (eg to protect precious or important things, or to warn us of danger etc). Tell the students that during this project, they will be designing, making and programming an alarm system that will protect an object against theft.

Q: How do sensors work? How can you use them to either detect intrusion or the removal of an object?

Ensure they understand that sensors work by 'waiting' for a 'trigger' so they can send information to, for example, a siren, buzzer etc. Discuss different ways of raising an alarm. Ask them to think of the different types of sensors used in alarm systems (motion / light / pressure / movement etc).

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Show the students an example alarm system using SAM. Place the light sensor with a 'valuable object' (a bag of sweets / can of drink etc) into a carboard box in the lid, and close the lid. Ask them if they can predict what will happen to the light sensor when you open the lid.

This system uses the compare block to only start the sound player playing when the lid is opened, and the level of light hitting the light sensor goes up dramatically.

Note: It would be a good idea to test this beforehand so that you can set the "compare" block to a sensible value.



Q: How else could you use light as a means of detecting an intrusion or theft?

Ask the students to work in groups. Get them to recreate what you have just done as a class to make sure everything is working as it should.

Now, give them some time to experiment with different ways of using the light and light sensor from their tray in an alarm system. If you have a SAM Labs Classroom Kit, they may use some of the other input blocks in their experiments.

Also, experiment with the alarms - a sound player is one. You can make two spinny buzzers (see Tips and Tricks later) from the blocks in the tray - how could multiple, wireless alarms be used?

Draw some examples of how your alarm system might look. Get the students to record all of their experiments, especially the one they decide upon.



4) THE HOLD BLOCK

Bring the students back together and ask some of them to share their solutions with the group. Ask them WHY they settled on the one they have. Ask them if it would be a good idea to 'tweak' their programmes so that their alarms sound continuously for a set amount of time. The HOLD block makes sure of this, by allowing us to 'keep the program going" for a set time (we used 5 seconds). Show the students how this works.

HINT: Ensure the student includes a FILTER block to allow the blocks to only reacts when the object is affected.



5 CHALLENGE: MULTIPLE INPUTS AND OUTPUTS

Draw your ultimate alarm system using multiple inputs and outputs. Ask them WHY an alarm system might use, for example, a motion sensor and a pressure sensor. Also, why would they have multiple alerts, for example a buzzer and a light?

Send the students off in their groups with the task of creating a multiple input/output alarm system to protect their treasure.

Get the students to record all of their experiments, especially the one they decide upon. At the end of the task, ask the groups to demonstrate their system to the rest of the class.

TIP for Students: experiment with the precious object and the position of the sensors.

What happens if you place a light in front of a light sensor, and then put an object between them? How could this be used to make a James Bond-proof alarm system?



DURING THE CLASS **Extension activity**

If some groups complete the task, they can be challenged further.

Q: How might your alarm system be made better, so you can capture evidence of an attempted theft?

Students could incorporate the Camera block, or the Tweet Out Block into their program. Ask the students to think of how this could be done and to experiment with solutions.

They could also think about a design for a stand/holder for their precious object and/or the SAM Blocks used in their alarm system.



Possible solution:

Think about how to incorporate the sensors into the stand to get the optimum response. For example try to make a stand with a hollow centre that allows the SAM Light Sensor to sit inside, making it a 'closed system' that will only see a change in light when the object is removed from the stand.

Q: Could this be expanded further?

RECORDING THEIR WORK

This is an ideal project for the students to video. They could even write playscripts and act out an attempted theft, and share their films on Microsoft Classroom (or similar).



Board Games

COMPUTER SCIENCE DESIGN & TECHNOLOGY

LABS

education@samlabs.com www.samlabs.com

Key information



SUBJECTS

Computer Science, Design & Technology.

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RECOMMENDED PRIOR KNOWLEDGE

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Basic understanding of SAM, and the SAM blocks used in the project. Basic Design & Technology principals.

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KEY STAGE

Key Stage 3



OUTCOMES

- Come up with a possible solution for a board game, using prototypes to develop the best design possible, and then evaluate it.
- Practise teamwork and collaborate to navigate through problems.
- Reflect on and review the process, their product and that of their peers.

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LEARNING OBJECTIVES

See Curriculum Alignment (next page).



GROUP SIZE

3 - 4 students

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TIME REQUIRED

This project is designed to run over a number of lessons to allow the students to work on and create their own board game using the SAM Labs STEAM kit.

The suggested duration is 5 one hour lessons.

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MATERIALS REQUIRED

- Computer or Tablet
- SAM Space Education app
- A selection of blocks based on the students requirements
- Pizza box
- Additional materials required by the students to design their board game

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Curriculum alignment

NATIONAL CURRICULUM STANDARDS

Computing - Key Stage 3

- Design, use and evaluate computational abstractions that model the state and behaviour of real-world problems and physical systems.
- Undertake creative projects that involve selecting, using, and combining multiple applications, preferably across a range of devices, to achieve challenging goals, including collecting and analysing data and meeting the needs of known users.
- Create, re-use, revise and re-purpose digital artefacts for a given audience, with attention to trustworthiness, design and usability.
- Understand a range of ways to use technology safely, respectfully, responsibly and securely, including protecting their online identity and privacy; recognise inappropriate content, contact and conduct and know how to report concerns.

https://www.gov.uk/government/ publications/national-curriculum-in-englandcomputing-programmes-of-study

Design & Technology - Key Stage 3

Design

- Identify and solve their own design problems and understand how to reformulate problems given to them.
- Develop specifications to inform the design of innovative, functional, appealing products that respond to needs in a variety of situations.
- Apply computing and use electronics to embed intelligence in products that respond to inputs [for example, sensors], and control outputs [for example, actuators], using programmable components [for example, microcontrollers].

https://www.gov.uk/government/ publications/national-curriculum-in-englanddesign-and-technology-programmesof-study. 01

BEFORE THE CLASS

This project is split across several lessons and gives the students time to develop their own ideas for a board game that is enhanced with electronic components. The students may take ideas from their favourite traditional board games and develop these using their knowledge of the SAM Labs STEAM kit, or develop entirely new board games.

The students will have the time and freedom to explore, experiment, trial and build their board games with a variety of different sensors.

During this project, the students will gain a valuable insight into the design and prototyping processes involved in developing a product.

The students will need access to all the usual materials found within a Design & Technology classroom, and if one is available, they may even choose to use a 3D printer. They will possibly also need access to standard art and modelling supplies too.

It will be useful to have a supply of flat-pack 'pizza style' boxes that can form the base of the board game and house the electronics inside it.

Consider dividing the class into larger teams than usual, so that each team can have access to two SAM group trays. If you own larger SAM kits, the bonus blocks could come in handy with this project!



02 BEFORE THE CLASS Final checklist

The following contains everything you need to prepare your SAM Labs environment before commencing the project. Please ensure you read each section carefully to ensure you have a problem free lesson.

DOWNLOAD THE APP

You can download the SAM Education app for OSX or Windows at **https://www.samlabs.com/app**.

SAM LOG IN

Create a SAM account if you don't already have one. SAM accounts are free and allow you to save your inventions to the cloud and download and modify them later, you can even share them with others.

CHARGE YOUR SAM BLOCKS

Even though the blocks can be used while tethered, they were designed as rechargeable devices that can be used a fair way away from your system or where they can't be plugged in. You can tell they are fully charged when they change colour from red to green.

Handy Tip: you can click on a block in the SAM space to see how much charge is left.

ADDITIONAL RESOURCES

For SAM support https://www.samlabs.com/support.



during the class Activity stages

PLANNING

Ask pupils to think about a favourite board game that they may have played and how it might be improved by adding light, sound or movement. Discuss how light, sound, music and movement of pieces could enhance a game to make it more engaging and fun.

Q: How might modern technology allow for a game to be improved?

Q: Could you create a completely new modern board game using technology?

Ask the students to share their ideas for peer discussion.

Put the students in small groups of 2 - 3 children and ask them to think of ideas about improving a board game of their choice, focusing on how they might use the SAM blocks to create the improvements. They can open the SAM Space Education App and use this to help them think through ideas and explore the different elements they could add. It is important at this point not to give them too much structure and allow them to explore.

Q: Which SAM Blocks would be useful in your board game design?

Q: How would you use these?

Q: Would they enhance the gameplay or be a fundamental feature of the game?

Ask the students to storyboard their ideas, so that they can plan how the game would be played. Use large sheets of paper so that the students can start drafting out ideas for the game, illustrating where and how the SAM blocks might be used.

Q: How would the SAM blocks be connected to the game?

Q: Would they be embedded into the board, or separate?

Q: What would be the role of the blocks within the context of the game?

Ask each group of students to present their storyboard for class discussion and peer review to help refine their ideas.

DESIGN AND DEVELOPING AN IDEA

Discuss how the SAM blocks could be used to prototype their ideas. Explore the meaning of prototyping and the processes involved in designing, creating, prototyping and evaluating designs. Ask the students to imagine their job was to develop board games but they had been briefed to work with emerging technologies to make them feel more relevant for the 21st Century. At this point, mention some of the limitations of bluetooth - for example, its proximity to the board and the need to pair.

Q: How might you address the limitations of bluetooth? Could you embed the SAM Blocks physically into the board?

Working in the SAM Space, start experimenting with connecting the blocks together so that they do what you want them to do within the context of your game designs. Build on the knowledge that the students already have of the SAM hardware and software blocks.

In their small groups, ask the students to build their design ideas and storyboard plans into a physical board game design. Give each pair a flat packed pizza box which they will need to assemble. Explain they can paint, use felt tips or print off designs to create their boards.

Ask them to think about how they will attach or embed the SAM blocks to work with their board game designs.

CREATING THE GAME

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Over the next few lessons allow the students to create their board games using whatever materials have been agreed upon. If the school has a 3D printer, some pupils may wish to design game pieces and print off their designs to use in their games. The SAM blocks can be attached to the inside of the pizza box and small holes can be cut into the box to allow sensors to pop through.

Ask the students to test the blocks and how they will work, before they attach them to their board games.

Q: Should you test your ideas with other people in the class?

Q: Is the gameplay improved by use the SAM Blocks that you have decided on?

Q: Do they make the game more fun, or do they enhance the game rules?

GETTING FEEDBACK AND IMPROVING THE PROTOTYPE

Remind the students that the task is to come up with a design which enhances the game by adding something extra using technology. An example may be that by using a light sensor and a SAM LED Light the game is improved when a player's piece lands on the square containing the light sensor (which detects the light being blocked) and the light comes on with either a red or a green light randomly. The red light means the player has to go back to the start point whereas the green light allows them to take an extra two steps along the board.

Q: How does the technology enhance your game experience?

Q: Could the technology be better embedded into the game design and rules?

If the students have access to a 3D printer, this lends itself to designing extra pieces for the game, added obstacles, etc.

Once the game has been created, allow different groups within the class to test the game and feed their thoughts back to the game creators to allow them to solve any issues or make changes to the game play.

EVALUATION

When the game has been finished, ask the students to evaluate their design experience.

Q: Can you describe the process that you have been through?

Q: Can you reflect on the importance of the different stages of design, including prototyping and testing?

Q: How successful do you feel that the final game is?

Q: Is there anything that you would change?

Q: Could you improve on the game design?



DURING THE CLASS **Extension activity**

If some groups complete the task, they can be challenged further.

Q: How is the game presented, can the students create rule cards, and posters to advertise the game?

Q: Could they arrange challenges between groups of students?

Q: Can they present their game to a wider audience?

Q: Could this be expanded further?

REAL-WORLD APPLICATIONS

The design process is common in most product design and development, and leads into several future career options for the students. Alongside this process, the students have developed thinking and teamwork skills, to appreciate the ideas of other and act on feedback, all of which are skills useful for future employment.

RECORDING THEIR WORK

Ensure the students have completed their student packs, recording their thoughts and solutions.

Other options: Create an e-book / poster / video, etc. to explain what they have done.



Civic Engagement

COMPUTER SCIENCE DESIGN & TECHNOLOGY CITIZENSHIP

LABS



This Lesson Plan has Twitter content. Not suitable for children under 13 years of age.

education@samlabs.com www.samlabs.com

Key information



SUBJECTS

Computing, Citizenship, Design & Technology.

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RECOMMENDED PRIOR KNOWLEDGE

Basic understanding of SAM, and the SAM Blocks used in the project. Basic understanding of Twitter.

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KEY STAGE

Key Stage 3



OUTCOMES

- To understand the design thinking process.

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- To produce a civic campaign on a topic of importance.
- To share the concepts of the campaign externally using SAM.
- To reflect and evaluate the feedback form sharing the campaign.

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GROUP SIZE

4-5 students

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TIME REQUIRED

Suggestion for 2 one hour sessions:

Session 1

15 minutes introduction and to build the SAM Space for Tweeting.45 minutes to work on the civic engagement campaign.

Session 2

30 minutes to review any twitter activity and adapt the campaign as appropriate.15 minutes to present the campaign to the class for reflection and peer review.10 minutes extension activity.5 minutes reflection and plenary.



LEARNING OBJECTIVES

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See Curriculum Alignment (next page).



MATERIALS REQUIRED

- Computer or Tablet
- SAM Space Education app
- 1 SAM Tray

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Curriculum alignment

NATIONAL CURRICULUM STANDARDS

Computing - Key Stage 3

- Design, use and evaluate computational abstractions that model the state and behaviour of real-world problems and physical systems.
- Understand several key algorithms that reflect computational thinking(for example, ones for sorting and searching; use logical reasoning to compare the utility of alternative algorithms for the same problem.
- Undertake creative projects that involve selecting, using, and combining multiple applications, preferably across a range of devices, to achieve challenging goals, including collecting and analysing data and meeting the needs of known users.
- Create, re-use, revise and re-purpose digital artefacts for a given audience, with attention to trustworthiness, design and usability.
- Understand a range of ways to use technology safely, respectfully, responsibly and securely, including protecting their online identity and privacy; recognise inappropriate content, contact and conduct and know how to report concerns.

https://www.gov.uk/government/ publications/national-curriculum-in-englandcomputing-programmes-of-study

Design & Technology - Key Stage 3

- Use research and exploration, such as the study of different cultures, to identify and understand user needs.
- Identify and solve their own design problems and understand how to reformulate problems given to them.
- Develop specifications to inform the design of innovative, functional, appealing products that respond to needs in a variety of situations.
- Develop and communicate design ideas using annotated sketches, detailed plans, 3D and mathematical modelling, oral and digital presentations and computer-based tools.
- Select from and use specialist tools, techniques, processes, equipment and machinery precisely, including computeraided manufacture.
- Analyse the work of past and present professionals and others to develop and broaden their understanding.
- Investigate new and emerging technologies.
- Test, evaluate and refine their ideas and products against a specification, taking into account the views of intended users and other interested groups.
- Understand developments in design and technology, its impact on individuals, society and the environment, and the responsibilities of designers, engineers and technologists.

https://www.gov.uk/government/ publications/national-curriculum-in-englanddesign-and-technology-programmesof-study

Curriculum alignment

Citizenship - Key Stage 3

- The precious liberties enjoyed by the citizens of the United Kingdom.
- The roles played by public institutions and voluntary groups in society, and the ways in which citizens work together to improve their communities, including opportunities to participate in school-based activities.

https://www.gov.uk/government/ publications/national-curriculum-in-englandcitizenship-programmes-of-study

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BEFORE THE CLASS

This project builds on knowledge gained in the KS3 lesson 'Twitter Battle'.

During this project, students will design a civic campaign that will get them to think about local or national issues. They can use technology to potentially help solve the problems. These may include things such as:

- The environment
- Future workforce
- Transport issues
- Issues that concern the students

Try to guide the students to pick issues that they can prototype possible solutions to with the SAM blocks available to them.

The students will share the ideas with the global community for feedback and discussion using Twitter, to help them guide and design the campaign.

The students will:

- Consider relevant hashtags (#) and Twitter IDs (@) to share their campaign ideas.
- Review and reflect on the feedback and adapt their campaign.

The students will use a range of SAM blocks to tweet about the campaign during the design stages.



Here is an example of what the students might create to help them tweet images about their campaign.



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ADDITIONAL RESOURCES

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during the class Activity stages

Explain to the students that they will work in small groups to design a civic engagement campaign, and that they are going to share this with the global community to help influence and guide how the final campaign will look.

Q: Have you used Twitter before?

Q: Describe what Twitter is in 140 characters! If you use Twitter, who do you follow?

Q: Are there any topics or feeds you follow?

Revisit the The Tweet Out and Tweet In blocks that were introduced in the lesson 'Twitter Battle', and explore the solution that they came up with to track and count tweets. Show the students a simple program on SAM Space which allow for tweets to be sent from an appropriate account. The students can expand on this program during the lesson.

Q: What other options would be useful to include in your tweets to help engage the global audience so that they respond?

Here is an example of what the students might create to help them tweet about their campaign, to include images and video etc.



Turn on the SAM Light Sensor and SAM LED Light, and drag these onto the canvas, along with the SAM Sound Player, SAM Photo Booth, SAM Message and SAM Tweet Out blocks.



Assemble the graph as shown, and configure the following blocks:

- Check the light sensor is acting as a button (see "Tips and Tricks" later for more details)
- Connect the Twitter block to a twitter account.
- Set the Interval block to 250 milliseconds.
- Set the Delay block to 5 seconds.
- Set the Hold block to 2 seconds.

How does this work?

It is an extremely effective "how to code" exercise to trace through the graph and figure out what it does before reading the explanation. It's suggested that you do this before the class to make it clear in your own head, and then take the class through it as a class exercise.

- 1. The light sensor, when covered, will trigger the toggle, turning it on.
- 2. The toggle will activate the Interval and Delay blocks.
 - a. The Interval block will begin pulsing its quarter-second pulses, which will cause the light to start flashing.
 - b. The Delay block will start counting down to five seconds. After five seconds, it will activate the Hold block, the Camera block, and also the weirdly connected Toggle block.
 - i. The Camera block will take the photo.
 - ii. The Hold block will activate the light and wait for the configured time before turning it off again (2 seconds).
 - iii. The backwards connection to the Toggle block will cause the whole system to switch off and wait for the button to be pressed again.

Put simply, when the button is pressed the light will begin flashing for five seconds. After five seconds, the light will turn on for two seconds while a photo is taken and tweeted. The button can then be pressed again to repeat the process.

Take this opportunity to talk to the students about responsible and safe use of social media.

Q: How is this creation potentially dangerous?

Q: What could be the consequence if you tweet a picture of somebody without their permission in a ridiculous posture?

Now that the system has been built, the students can start to design their campaign. Guide their discussions to fit in with the remit of KS3 subject content (see previous section on Curriculum Alignment).

- Q: What issues are relevant to young people in today?
- Q: Are these local, national or global problems?
- Q: How could you assess the impact of the problem?
- Q: Could technology be used to help solve the issues?
- Q: How could this be communicated to people?

Once the students have decided on their topics for their campaigns, explain the design thinking process.



Work through each of the design thinking stages with the students, and encourage them to tweet and share ideas to the community to help guide their planning.

Q: Are text-based tweets enough?

- Q: Would tweeting photos or videos be beneficial to help explain your ideas?
- Q: Could you design graphical content to help explain issues?

GAINING EMPATHY

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The first stage of this process is to develop an empathy for a problem, which involves investigating the issues and listening to the needs of the people involved in the problem that you are trying to solve.

Q: Who does the issue affect? What are their problems?

Q: Is there anyone else involved in the issue?

This human element is fundamental to the design thinking approach. At this stage, a lot of research is needed to fully understand the aspects of the issues.

DEFINING THE PROBLEM

During this stage, we pull together all the insights collected during the empathise stage, and began to analyse the information to define the core problems that the campaign is aimed at. Here we start to define a human-centred problem.

Q: Can you use the global community through Twitter to help define the problem?

IDEATE

Now we have identified the problem, we can start to plan how we might address it, and this session is about developing as many ideas as possible. Each of these ideas should be explored, as some of them could end up contributing to the final solution.

Q: What are the skills within your group?

Q: Can you use these different skills to generate different solutions and ideas for your campaign?

Q: Will tweeting your ideas help to develop them with responses from the global community?

PROTOTYPE

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This stage involves developing a solution to the problem. This could involve sketching, building with the SAM Blocks or creating videos presenting your ideas.

Q: Do you need to test the final outcomes, or can you test small elements of the campaign?

TEST

The final stage of the process is to test out your ideas with other people. Use your Twitter account to share the results with the global community and get some feedback. Don't forget to find appropriate hashtags.

Q: What was the response to your project?

Q: Was the feedback what you expected?



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Now the the design thinking process is complete, ask the students to record and reflect on the process that they have been through. The students can present their campaigns to the class.

Q: How did the feedback from the Twitter community help to guide and develop your campaign?



DURING THE CLASS **Extension activity**

If some groups complete the task, they can be challenged further. Using the feedback from the class presentations, and having seen the campaigns of their peers, are there any other options for the students to develop their own campaigns? Did you see anything that they could use in their campaign, or could they use different SAMs blocks that hadn't been considered before?

Q: Could this be expanded further?

Q: Can we develop the engagement with the campaigns further?

Q: Could we promote the ideas by creating a video presentation showcasing the process and the outcomes, and share this to the Twitter community too?

Q: Are there any other ways that the campaign outcomes can be spread further to amplify the message?



What do you need to know?

Make sure you have registered a Twitter account and paired it with SAM Space before the session. Students can use the same log on, unless they wish to use their own Twitter account.



Crazy Cars! Part 1

LABS

COMPUTER SCIENCE DESIGN & TECHNOLOGY

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Key information



SUBJECTS

Computing, Design & Technology.

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KEY STAGE

Key Stage 2



OUTCOMES

- To build and program a remote control buggy.
- To create a program to control the buggy and drive it around the room.
- To explore other ways of controlling their buggies and to create bespoke remote controls.
- Practise teamwork and collaborate to navigate through problems.
- Reflect on and review the process, the product and that of their peers.

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LEARNING OBJECTIVES

See Curriculum Alignment (next page).



RECOMMENDED PRIOR KNOWLEDGE

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Basic understanding of SAM, and the SAM blocks used in the project.



GROUP SIZE

2-3 students

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TIME REQUIRED

NB: This is Part 1 of a 2-part project. One flows into the other, but they can be taught as separate entities. Timings are approximate, depending on the time needed to be given to each stage, and the experience of the students.

Suggestion for a 1 hour session:

Introduction to concept - 5 minutes. Activity Stages - 50 minutes. Reflection and Plenary - 5 minutes.



MATERIALS REQUIRED

- Computer or Tablet
- SAM Space Education app
- 1 SAM Tray
- Tape for a 'maze' (if required)
- A range of remote control cars / toys

The students may use Other SAMs if needed in their projects.
Curriculum alignment

NATIONAL CURRICULUM STANDARDS

Computing - Key Stage 2

- Design, write and debug programs that accomplish specific goals, including controlling or simulating physical systems; solve problems by decomposing them into smaller parts.
- Use sequence, selection, and repetition in programs; work with variables and various forms of input and output.
- Use technology safely, respectfully and responsibly; recognise acceptable/ unacceptable behaviour; identify a range of ways to report concerns about content and contact.

https://www.gov.uk/government/ publications/national-curriculum-in-englandcomputing-programmes-of-study

Design & Technology - Key Stage 2

Design

- Use research and develop design criteria to inform the design of innovative, functional, appealing products that are fit for purpose, aimed at particular individuals or groups.

Technical Knowledge

- Understand and use electrical systems in their products (for example, series circuits incorporating switches, bulbs, buzzers and motors).
- Apply their understanding of computing to program, monitor and control their products.

https://www.gov.uk/government/publications/ national-curriculum-in-england-design-andtechnology-programmes-of-study

PROGRESSION PATHWAYS / COMPUTATIONAL THINKING CONCEPT

Programing and development

- Creates programs that implement algorithms to achieve given goals. (AL)
- Uses post-tested loop e.g. 'until', and a sequence of selection statements in programs, including an if, then and else statement. (AL)

Hardware and Processing

 Knows that computers collect data from various input devices, including sensors and application software (AB)

Computational Thinking Concept: AB = Abstraction; DE = Decomposition; AL = Algorithmic Thinking; EV = Evaluation; GE = Generalisation

https://community.computingatschool.org. uk/resources/2324



BEFORE THE CLASS

During this project, students will construct and program a simple remote control buggy, which will drive forwards, backwards and turn.

They will test their builds to make sure their programs work in the way they want them to.

Following this, students will be tasked with creating a functional remote control for their buggies using a range of SAMs. Here, they will explore combining sensors and controllers to create a system that works best for them.

Below is an example solution to the final challenge (create a remote control for your buggy).





02 BEFORE THE CLASS Final checklist

The following contains everything you need to prepare your SAM Labs environment before commencing the project. Please ensure you read each section carefully to ensure you have a problem free lesson.

DOWNLOAD THE APP

You can download the SAM Education app for OSX or Windows at **https://www.samlabs.com/app**.

SAM LOG IN

Create a SAM account if you don't already have one. SAM accounts are free and allow you to save your inventions to the cloud and download and modify them later, you can even share them with others.

CHARGE YOUR SAM BLOCKS

Even though the blocks can be used while tethered, they were designed as rechargeable devices that can be used a fair way away from your system or where they can't be plugged in. You can tell they are fully charged when they change colour from red to green.

Handy Tip: you can click on a block in the SAM space to see how much charge is left.

ADDITIONAL RESOURCES

For SAM support https://www.samlabs.com/support.



during the class Activity stages

ACTIVITY 1

Begin by asking the students if they have ever owned, or played with, a remote control car, or other vehicle. Have some in the classroom to show the students. Discuss how they are controlled, and in which direction they can travel. Can they drive at different speeds / turn corners / spin on the spot etc? Time and resources permitting, the students could try out the different remote control vehicles and drive them around the space.

Q: What is an example of a remote controlled car or vehicle?

Q: How can you control the speed and direction of this vehicle?

Tell the students that during the course of this session, they will make their own robotic buggies (or cars) and explore different ways to control them. y the end of the session, they will have created their own unique remote control system for driving their cars around the room.

Talk to the students about their SAM Tray, and point out the chassis, wheels and roller balls. Tell the students that these can be combined with SAM Blocks to create a driving base (or buggy). Tell the students that they will need motors for each wheel (x2) and send them away in small groups (2-3) to build their buggy. Photograph or draw the design of your buggy.

NB: Because of the parts used in this stage, the student's buggies may well be very similar, or even the same. This is OK, as their programs will be individual.

Bring the class back together and have them look at each other's buggies. Ge them to check that they have 2 wheels and something which balances the buggy (eg the roller ball), and that all the SAM blocks are securely fitted.

Tell the students that you will now look at creating a simple program to control a buggy using their device. Remind them that, even if they replicate what you are about to create, their buggy might behave differently to yours. The example below uses one virtual button to turn on the 2 DC Motors (remember to set one to Clockwise and one to Anti-Clockwise by double clicking on the block). The other virtual button changes the direction of the motors, so you have a program that will drive your buggy forwards and backwards.



Send the students off to try their own version of this program.

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Q: Record the progress of your buggy. Please include what did and didn't work.

6 When they have created a 'forwards and backwards' program, encourage them to experiment with other blocks so that they can turn their buggies left and right.

The example below builds on the one above, and uses two further blocks to control one motor each, enabling the buggy to turn.



ACTIVITY 2

2

Tell the students that their next challenge will be to create and program a remote control (just like the remote control cars they tried out, except that the control buttons are on their device).

Q: Which SAM Blocks should you use to control your buggy?

Q: How does it work?

Remember to point out the Controllers and how these can be used with SAM Blocks.

NB: Answers might include using Sliders for forwards / backwards / speed control, and Buttons to change direction.

A good design exercise can be conducted here: have the students think about how they hold the device they're using to control the vehicle, and position the virtual buttons and sliders on it such that their fingers can intuitively reach the controls they need to use. The following is an example:



Send the students to experiment with different SAM Blocks and how they affect their Motors.

Q: Which SAM Blocks should you use to control your buggy?

Q: How does it work?

You might want to demonstrate a very simple solution if the students need it. The one below uses a single Slider to control the speed of the motors.



Once all the buggies have been programmed and the controllers programmed, the students could drive them around a taped-out maze on the floor.

4) Ensure the students evaluate their work.

Q: What went well?

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Q: What could have gone better?

Q: How might your buggy be improved next time?



DURING THE CLASS **Extension activity**

There is no specific Extension activity for this project, as Part 2 builds upon what the students have achieved here.

Q: Could this be expanded further?

RECORDING THEIR WORK

As well as their work books, this could be done through photographs and video and built into an ebook.



Crazy Cars! Part 2

LABS

COMPUTER SCIENCE DESIGN & TECHNOLOGY

education@samlabs.com www.samlabs.com

Key information



SUBJECTS

Computing, Design & Technology.

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RECOMMENDED PRIOR KNOWLEDGE

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Basic understanding of SAM, and the SAM blocks used in the project.

Completion of Crazy Cars! Part 1.



KEY STAGE

Key Stage 2



OUTCOMES

- To cement an understanding of the previous project.
- To build on the previous project and extend programming capabilities.

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- To create programs to control a buggy and enhance "game play".
- Practice teamwork and collaborate to navigate through problems.

- Reflect on and review the process, the product and that of their peers.



LEARNING OBJECTIVES

See Curriculum Alignment (next page).



GROUP SIZE

2-3 students

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TIME REQUIRED

NB: This is Part 2 of a 2-part project. One flows into the other, but they can be taught as separate entities. Timings are approximate, depending on the time needed to be given to each stage, and the experience of the students.

Suggestion for a 1 hour session:

Introduction to concept - 5 minutes. Activity Stages - 50 minutes. Reflection and Plenary - 5 minutes.



MATERIALS REQUIRED

- Computer or Tablet
- SAM Space Education app
- 1 SAM Tray
- Boxes or blocks to create a 'maze' or course to drive through

The students may use Other SAMs if needed in their projects.

Curriculum alignment

NATIONAL CURRICULUM STANDARDS

Computing - Key Stage 2

- Design, write and debug programs that accomplish specific goals, including controlling or simulating physical systems; solve problems by decomposing them into smaller parts.
- Use sequence, selection, and repetition in programs; work with variables and various forms of input and output.
- Use technology safely, respectfully and responsibly; recognise acceptable/ unacceptable behaviour; identify a range of ways to report concerns about content and contact.

https://www.gov.uk/government/ publications/national-curriculum-in-englandcomputing-programmes-of-study

Design & Technology - Key Stage 2

Design

- Use research and develop design criteria to inform the design of innovative, functional, appealing products that are fit for purpose, aimed at particular individuals or groups.

Technical Knowledge

- Understand and use electrical systems in their products (for example, series circuits incorporating switches, bulbs, buzzers and motors).
- Apply their understanding of computing to program, monitor and control their products.

https://www.gov.uk/government/publications/ national-curriculum-in-england-design-andtechnology-programmes-of-study

PROGRESSION PATHWAYS / COMPUTATIONAL THINKING CONCEPT

Programing and development

- Creates programs that implement algorithms to achieve given goals. (AL)
- Uses post-tested loop e.g. 'until', and a sequence of selection statements in programs, including an if, then and else statement. (AL)

Hardware and Processing

 Knows that computers collect data from various input devices, including sensors and application software (AB)

Computational Thinking Concept: AB = Abstraction; DE = Decomposition; AL = Algorithmic Thinking; EV = Evaluation; GE = Generalisation

https://community.computingatschool.org. uk/resources/2324



BEFORE THE CLASS

During this project, students will use the buggies and remote control systems from the previous project. They will take part in two competitions to drive their buggies around a course.

For each, students will need to create new programs and functional systems to make the competitions fair and exciting!

They will need to try and test their builds and programs to make sure they work in the way they want them to, thereby developing computational thinking.

Below is an example solution to the final challenge.





02 BEFORE THE CLASS Final checklist

The following contains everything you need to prepare your SAM Labs environment before commencing the project. Please ensure you read each section carefully to ensure you have a problem free lesson.

DOWNLOAD THE APP

You can download the SAM Education app for OSX or Windows at **https://www.samlabs.com/app**.

SAM LOG IN

Create a SAM account if you don't already have one. SAM accounts are free and allow you to save your inventions to the cloud and download and modify them later, you can even share them with others.

CHARGE YOUR SAM BLOCKS

Even though the blocks can be used while tethered, they were designed as rechargeable devices that can be used a fair way away from your system or where they can't be plugged in. You can tell they are fully charged when they change colour from red to green.

Handy Tip: you can click on a block in the SAM space to see how much charge is left.

ADDITIONAL RESOURCES

For SAM support https://www.samlabs.com/support.

03

during the class **Activity stages**

ACTIVITY 1 (MAIN ACTIVITY)

During this activity, students will need to modify their buggies to include a Button which is depressed when the buggies drive into an object. This button will be housed on the front of the car.

Students will then work with other groups to design a 'time penalty' system for when they race around their course.

Recap on the previous project (Crazy Cars! Part 1). If other students have been using the resources then the class will need to rebuild and program their remote control buggies again.

Get the students to do this and to make sure that their remote controls and their programs are working as they should.

Tell the students that during the course of this session, they will need to adapt the design of their buggies, so that if they drive into an obstacle, 'something' will happen.

Get the students to work in their small groups to attach a Light Sensor to the front of their buggies. This may mean some re-designing or re-thinking of their buggies. A fun extra is to attach the LED block from their tray to the buggy.

Q: What block should you add to your buggy so something happens when you run into an obstacle?

3

The next stage is for the students to create a program which:

- Responds to the input (the Light Sensor)
- Produces an output (possibilities include sound and light)
- Registers how many times their buggy collides with an obstacle.

Give the students time to experiment and come up with a solution that works for them.

Q: What input are you going to use for your buggy?

Q: What output?

Q: How will you register how many times you collide with an obstacle?

Have them try it out by driving their buggies into an obstacle.

In the example below, when the light sensor collides with an obstacle, a sound is played sounds, the RGB LED illuminates red, and the Counter indicates how many times the Button has been activated.



The next stage is for two groups to work together to design and build a small course to drive their buggies around (examples might be a maze-type design or an obstacle course). Give the students access to the blocks / boxes you have collected.

Q: What is your course going to look like?

NB: They will need to ensure there is enough room for their buggies to drive through / around the course, and make it achievable, yet challenging.



Finally, the teams take turns driving around the courses.

Ask the teams to time how long it takes their opposing team to complete the course. Each time they collide with an obstacle, and it is registered on the Counter, they must incur a time penalty.

Q: What is the time penalty?

Q: What time did you get around the course?

They could have several attempts each, taking turns, and then calculate the average time.



DURING THE CLASS Extension activity

ACTIVITY 2

Tell the students that their next challenge will be to create a system and program which will indicate when their buggy crosses the finish line. This will create a fairer test.

- Q: Which SAM Blocks should you use for sensing the crossing of the line?
- Q: Why is an indicator on the finish line a good idea?
- Q: Can you think of any situations outside the classroom where this is used?

(Examples might include athletics races, goal-line technology etc).

Send the students to experiment with creating a system and a program that fulfills the design brief. Note that the students will need to remove their collision detection system to reuse the Light Sensor block!

Q: What SAMs are you going to use for your experiment?

Get them to record all their findings before they settle on the one that they are happy with.

The example below uses the Light Sensor (configured as a Light Sensor rather than as a buton) with a filter to play a sound. The Light Sensor should be positioned such that a car driving past puts it in shadow. The function of the Filter block is to decide what light level indicates a car driving over the finish line. You will need to experiment to find the correct level for your classroom.



Q: Could this be expanded further?

As a further extension, students could incorporate the camera into their programs so that the buggies are captured crossing the finish line. This could then be tweeted to the school Twitter account, as shown in the example below.



RECORDING THEIR WORK

As well as their work books, this could be done through photographs and video and built into an ebook.





Hands On Buzzers!

COMPUTER SCIENCE DESIGN & TECHNOLOGY

education@samlabs.com samlabs.com/education

Key information



SUBJECTS

Computing, Design & Technology, Subject of Choice.

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KEY STAGE

Key Stage 2



OUTCOMES

- To create a system that measures reaction times in a variety of ways.
- Practice teamwork and collaborate to navigate through problems.
- Reflect on and review the process, the product and that of their peers.



LEARNING OBJECTIVES

See Curriculum Alignment (next page).



RECOMMENDED PRIOR KNOWLEDGE

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Basic understanding of SAM, and the SAM blocks used in the project.



GROUP SIZE

3 students



TIME REQUIRED

Suggestion for a 1 hour session:

Introduction to concept - 5 minutes. Activity Stages - 40-50 minutes. Extension activity - 10 minutes. Reflection and Plenary - 5 minutes.



MATERIALS REQUIRED

- Computer or Tablet
- SAM Space Education app
- 1 SAM Tray
- Any other SAMs the students may need

You may want to have the students build quiz show style buzzers that will depress the SAM Buttons. For SAM support: https://www.samlabs.com/support

Curriculum alignment

NATIONAL CURRICULUM STANDARDS

Computing - Key Stage 2

- Design, write and debug programs that accomplish specific goals, including controlling or simulating physical systems; solve problems by decomposing them into smaller parts.
- Use sequence, selection, and repetition in programs; work with variables and various forms of input and output.
- Use technology safely, respectfully and responsibly; recognise acceptable/ unacceptable behaviour; identify a range of ways to report concerns about content and contact.

https://www.gov.uk/government/ publications/national-curriculum-in-englandcomputing-programmes-of-study

Design & Technology - Key Stage 2

Technical Knowledge

- Understand and use electrical systems in their products (for example, series circuits incorporating switches, bulbs, buzzers and motors).
- Apply their understanding of computing to program, monitor and control their products.

https://www.gov.uk/government/ publications/national-curriculum-in-englanddesign-and-technology-programmesof-study

PROGRESSION PATHWAYS / COMPUTATIONAL THINKING CONCEPT

Programing and development

- Creates programs that implement algorithms to achieve given goals. (AL)
- Uses post-tested loop e.g. 'until', and a sequence of selection statements in programs, including an if, then and else statement. (AL)

Hardware and Processing

 Knows that computers collect data from various input devices, including sensors and application software (AB)

Computational Thinking Concept: AB = Abstraction; DE = Decomposition; AL = Algorithmic Thinking; EV = Evaluation; GE = Generalisation

https://community.computingatschool.org. uk/resources/2324



BEFORE THE CLASS

During this project, students will explore the features of a range of SAM blocks in order to create and program a reaction timer.

They will work together to discover how best to configure and program the blocks through a series of short activities, building up their understanding before completing a challenge.

They will create their own reaction-timing game which can be used in quizzes, etc.

Below is an example solution to the extension activity. This will be explained in the documentation.





02 BEFORE THE CLASS Final checklist

The following contains everything you need to prepare your SAM Labs environment before commencing the project. Please ensure you read each section carefully to ensure you have a problem free lesson.

DOWNLOAD THE APP

You can download the SAM Education app for OSX or Windows at **https://www.samlabs.com/app**.

SAM LOG IN

Create a SAM account if you don't already have one. SAM accounts are free and allow you to save your inventions to the cloud and download and modify them later, you can even share them with others.

CHARGE YOUR SAM BLOCKS

Even though the blocks can be used while tethered, they were designed as rechargeable devices that can be used a fair way away from your system or where they can't be plugged in. You can tell they are fully charged when they change colour from red to green.

Handy Tip: you can click on a block in the SAM space to see how much charge is left.

ADDITIONAL RESOURCES

For SAM support https://www.samlabs.com/support.

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during the class Activity stages

Tell the students that during this project they will explore how fast they can react to something, and that they will create and program a system that tests reaction time.

Q: What situation/s would you need to react or respond quickly to, for example, a question or other stimulus?

Q: What situations might you find yourself in where your reactions need to be quick?

NB: Draw out situations such as: putting their hands up to answer a quiz question in class, buzzing in on a game show to answer a question (you might have some examples of this from YouTube (or similar)), Pulling away from, or stopping at, traffic lights, athletes responding to a starting pistol etc.

Tell the students that they will create several small programs that will explore how they can use SAM Labs to test reaction times, and that these will build up to a final challenge. Remind them that, although you will be giving them some ideas, they will be free to create systems that suit them. Show the students the example below (or similar).



This example uses two inputs - the Light Sensor (set to "button" mode - see "Tips and Tricks", later) and a Button (as a virtual button). Using the Colour block, we can use the inputs to set the LED to two different colours: covering the light sensor will turn it green, while pressing the Button will turn it red.

Send the students off in groups of three. Ask them to create a program similar to the one you have shown them and make sure it works.

Q: Record your work through a photograph / screenshot / drawings. Why did you settle on your program?

Have the students create a small game. The aim of the game is to see who can press their button the fastest.

The example you've already shown them would work, but challenge them to add something extra: a more exciting notification of when each button is pressed, perhaps.

Now, have them analyse their game.

Q: What worked well with your game?

Q: What might work better?

Q: What other SAM Blocks could you include to make it better, or easier to know who won?

In the example below, each input (lght sensor and button) will produce two different outputs - a light and a sound (using the Buzzer). The children can then tell who won by which note starts playing first.

The children can drop a "sleeping" buzzer into their project, and the sound will play through the device's speaker. Alternatively, you can attach a physical Buzzer block if you have one.

The light sensor will change the light to blue and produce a low note. The Button will change the light to red and produce a high note. Encourage the students to experiment with their own solutions.





DURING THE CLASS **Extension activity**

Tell the students that they are going to introduce some more programming into their systems so that the game is more competitive.

One player presses the virtual button, and the second player has to cover the light sensor as faste as possible. The system will time their reaction speed! Get the students to try to put together the example below. Tell them that this is a fairly simple way to show them how we might use other SAM blocks to time reaction speed.



In this example, the button sets the RGB LED to blue. At the same time it starts the Counter (the counting units are set by double clicking the Interval Block and setting it to 10ms). This example also uses a Toggle block to make sure that once the button has been pressed, the timer stays on. The light sensor will change the RGB LED to red, and also stop the timer! The timer above, reading 027, tell us that it took 2.7seconds from the RGB LED turning blue until the light sensor was pressed.

Send the students to experiment with this example and to create a system that works for them.

Record your work through a photograph / screenshot / drawings.

Q: Why did you settle on your program?

Q: Did you need the Toggle?

Q: What happens if you do not use it?

Q: Can they experiment with different time intervals?

Q: How does that affect the output?

FINAL CHALLENGE

For the final challenge, reintroduce the sounds from the earlier example. Another fun thing to do is to make a spinny-buzzer (see Tips and Tricks) and use it to signal when a button has been pressed - the buzzer could spin around while the counter is counting!



RECORDING THEIR WORK

Video / photograph / ebooks stored on Microsoft Classroom (or similar).

Encourage the students to create their own solution to the task and to try them out.

What worked well? What could be improved? Who has the fastest reactions?

Q: Could this be expanded further?

The reaction timers could be used in class quizzes. The students could devise their own series of questions based on a current class topic.

Work can be photographed or videoed and uploaded to Microsoft Classroom (or similar).





How fast?

COMPUTER SCIENCE MATHEMATICS

education@samlabs.com samlabs.com/education

Key information



SUBJECTS

Computing, Mathematics.

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RECOMMENDED PRIOR KNOWLEDGE

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Basic understanding of SAM, and the SAM blocks used in the project.

An understanding of how to calculate speed (distance \div time).

NB: Not essential, as this can be covered during the session.

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KEY STAGE

Key Stage 2



LEARNING OBJECTIVES

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See Curriculum Alignment (next page).

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GROUP SIZE

2-3 students

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TIME REQUIRED

Suggestion for a 1 hour session:

Introduction to concept - 5 minutes. Activity Stages - 40 minutes. Extension activity - 10 minutes. Reflection and Plenary - 5 minutes.

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OUTCOMES

- Set up systems to measure speed using SAM Labs.
- Assess the effectiveness of their systems and decide on the best solution.
- Calculate speed using a known formula.
- Practice teamwork and collaborate to navigate through problems.
- Reflect on and review the process, their product and that of their peers.



MATERIALS REQUIRED

- SAM Chassis
- SAM DC Motors x2
- SAM DC Button x2
- Wheels x2
- Measuring tape
- Something to mark the floor with (chalk / tape, etc)

- Stopwatches (one per group)

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Curriculum alignment

NATIONAL CURRICULUM STANDARDS

Computing - Key Stage 2

- Design, write and debug programs that accomplish specific goals, including controlling or simulating physical systems; solve problems by decomposing them into smaller parts.
- Use sequence, selection, and repetition in programs; work with variables and various forms of input and output.
- Select, use and combine a variety of software (including internet services) on a range of digital devices to design and create a range of programs, systems and content that accomplish given goals, including collecting, analysing, evaluating and presenting data and information.
- Use technology safely, respectfully and responsibly; recognise acceptable/ unacceptable behaviour; identify a range of ways to report concerns about content and contact.

https://www.gov.uk/government/ publications/national-curriculum-in-englandcomputing-programmes-of-study

Design & Technology - Key Stage 2

Number - Multiplication and Division

- Solve problems involving addition, subtraction, multiplication and division and a combination of these, including understanding the meaning of the equals sign.
- Solve problems involving multiplication and division, including scaling by simple fractions and problems involving simple rates.

Algebra

- Pupils should be introduced to the use of symbols and letters to represent variables and unknowns in mathematical situations that they already understand, such as: formulae in mathematics and science.

Measurement

- Solve problems involving the calculation and conversion of units of measure, using decimal notation up to three decimal places where appropriate.

NB: The calculation for speed (Speed = Distance ÷ Time) is a requirement of Key Stage 3 Physics, but can be covered in Upper KS2 according to the statements of the National Curriculum (above): speed and the quantitative relationship between average speed, distance and time (speed = distance ÷ time).

Curriculum alignment

PROGRESSION PATHWAYS / COMPUTATIONAL THINKING CONCEPT

Algorithms

- Understands that algorithms are implemented on digital devices as programs.(AL)
- Designs simple algorithms using loops, and selection i.e. if statements. (AL)

Programing and development

- Uses arithmetic operators, if statements, and loops, within programs. (AL)
- Detects and corrects simple semantic errors i.e. debugging, in programs. (AL)

Hardware and Processing

- Recognises and can use a range of input and output devices.

Information Technology

- Uses technology with increasing independence to purposefully organise digital content. (AB)
- Uses a variety of software to manipulate and present digital content: data and information. (AL)
- Shares their experiences of technology in school and beyond the classroom. (GE) (EV)
- Talks about their work and makes improvements to solutions based on feedback received. (EV)

Computational Thinking Concept: AB = Abstraction; DE = Decomposition; AL = Algorithmic Thinking; EV = Evaluation; GE = Generalisation.

https://community.computingatschool.org. uk/resources/2324



BEFORE THE CLASS

During this project, students will build a simple car using the chassis and DC motors.

They will work together to develop their mathematical understanding by measuring the speed of their cars using the calculation Speed = Distance \div Time.

They will use SAM Space to create the most efficient program for their cars.





02 BEFORE THE CLASS Final checklist

The following contains everything you need to prepare your SAM Labs environment before commencing the project. Please ensure you read each section carefully to ensure you have a problem free lesson.

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SAM LOG IN

Create a SAM account if you don't already have one. SAM accounts are free and allow you to save your inventions to the cloud and download and modify them later, you can even share them with others.

CHARGE YOUR SAM BLOCKS

Even though the blocks can be used while tethered, they were designed as rechargeable devices that can be used a fair way away from your system or where they can't be plugged in. You can tell they are fully charged when they change colour from red to green.

Handy Tip: you can click on a block in the SAM space to see how much charge is left.

ADDITIONAL RESOURCES

For SAM support https://www.samlabs.com/support.

03

during the class Activity stages

Tell the students that during this session they will make a car using SAM and use a combination of programming and mathematics to work out how fast their cars go.



Q: What devices are used to measure how fast something is moving?

Draw out examples such as speed cameras on roads and systems used in sporting events such as Formula 1.



Play the students a video clip of Usain Bolt running in the 100m.

Q: How fast do you think Bolt ran the 100m?

Tell the students that by using a simple calculation, we can work out exactly how many meters per second he ran.

Perform the calculation as a class, using the formula SPEED = 100m / TIME



5

Send the students away in small groups and give them a few minutes to find 2 or 3 other 100m races and calculate the speed of the winning athlete. This will get them used to performing the calculation. **NB: They may need to use calculators.**

Ask the students, in their groups, to build a simple car using the SAM chassis, 2 DC motors and 2 wheels. Give them a further criteria for their programming: the cars will need to be started by the use of a virtual button in the app (see the Tips and Tricks section later for how to do this).

An example programming solution is below.


When the button is pressed and held down, the DC motors will turn.

Have the students ensure that one of the motors is rotating in the opposite direction to the other (double click on the Motor block). This will ensure the cars travel in a straight line.

An alternative solution is shown below, using the Toggle to keep the motors on. When the button is pressed and released, the motors will turn on. When it is pressed again, they will stop.



When the students are happy with their builds and solutions (they may have a different one to the examples above!), gather them together.

In a good-sized space, measure out a set distance on the floor (eg 5m, 10m etc). Tell the students that, just like in the 100, they will use a set distance and time how long it takes for their cars to cross the finish line. Taking those 2 readings, they will be able to work out if their cars are faster than Usain Bolt!

Get the students to perform the test and calculate the speed of their cars. Ask them to perform the test a few times and take an average.

Now they know the formula for working out speed (SPEED = DISTANCE / TIME) they can calculate how fast your car went! **NB: Don't forget that the unit of speed will be Meters per Second (m/s).**

- Q: What speed did your car go?
- Q: Is taking one reading a good thing?
- Q: What variables are there (mistakes that could be made)?

Perform the test again two or three more times and work out the average speed of your car.

Tell the students that for the next round of testing, they will need to change their programs to make their cars run for a set amount of time.

Q: What is a sensible time to run your car for?

For this test, students will run their cars for a set time (5s, 10sec etc), and they will then need to measure how far the cars travelled. From this data they can calculate the speed.

Again, ask them to take several readings and calculate the average speed.

Q: What was the average speed of your car?

The example program below uses the Hold block to turn the motors on for a set amount of time.

INPUTS	CONNECTIONS	OUTPUTS
BUTTON	THOLD	DC MOTOR
	· ·	

9 Ask the students to compare the 2 different ways of calculating speed.

Q: Which was your favourite way of calculating speed?

Q: Why?



DURING THE CLASS Extension activity

Students could extend their programming so that SAM Space counts how long the motors run for before being stopped. **NB: they would need a set distance to travel.**

Ask the students to reprogram their cars so that the programs include a counter.

Q: Does including a counter make a difference?

Q: Is it a better solution, or do you prefer using a stopwatch?

An example solution is given below:



Q: Could this be expanded further?

RECORDING THEIR WORK

Cameras and video cameras would be very useful here. Students could record their cars traveling, take screenshots of programming solutions and photographs of their calculations and use this as evidence of learning.



Light-chasing Robot

COMPUTER SCIENCE DESIGN & TECHNOLOGY

LABS

education@samlabs.com samlabs.com/education

Key information



SUBJECTS

Computing, Design & Technology.



RECOMMENDED PRIOR KNOWLEDGE

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Basic understanding of SAM, and the SAM Blocks used in the project.

An understanding of sensors (particularly light sensors) and how they might be used in the real world.

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KEY STAGE

Key Stage 2



OUTCOMES

- Create a vehicle that responds to light and follows a bright source.

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- Explore the applied use of SAM Light Sensors to control motors, creating a vehicle capable of tracking a light source.
- Practise teamwork and collaborate to navigate through problems.
- Reflect on and review the process, their product and that of their peers.

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LEARNING OBJECTIVES

See Curriculum Alignment (next page).



GROUP SIZE

2-3 students

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TIME REQUIRED

NB: This project may go over two sessions, depending on the time needed to be given to each stage, and the experience of the students.

Suggestion for a 1 hour session:

Introduction to concept - 5 minutes. Activity Stages - 40 minutes. Extension activity - 10 minutes. Reflection and Plenary - 5 minutes.



MATERIALS REQUIRED

- Computer or Tablet
- SAM Space Education app
- SAM group tray from a SAM kit
- A bright (LED) flashlight
- Alphabet for each group, sturdy card, elastic bands, double-sided tape.

 Books about secret codes, examples of coded messages.

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Curriculum alignment

NATIONAL CURRICULUM STANDARDS

Computing - Key Stage 2

- Design, write and debug programs that accomplish specific goals, including controlling or simulating physical systems; solve problems by decomposing them into smaller parts.
- Use sequence, selection, and repetition in programs; work with variables and various forms of input and output.
- Use technology safely, respectfully and responsibly; recognise acceptable/ unacceptable behaviour; identify a range of ways to report concerns about content and contact.

https://www.gov.uk/government/ publications/national-curriculum-in-englandcomputing-programmes-of-study

Design & Technology - Key Stage 2

Design

- Use research and develop design criteria to inform the design of innovative, functional, appealing products that are fit for purpose, aimed at particular individuals or groups.

Make

 Select from and use a wider range of materials and components, including construction materials, textiles and ingredients, according to their functional properties and aesthetic qualities.

Technical Knowledge

- Understand and use electrical systems in their products (for example, series circuits incorporating switches, bulbs, buzzers and motors).
- Apply their understanding of computing to program, monitor and control their products.

https://www.gov.uk/government/ publications/national-curriculum-in-englanddesign-and-technology-programmesof-study.

Curriculum alignment

PROGRESSION PATHWAYS / COMPUTATIONAL THINKING CONCEPT

Programing and development

- Creates programs that implement algorithms to achieve given goals. (AL)
- Uses post-tested loop e.g. 'until', and a sequence of selection statements in programs, including an if, then and else statement. (AL)

Hardware and Processing

 Knows that computers collect data from various input devices, including sensors and application software (AB)

Computational Thinking Concept: AB = Abstraction; DE = Decomposition; AL = Algorithmic Thinking; EV = Evaluation; GE = Generalisation.

https://community.computingatschool.org. uk/resources/2324



BEFORE THE CLASS

During this project, students will build and control a robot buggy that follows a light source.

They will understand that the brighter the light source, the faster their motors will go.

They will understand the function of the Filter, and learn how to configure their models so that they behave as the students want them to.

They will work together to discover how best to configure and program the blocks through a series of short activities.

Below is an example solution to the final challenge.

Note that this full solution requires two light sensors, so you may need to join class groups together for the final challenge so that they can pool the contents of their trays!





02 BEFORE THE CLASS Final checklist

The following contains everything you need to prepare your SAM Labs environment before commencing the project. Please ensure you read each section carefully to ensure you have a problem free lesson.

DOWNLOAD THE APP

You can download the SAM Education app for OSX or Windows at https://www.samlabs.com/app.

SAM LOG IN

Create a SAM account if you don't already have one. SAM accounts are free and allow you to save your inventions to the cloud and download and modify them later, you can even share them with others.

CHARGE YOUR SAM BLOCKS

Even though the blocks can be used while tethered, they were designed as rechargeable devices that can be used a fair way away from your system or where they can't be plugged in. You can tell they are fully charged when they change colour from red to green.

Handy Tip: you can click on a block in the SAM space to see how much charge is left.

ADDITIONAL RESOURCES

For SAM support https://www.samlabs.com/support.

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during the class Activity stages

Discuss with students their understanding of light sensors.

Q: What examples can you think of that react to changes in light, or are dependent on changes in light conditions?

One example here is street lights (which illuminate when the ambient light drops below a set parameter).

Tell the students that during this project they will build and program a robot car / buggy which uses light sensors to drive. Their cars will follow a bright light, and this is how they will control their builds.

Show the students an example of a pre-built car using 2 DC Motors, a light sensor and the SAM chassis. See example below:



Challenge the students to build a program that will make the car drive forward when they shine a light on the light sensor. The following is a sample solution:



(4)

Q: Why do we need to use the Filter block?

With a lot of ambient light in the classroom, the light sensor might already be sensing enough light to start driving on its own. In this case, you want to set the filter's lower value to a number a bit higher than the ambient number, so that the car only starts driving when you shine a torch on the sensor.

Q: Why do you think your wheels might react differently to your teachers?

The ambient light levels will change all over the classroom; this may require you to adjust the configuration of the filters. A good exercise is to have the students run their cars both filtered and unfiltered, and compare the behaviour of them.

Have the students adjust their filter blocks such that the car only drives forward when they shine a light on the sensors.

Note that this activity works best in a darker environment - you could turn the classroom lights off.

Have the students "lead" their car forward by shining a light on the sensor.

(5)

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Q: If the car spins in a circle, what will you need to configure on the motors so that they drive the car in a straight line instead?

The students adjust the behaviour of the motors by setting their speed and direction in the motor block's configuration window.

HAVE A RACE! When the students have built their buggies and got them driving well, have them 'race' each other in the corridor or other open space. Get them to analyse their buggies and programs.

Q: How could you improve the speed and / or accuracy of your buggy?

In order to gain more control over the buggies, we could add a second light sensor. This will enable steering, and give us greater control over motor speed.

NB: There is only one Light Sensor in each SAM tray. Groups may need to join toghether to use a second Light Sensor.

Suggest adding a second light sensor, and explain how having each motor controlled by a light sensor would make the car steer towards the light source.



This is a solution that works; the program is on the next page.



Students will need to use another block to attach the controller to the chassis.

This program ensures that each light sensor controls one motor, meaning that the closer the light source is to one sensor (and the further away from the other), the faster that motor will spin (and the slower the other one will spin).

Send the students to add to their builds and to experiment with their programs so that they can 'steer' their buggies with their torches.

IDEA FOR A WHOLE CLASS CHALLENGE:

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Q: Can they steer their buggies succesfully around a maze taped out on the floor?



DURING THE CLASS **Extension activity**

If some groups complete the task, they can be challenged further.

CHALLENGE:

Q: What could you add to your buggy, that would sound an alarm if you crashed into something?

The solution below shows a Button mounted at the front of the buggy, and the program will play a sound when the sensor is activated.





Q: Could this be expanded further?

RECORDING THEIR WORK

Video / photograph / ebooks stored on Microsoft Classroom (or similar).



What do you need to know?

Ensure that you have set up and properly configured your program before demonstrating to the students.

Or, you might know what the parameters of the Filter block should be, and set these during the discussion.





Logical Thinking

COMPUTER SCIENCE

education@samlabs.com www.samlabs.com

Key information



SUBJECTS

Computing.



RECOMMENDED PRIOR KNOWLEDGE

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Basic understanding of SAM, and the SAM blocks used in the project. An understanding of basic Boolean Logic.

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KEY STAGE

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Key Stage 3



OUTCOMES

- To build a camera with logic based controls.

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- Understand AND and OR logic.
- Practice teamwork and collaborate to navigate through problems.
- Reflect on and review the process, their product and that of their peers.

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LEARNING OBJECTIVES

See Curriculum Alignment (next page).



GROUP SIZE

2-3 students

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TIME REQUIRED

NB: This project may go over two sessions, depending on the time needed to be given to each stage, and the experience of the students.

Suggestion for a 1 hour session:

Introduction to concept - 5 minutes. Activity Stages - 40 minutes. Extension activity - 10 minutes. Reflection and Plenary - 5 minutes.



MATERIALS REQUIRED

- SAM Space Education app
- 1 SAM Tray

Curriculum alignment

NATIONAL CURRICULUM STANDARDS

Computing - Key Stage 3

- Design, use and evaluate computational abstractions that model the state and behaviour of real-world problems and physical systems.
- Understand several key algorithms that reflect computational thinking [for example, ones for sorting and searching]; use logical reasoning to compare the utility of alternative algorithms for the same problem.
- Understand simple Boolean logic [for example, AND, OR and NOT] and some of its uses in circuits and programming; understand how numbers can be represented in binary, and be able to carry out simple operations on binary numbers [for example, binary addition, and conversion between binary and decimal].
- Understand a range of ways to use technology safely, respectfully, responsibly and securely, including protecting their online identity and privacy; recognise inappropriate content, contact and conduct and know how to report concerns.

https://www.gov.uk/government/ publications/national-curriculum-in-englandcomputing-programmes-of-study



BEFORE THE CLASS

This lesson focusses on the core processes behind Boolean logic, and students will develop an understanding of the AND and OR processes. The students will build a system in the SAM Space that will make use of these processes to help control a camera. The camera will be developed by the students further as they explore the various SAM blocks.

The initial camera will involve a light sensor that will illuminate the RGB LED block when it measures that there is sufficient light to take a picture, and then the button can be pressed to take the photo. If there is not enough light, the RGB LED will not illuminate so the button will not work and no photo will be taken.

At this stage, the camera in the SAM Space may look like this:



However, this is only the first stage and the students can develop and build on this starting point design.

Please ensure that the hardware blocks are charged and paired to the computer before starting this lesson.



02 BEFORE THE CLASS Final checklist

The following contains everything you need to prepare your SAM Labs environment before commencing the project. Please ensure you read each section carefully to ensure you have a problem free lesson.

DOWNLOAD THE APP

You can download the SAM Education app for OSX or Windows at **https://www.samlabs.com/app**.

SAM LOG IN

Create a SAM account if you don't already have one. SAM accounts are free and allow you to save your inventions to the cloud and download and modify them later, you can even share them with others.

CHARGE YOUR SAM BLOCKS

Even though the blocks can be used while tethered, they were designed as rechargeable devices that can be used a fair way away from your system or where they can't be plugged in. You can tell they are fully charged when they change colour from red to green.

Handy Tip: you can click on a block in the SAM space to see how much charge is left.

ADDITIONAL RESOURCES

For SAM support https://www.samlabs.com/support.

03

during the class Activity stages

Introduce the plan for the project, and tell the students that we will explore some aspects of Boolean Logic to help us create a camera system. The initial camera will assess the ambient light levels, and if there is enough light, it will illuminate an LED to tell us that the system is able to take a photograph by pressing a virtual button in the app.

Q: Why is a camera that monitors the light levels useful?

Q: What blocks might we need to use to achieve this?

Ask the students to explore the following blocks and to try and create their own design in the SAM Space to create a camera with these features:

- Light sensor
- RGB LED
- Button (a virtual one in the app see the "tips and tricks" section at the end for more info).
- Comparison
- Camera
- They can use the supplied red chassis for holding their light and light sensor blocks.

Q: Why are we using a comparison block?

Explain that the comparison block can be used so that the light goes on when the light level is high enough.

Q: Why are we using an AND block?

The AND block will send a "true" value only when all of its input values are "true". That is, it only tells the camera to take the picture when the light level is correct AND the button is being pressed.

The solution may look something like this:



Here the light sensor is detecting an ambient light level of '48', and the comparison is set to trigger the light when the sensor senses a light level greater than '30'. Are these the best settings for the filter?

Q: Does the camera work as expected, and the RGB LED come on when you increase the ambient light allowing you to take a photograph?

Now we want to expand the camera to make the notification from the RGB LED more useful to the user. Currently the RGB LED illuminates white when there is enough ambient light to take photograph.

Q: How could we make this notification more user friendly?

Q: Could we change the colour?

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Suggest that we could create a design where the RGB LED is illuminated red when there is not enough available light, but turns green when there is enough light. Allow the students to explore this. There are many solutions, using either a second filter block and two colour blocks, or possibly two comparison blocks with two colour blocks. A possible solution to this problem is:



Here we have two comparison blocks set to different comparisons. When the light level is low (between a range of 0 and 30) the lower comparison works, triggering the red color block to set the LED's colour to red.

When the light level is higher (greater than 30) the green block is triggered to set the LED colour.

Q: In this example here, are these the best values?

Q: What happens when the ambient light level is exactly 30?

Q: Is there a way to disable the camera if the light level gets too high? What would be the purpose of this?

To ensure that the photo can only be taken when the light levels are high enough (i.e. the RGB LED is illuminated green), we need the system to only take a picture when the button is pressed AND the light level matches the green-connected filter. As the red-connected filter is not connected, no photo can be taken when the light level is low.

Now we can expand this camera to include an OR block, which will give the children the ability to override the light-sensing functionality. Ask the students to think about including an override button so that the photo will be taken if the light is bright enough OR if the override button is pressed. To do this, we will include another virtual button as well as introducing an OR block.

The solution may look like:



Q: Under what circumstancdes would we want to override the brightness sensing?

Q: Can you think of other systems where we occasionally need to override built-in safeguards?

The OR block here allows the "is it bright enough?" signal to come either from the light sensor and its "green" comparison, or from the override button being pressed.

Note that this solution with two virtual buttons will work on tablets where you can press both buttons simultaneously. For desktop-style computers, you may need to use a physical button block from either the Classroom or Team kits.

Ask the students to work on fine tuning and expanding the camera setup.

Q: Can you fine tune the filter settings to improve the camera performance?

Q: What do you want to do with the photographs that are being taken?

You should find the photos in your Android or iOS device's gallery. In the desktop versions of SAM Space, the images will be in the Pictures folder of the logged-in user's profile.

Q: Could you add a Twitter block to automatically tweet the photos that you take?

Q: Why might this be useful?

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Q: Why might this be dangerous?



DURING THE CLASS **Extension activity**

Q: How can we expand the camera system further?

Q: Are there any other features that we can integrate into the camera?

Suggest that the students could look at adding the Sound Player block so that an audio file (music or a voice message) is played when a photograph is taken.

Q: How could the Sound Player block be used?

Q: Could two sound player blocks and filters be used instead of, or alongside, the RGB LED to give audible guidance on the light levels?

Ask the students to present their additions to the group for peer review.

Q: Could this be expanded further?

There are three other logic blocks available in the SAM Space, NAND, NOR and XOR.

Q: Could these be plugged into the camera in place of the AND and OR block?

Q: What would that do?

REAL-WORLD APPLICATIONS

Using Boolean Logic has many real world applications, especially within the fields of product design. It will determine how many devices work, and is a key part of how user friendly devices and software is.

RECORDING THEIR WORK

Ensure the students have completed their student packs, recording their thoughts and solutions.

Other options: Create an e-book / poster / video, etc. to explain what they have done.



Morse Code Magic

LABS

COMPUTER SCIENCE DESIGN & TECHNOLOGY MATHEMATICS HISTORY

education@samlabs.com www.samlabs.com

Key information



SUBJECTS

Computing, Science, Design & Technology, Mathematics, History.



KEY STAGE

Key Stage 2



OUTCOMES

- To learn about alternative forms of communication (Morse Code).
- Practice teamwork and collaborate to navigate through problems.
- Reflect on and review the process, the product and that of their peers.
- Invent SAM's Morse Code Torch.
- Learn how to make a Morse Code Machine using SAM Sace.
- Write and execute messages via the Morse Code Machine.



LEARNING OBJECTIVES

See Curriculum Alignment (next page).

RECOMMENDED PRIOR KNOWLEDGE

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Basic understanding of SAM, and the SAM blocks used in the project.

If studying World War 2 / Communications, knowing about Morse Code would be useful.

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GROUP SIZE

2-3 students

X

MATERIALS REQUIRED

- Computer or Tablet
- SAM Space Education app
- 1 SAM Tray
- Scissors, cardboard, coloured paper, glue
- SAM Space Education app.

You will need: A printout of the Morse Code alphabet for each group, sturdy card, elastic bands, double-sided tape. Books about secret codes, examples of coded messages.

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TIME REQUIRED

NB: This project may go over two sessions, depending on the time needed to be given to each stage, and the experience of the students.

Suggestion for a 1 hour session:

Introduction to concept - 5 minutes. Activity Stages - 40 - 50 minutes. Extension activity - 10 -20 minutes. Reflection and Plenary - 5 minutes.

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Curriculum alignment

NATIONAL CURRICULUM STANDARDS

Computing - Key Stage 2

- Design, write and debug programs that accomplish specific goals, including controlling or simulating physical systems; solve problems by decomposing them into smaller parts.
- Use sequence, selection, and repetition in programs; work with variables and various forms of input and output.
- Use technology safely, respectfully and responsibly; recognise acceptable/ unacceptable behaviour; identify a range of ways to report concerns about content and contact.

https://www.gov.uk/government/ publications/national-curriculum-in-englandcomputing-programmes-of-study

Design & Technology - Key Stage 2

Design

- Use research and develop design criteria to inform the design of innovative, functional, appealing products that are fit for purpose, aimed at particular individuals or groups.

Technical Knowledge

- Understand and use electrical systems in their products (for example, series circuits incorporating switches, bulbs, buzzers and motors).
- Apply their understanding of computing to program, monitor and control their products.

https://www.gov.uk/government/ publications/national-curriculum-in-englanddesign-and-technology-programmesof-study

Mathematics - Key Stage 2

Geometry

- Draw 2-D shapes and make 3-D shapes using modelling materials; recognise 3-D

https://www.gov.uk/government/ publications/national-curriculum-inengland-mathematics-programmesof-study

Science - Key Stage 2

Electricity

- Construct a simple series electrical circuit, identifying and naming its basic parts, including cells, wires, bulbs, switches and buzzers.
- Recognise that a switch opens and closes a circuit and associate this with whether or not a lamp lights in a simple series circuit.

https://www.gov.uk/government/ publications/national-curriculum-inengland-science-programmes-of-study

History - Key Stage 2

Beyond 1066 - themes

- A study of an aspect or theme in British history that extends pupils' chronological knowledge beyond 1066.

Curriculum alignment

PROGRESSION PATHWAYS / COMPUTATIONAL THINKING CONCEPT

Programing and development

- Creates programs that implement algorithms to achieve given goals. (AL)
- Declares and assigns variables. (AB)

Information Technology

- Uses technology with increasing independence to purposefully organise digital content. (AB)
- Shows an awareness for the quality of digital content collected (EV)

Hardware and Processing

- Knows that computers collect data from various input devices, including sensors and application software (AB)

Computational Thinking Concept: AB = Abstraction; DE = Decomposition; AL = Algorithmic Thinking; EV = Evaluation; GE = Generalisation.

https://community.computingatschool.org. uk/resources/2324

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BEFORE THE CLASS

Morse code revolutionised long-distance communication prior to inventions such as the telephone and emails. During this project, students will think about how technology can be used to develop solutions and create codes.

They will work together to discover how best to configure and program SAM blocks through a series of short activities, leading to a bigger challenge to create and program a Morse Code machine capable of sending messages in a variety of ways.



Below is an example solution to the final challenge.

WHAT DO YOU NEED TO KNOW?

Some online video clips which might be useful:

- How it Works: Morse Code:

https://www.youtube.com/watch?v=xsDk5_bktFo

- SOS with a torch:

https://www.youtube.com/watch?v=k8m8R4x0Mgk



02 BEFORE THE CLASS Final checklist

The following contains everything you need to prepare your SAM Labs environment before commencing the project. Please ensure you read each section carefully to ensure you have a problem free lesson.

DOWNLOAD THE APP

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SAM LOG IN

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CHARGE YOUR SAM BLOCKS

Even though the blocks can be used while tethered, they were designed as rechargeable devices that can be used a fair way away from your system or where they can't be plugged in. You can tell they are fully charged when they change colour from red to green.

Handy Tip: you can click on a block in the SAM space to see how much charge is left.

ADDITIONAL RESOURCES

For SAM support https://www.samlabs.com/support.

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during the class Activity stages

Have a discussion with the students about methods of communication.

Q: How do they communicate with their friends and family?

Draw out that before instant messaging, and in particular during war time, a coded messaging system was used called Morse Code. Give the students some background to this: (https://en.wikipedia.org/wiki/Morse_code)

It would be very useful here to show the students a video clip of Morse Code in action, or an actual Morse code machine.

Tell the students that during this project, they will make and program some Morse code machines of their own, and use them to send messages to each other.

Introduce the Light Sensor (in Button mode; see Tips and Tricks, later) and RGB LED SAMs. On SAM Space, remind the students how to connect them and show them how to choose a colour on the LED (Double click on the block in SAM Space and click on the colour required).

INPUTS	CONNECTIONS	OUTPUTS
LIGHT SENSOR		RGB LED
	•	•


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Send the students away in small groups and ask them to replicate what you have just demonstrated.

Q: Which colour works best?

Encourage them to see which colour works best. Ask the students to send messages to each other using the Morse Code alphabet as reference. Write the message you will send.

The 'message receiver' should write down what they think is being 'said' to them.

Bring the students back together and ask them how the messaging went. Was it easy or difficult to send and to understand the messages? Point out that during the war, those who performed this type of communication did so very quickly, as urgent messages often needed to be sent and received. They learned how to "read" morse like we have learned to read text.

Tell the students that, as well as using light, Morse code signals could also be transmitted using sound, and that instead of short and long bursts of light, a series of 'dots' and 'dashes' were used. Ask the students to adapt their programs and blocks to send Morse code using sound (Hint: They may use a Spinny Buzzer (see Tips and Tricks, later) here, or even BOTH a Spinny Buzzer and LED). Once this is complete, they should have a solution similar to one of the following.

Q: Which method do you prefer, and why?



Option 1: Buzzer output

Option 2: Buzzer and RGB Led output



7) NEXT STAGE - THE MORSE CODE MACHINE CHALLENGE

Tell the students that, through using modern technology like SAM Labs, we can send messages using Morse code without necessarily needing to know the alphabet off by heart!

Introduce the SAM Text block and the Morse Code Block. Drag them onto the SAM Space in between the Button and the LED and the BUZZER.



Demonstrate to the students how, by entering some text (Maybe type "Hello") into the Text box, which appears when you double click on the block, the Morse Code block converts it and then outputs the message to the LED.

TIP: You will need to keep the Button pressed until the whole message has gone through.

Ask the students what you might use so you can simply press the button, let it go and the message will still go through.

TIP: You will need to use the HOLD block, and adjust the time to accommodate the message length.

Send the children off and set the challenge: To build and program a Morse Code machine that will send a message. They will need to experiment with the HOLD command, and may choose to use light, sound or both as their output.

Q: What other blocks could you add? Record your final program.

Encourage them to experiment and try different solutions before settling on, and recording their final solution.

Example of a possible programming solution, using both sound and light and outputs.





DURING THE CLASS **Extension activity**

If some groups complete the task, they can be challenged further.

Using card and other construction materials, challenge the students to create a Morse Code "Torch".

Students could make a rectangular prism and mount the light at one end and the button on top in order to send messages. They could place the buzzer near their message recipient in order to have two ways of sending their message.

Encourage them to be as creative as possible and to change their programming to suit their creation.

Q: Could this be expanded further?

Mathematics and D&T could be further explored to find the best solution to house the Morse Code Machine. They could then be tested in a variety of conditions.

Students could record their work using photographs, screenshots and video and upload to Microsoft Classroom (or similar).

INTERNATIONAL MORSE CODE

- 1. The lenght of a dot is one unit
- 2. A dash is three units.
- 3. The space between parts of the same letter is one unit.
- 4. The space between letters is three units.
- 5. The space between words is seven units.





Photosynthesis

COMPUTER SCIENCE SCIENCE (BIOLOGY)

LABS

education@samlabs.com www.samlabs.com

Key information



SUBJECTS

Computer Science and Science (Biology).

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RECOMMENDED PRIOR KNOWLEDGE

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Basic understanding of SAM, and the SAM blocks used in the project. Basic understanding of photosynthesis.

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KEY STAGE

Key Stage 3



OUTCOMES

- Understand what affects the rate of photosynthesis.
- Create a counter system with built-in time facility.
- Practice teamwork and collaborate to navigate through problems.
- Reflect on and review the process, their product and that of their peers.

2-3 students

GROUP SIZE

TIME REQUIRED

NB: This project may go over two sessions, depending on the time needed to be given to each stage, and the experience of the students.

Suggestion for a 1 hour session:

Introduction to concept - 5 minutes. Build the SAM system - 10 minutes. Activity Stages - 30 minutes. Extension activity - 10 minutes. Reflection and Plenary - 5 minutes.



LEARNING OBJECTIVES

See Curriculum Alignment (next page).



MATERIALS REQUIRED

- 1 SAM Tray
- Tank or glass container (a large beaker may also work)

- Pondwater
- Pondweed
- Lamp
- Ruler

Curriculum alignment

NATIONAL CURRICULUM STANDARDS

Computing - Key Stage 2

- Design, write and debug programs that accomplish specific goals, including controlling or simulating physical systems; solve problems by decomposing them into smaller parts.
- Use sequence, selection, and repetition in programs; work with variables and various forms of input and output.
- Use technology safely, respectfully and responsibly; recognise acceptable/ unacceptable behaviour; identify a range of ways to report concerns about content and contact.

https://www.gov.uk/government/ publications/national-curriculum-in-englandcomputing-programmes-of-study

Number - Multiplication and Division

- Solve one-step problems involving multiplication and division, by calculating the answer using concrete objects, pictorial representations and arrays with the support of the teacher

Science (Biology) - Key Stage 3

- The reactants in, and products of, photosynthesis, and a word summary for photosynthesis.
- The dependence of almost all life on Earth on the ability of photosynthetic organisms, such as plants and algae, to use sunlight in photosynthesis to build organic molecules that are an essential energy store and to maintain levels of oxygen and carbon dioxide in the atmosphere.
- The adaptations of leaves for photosynthesis.

https://www.gov.uk/government/ publications/national-curriculum-in-englandscience-programmes-of-study 01

BEFORE THE CLASS

This lesson examines the impact of the changes in light on the rate of photosynthesis, the process whereby plants use the energy from light to generate chemical energy that can be used by the plant. As a byproduct of this process, oxygen is produced.

The students will set up a glass tank containing water and pondweed, and shine a lamp on this to simulate sunlight. The students should be able to see the plant creating oxygen as it releases bubbles into the water.

Using SAM Labs blocks, the students will created a counter to help them keep track of the number of bubbles released by the pond weed, as well as a timer to ensure that all the experiments run for the same timeframe.

The final SAM Space created by the students may look like this:





02 BEFORE THE CLASS Final checklist

The following contains everything you need to prepare your SAM Labs environment before commencing the project. Please ensure you read each section carefully to ensure you have a problem free lesson.

DOWNLOAD THE APP

You can download the SAM Education app for OSX or Windows at **https://www.samlabs.com/app**.

SAM LOG IN

Create a SAM account if you don't already have one. SAM accounts are free and allow you to save your inventions to the cloud and download and modify them later, you can even share them with others.

CHARGE YOUR SAM BLOCKS

Even though the blocks can be used while tethered, they were designed as rechargeable devices that can be used a fair way away from your system or where they can't be plugged in. You can tell they are fully charged when they change colour from red to green.

Handy Tip: you can click on a block in the SAM space to see how much charge is left.

ADDITIONAL RESOURCES

For SAM support https://www.samlabs.com/support.

O3 DURING THE CLASS Activity stages

Introduce the topic and explain to the students that we are going to measure the rate of photosynthesis using pondweed over a set time. We are also going to explore what could impact the rate of photosynthesis.

Q: How much do you already know about photosynthesis, what is it?

Q: How might we be able to measure the rate that a plant photosynthesises?

Q: What could impact on the rate of photosynthesis in plants?

Explain the process of photosynthesis to the students, and importantly that oxygen is a byproduct of this process. By using plants that live underwater, we can actually see the oxygen being released by the plant in the form of bubbles.

Q: How can we use these bubbles to record the rate of photosynthesis?

Thus, we need to build a system that will not only let us count the number of bubbles produced by the plant, but also create a timer so that we can repeat the experiment under different conditions, but keep the time factor constant.

Challenge the students to create a simple counter, along with a timer that can be set to 1 minute. We want a Counter so that every time the plant releases a bubble, we can have the programme record it so that we can keep track of how much oxygen is released.

Q: What SAM blocks would you need to create this system?

Q: How would you connect them together?

The students may come up with various solutions, but a simple setup could be created by using the light sensor in their tray as a button to register a bubble, and a spinny-buzzer for when the timer runs out. A sleeping SAM button used as a virtual button in the app can be used to start the timer. See the Tips and Tricks section at the end for more information on these two items.

Ensure that these blocks are charged and paired to the computer.

Drag the light sensor to the SAM space along with a Counter block and connect the two.

INPUTS	CONNECTIONS	OUTPUTS	•
LIGHT SENSOR	COUNTER		· · · · · ·

For the timer, we are going to create a parallel programme in the same space unconnected to the counter, so that the two can run independently.

Drag a Sleeping SAM Button block and the motor block from your spinny-buzzer to the SAM Space. Add a "Delay" block set to one minute, and a "Hold" block set to two seconds.

Looking at the below SAM code:

5

- 1. When the button is pressed, it will trigger the Delay block which will start counting down its configured delay.
- 2. When its delay runs out, it will trigger the Hold block. The Hold block will trigger the motor on your spinny-buzzer, and keep it triggered (so the motor keeps going) for the configured time.

This setup gives us a timer that will buzz and spin when our time runs out, which will stay consistent across experiments. We now have an accurate time period in which to count the bubbles being released from the plant.

Double click the delay block to set the time parameter to 1 minute.

Now, if we connected the motor, we would only get a very short sound that related to how long the button had physically been pressed for, albeit after a delay of 1 minute. So we need to add a hold block before we attach the buzzer.



Now we're ready to set up the experiment:

6



Place the pondweed in the tank and shine the lamp directly onto it from a distance of 10 cm from the tank.

Once it is set up, leave the lamp shining on the pondweed for at least 5 minutes so that the plant can acclimatise to the lighting conditions.

Q: Why is it important to let the plant acclimatise to the lighting conditions?

Ask the students to use their SAM Space set up to time a one minute period, and use their counter to log the number of bubbles they see being released from the plant within that time period.

Q: How many bubbles were released by the plant in a 1 minute time period?

Q: Can you create a table to record this?

8

Now that we have one reading, move the lamp further away from the tank to a distance of 20cm.

Don't forget to leave the plant for a few minutes under the new lighting conditions to acclimatise to the changes.

Repeat the test and add the results to your table.

9

Repeat the test several more times, each time moving the lamp another 10cm from the tank with the final test being done with the lamp at a distance of 50cm from the tank.

The student table of results may look like:

Lamp Distance from the Tank (cm)	Number of bubbles released by plant
10	
20	
30	
40	
50	

10

Ask the students to examine their results and present their findings to the group for peer review.

Q: What do the results tell you?

Q: Were these what you expected?

Q: Were their any discrepancies in the results, can you account for these?

Q: Was there anything you could have improved in the test or the set up?



DURING THE CLASS **Extension activity**

Q: Are there any other conditions that could be changed?

Repeat the test to see how the results changed. We could assess the impact of pollution on the water, and see if this made any difference. How could we make the water dirtier, for example?

Q: Could this be expanded further?

Can we present our findings in a more useful way, by creating graphs which would help to assess any correlations in the results.

RECORDING THEIR WORK

Ensure the students have completed their student packs, recording their thoughts and solutions.

Other options: Create an e-book / poster / video, etc. to explain what they have done.



Pi, what is it good for?

LABS

COMPUTER SCIENCE DESIGN & TECHNOLOGY MATHEMATICS

education@samlabs.com www.samlabs.com

Key information



SUBJECTS

Computing, Design & Technology, Mathematics.



KEY STAGE

Key Stage 3



OUTCOMES

- Design a buggy to test variations in wheel size.

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- Create controlled testing conditions through coding.
- Understand how Pi can be used to calculate wheel circumference.
- Understand how wheel circumference impacts on distance traveled.

- Practice teamwork and collaborate to navigate through problems.
- Reflect on and review the process, their product and that of their peers.



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LEARNING OBJECTIVES

See Curriculum Alignment (next page).



RECOMMENDED PRIOR KNOWLEDGE

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Basic understanding of SAM, and the SAM blocks used in the project.



GROUP SIZE

2-3 students

TIME REQUIRED

NB: This project may go over two sessions, depending on the time needed to be given to each stage, and the experience of the students.

Suggestion for a 1 hour session:

Introduction to concept - 5 minutes. Building and design stages - 20 minutes. Testing stage - 20 minutes. Extension activity - 10 minutes. Reflection and Plenary - 5 minutes.



MATERIALS REQUIRED

- 1 SAM Tray

Curriculum alignment

NATIONAL CURRICULUM STANDARDS

Computing - Key Stage 3

- Design, use and evaluate computational abstractions that model the state and behaviour of real-world problems and physical systems.
- Undertake creative projects that involve selecting, using, and combining multiple applications, preferably across a range of devices, to achieve challenging goals, including collecting and analysing data and meeting the needs of known users.
- Create, re-use, revise and re-purpose digital artefacts for a given audience, with attention to trustworthiness, design and usability.
- Understand a range of ways to use technology safely, respectfully, responsibly and securely, including protecting their online identity and privacy; recognise inappropriate content, contact and conduct and know how to report concerns.

https://www.gov.uk/government/ publications/national-curriculum-in-englandcomputing-programmes-of-study

Science - Key Stage 3

 Speed and the quantitative relationship between average speed, distance and time (speed = distance ÷ time).

https://www.gov.uk/government/ publications/national-curriculum-in-englandscience-programmes-of-study

Design & Technology - Key Stage 3

Number - Multiplication and Division

- Identify and solve their own design problems and understand how to reformulate problems given to them.
- Develop specifications to inform the design of innovative, functional, appealing products that respond to needs in a variety of situations.
- Apply computing and use electronics to embed intelligence in products that respond to inputs [for example, sensors], and control outputs [for example, actuators], using programmable components [for example, microcontrollers].

https://www.gov.uk/government/ publications/national-curriculum-in-englanddesign-and-technology-programmesof-study.

Maths - Key Stage 3

- Use algebra to generalise the structure of arithmetic, including to formulate mathematical relationships.
- Develop their mathematical knowledge, in part through solving problems and evaluating the outcomes, including multi-step problems.
- Calculate and solve problems involving: perimeters of 2-D shapes (including circles), areas of circles and composite shapes.

https://www.gov.uk/government/ publications/national-curriculum-in-englandmathematics-programmes-of-study

01

BEFORE THE CLASS

In this lesson the students will design and create their own buggy, powered by the SAM DC Motor blocks. The buggy will have a flexible design so that the wheel size can be changed, and the distance that the buggy travels in a set time can be measured to assess the impact that wheel size has on the design.

The students will use Pi to calculate the wheel circumference of the wheels, work out the number of wheel rotations in a set time period, and calculate how far the buggy will travel with different sized wheels. They will perform the test to check their calculations.

The buggy will be programmed under controlled conditions with the SAM Blocks, and below is an example solution to the final challenge.





02 BEFORE THE CLASS Final checklist

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Handy Tip: you can click on a block in the SAM space to see how much charge is left.

ADDITIONAL RESOURCES

For SAM support https://www.samlabs.com/support.

03

during the class Activity stages

Explain to the students that they will be exploring pi, circumferences and speed, working in small groups with a buggy designed with SAM blocks and the accessories in the team's kit. Their design has to be flexible enough to enable the use of both the included wheels and the included cogs on the two DC Motor blocks. It should have a control button that makes the buggy drive forward for a fixed amount of time.

Q: Using the SAM blocks and accessories, what options do you have to design your buggy?

Q: Is the design flexible so you can change the wheels for the cogs?

Q: If you drive the buggy forward, does it go in a straight(ish) line?

Ask the students at this design stage to hypothesise as to what effect changing the wheel size will have on the movement of the buggy.

Q: How might the different wheel sizes impact on the speed of the buggy, or the distance it travels?

Encourage the students to create their own design for the buggy. On the next page there is a suggestion of what the students could create.

Note that this is looking at the underside of the buggy so that you can see the blocks and accessories attached to the SAM chassis.

Note the use of the extra SAM light block with the LEGO(tm) jacket at the front of the buggy. This helps the buggy to travel in a straight line.





Open SAM Space and add the SAM DC Motor blocks to the space, along with a SAM Light Sensor block in button mode (see Tips & Tricks, later). Connect these together with a Hold block as shown below.



Double click the hold block to adjust the parameters and set the hold for a duration of 5 seconds. This means that when the button is pressed the SAM DC motors will run for 5 seconds before stopping.

We also need to reverse one of the DC motors so that when they run, they will drive the buggy forwards, otherwise they will make the buggy spin around in circles (as the motors are facing opposite directions as they're attached to the buggy).

Double click one of the DC Motor blocks and set the direction in the parameters to anti-clockwise. Quickly test the buggy to check it travels in the correct direction, if not reset the DC Motor and reverse the other one.

Now it is time to test the buggy. Find a smooth, level surface and use masking tape or similar to mark a start line. Place the buggy behind the start line and cover the light sensor.

The buggy should travel forwards for 5 seconds. Accurately measure the distance the buggy has travelled and note down the results. It is worth testing this two or three times.

Q: Were the results from each test consistent? Does your programming of the SAM Blocks work, or is there anything you can improve? Is a 5 second run time long enough?



We now know how far the buggy will travel with the wheels that have been used over a set period of time. (In this case 5 seconds)

Ask the students to calculate the speed that the buggy is travelling. They may need some help with the formula:

Distance in meters / time in seconds

This will give the students the speed that their buggy has travelled in metres per second (m/s).

In order to predict how far the buggy will travel with different size wheels, we need to calculate two more things: the circumference of the wheels and the number of rotations that happen within the 5 second time period.

We can work out the circumference of a wheel using Pi, which is a constant figure of 3.142. Measure the diameter (d) of the wheel in millimeters and use the calculation below to work out the circumference:

3.142 x diameter

Now we know the circumference of the wheel, along with the distance it travelled within a set time period, we can calculate how many rotations (R) of the wheel occurred within that time period. To do this we need to calculate:

Distance travelled / circumference

With all these details, ask the students to calculate how far the buggy will travel with different size wheels. To do this, they will need to:

Number of rotations x circumference of the new wheel

Ask the students to create a table to record the results of the calculations, and then perform the actual test with the new wheels. Ensure that the buggy always starts from the same starting point, and that the distances are measured accurately. They can record their results in a table similar to the one below:

Wheel size	Predicted distance travelled	Actual distance travelled

Q: Were your calculations accurate?

Q: Does a run time of 5 seconds provide enough time to accurately measure and calculate the results?

Q: What happens if you increase this time by altering the delay block (remembering to re do your calculations)?



DURING THE CLASS **Extension activity**

If some groups complete the task, they can be challenged further. Encourage students to think about finding other solutions to varying the wheel size.

Q: Can you build wheels from other materials and attach them to the buggy?

Q: What effect do you think bigger wheels will have on the number of times the wheels will turn in five seconds?

REAL-WORLD APPLICATIONS

This knowledge is significant in many real world applications, most notably car and vehicle design. Similarly though, this knowledge can be important in various design areas that involve using gears and cogs.

RECORDING THEIR WORK

Ensure the students have completed their student packs, recording their thoughts and solutions.

Other options: Create an e-book / poster / video, etc. to explain what they have done.



Probability

LABS

COMPUTER SCIENCE DESIGN & TECHNOLOGY MATHEMATICS

education@samlabs.com www.samlabs.com

Key information



SUBJECTS

Computing, Mathematics, Design & Technology.



KEY STAGE

Key Stage 3



OUTCOMES

- Create a system to control spinners with motors.

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- Understand the use of delays to control timings and outputs.
- Develop a knowledge of probability.
- Practice teamwork and collaborate to navigate through problems.
- Reflect on and review the process, their product and that of their peers.

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LEARNING OBJECTIVES

See Curriculum Alignment (next page).



RECOMMENDED PRIOR KNOWLEDGE

.

Basic understanding of SAM, and the SAM Blocks used in the project.



GROUP SIZE

2-3 students

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TIME REQUIRED

NB: This project may go over two sessions, depending on the time needed to be given to each stage, and the experience of the students.

Suggestion for a 1 hour session:

Introduction to concept - 5 minutes. Activity Stages - 40 minutes. Extension activity - 10 minutes. Reflection and Plenary - 5 minutes.



MATERIALS REQUIRED

- SAM Space Education app
- 1 SAM Tray
- 2 x A4 sheets of paper or card
- Ruler

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- Coloured pencils

Curriculum alignment

NATIONAL CURRICULUM STANDARDS

Computing - Key Stage 3

- Design, write and debug programs that accomplish specific goals, including controlling or simulating physical systems; solve problems by decomposing them into smaller parts.
- Use sequence, selection, and repetition in programs; work with variables and various forms of input and output.
- Use technology safely, respectfully and responsibly; recognise acceptable/ unacceptable behaviour; identify a range of ways to report concerns about content and contact.

https://www.gov.uk/government/ publications/national-curriculum-in-englandcomputing-programmes-of-study

Design & Technology - Key Stage 3

Design

- Use research and develop design criteria to inform the design of innovative, functional, appealing products that are fit for purpose, aimed at particular individuals or groups.

Technical Knowledge

- Understand and use electrical systems in their products (for example, series circuits incorporating switches, bulbs, buzzers and motors).
- Apply their understanding of computing to program, monitor and control their products.

https://www.gov.uk/government/ publications/national-curriculum-in-englanddesign-and-technology-programmesof-study

Maths - Key Stage 3

- Record, describe and analyse the frequency of outcomes of simple probability experiments involving randomness, fairness, equally and unequally likely outcomes, using appropriate language and the 0-1 probability scale.
- Understand that the probabilities of all possible outcomes sum to 1.
- Enumerate sets and unions/intersections of sets systematically, using tables, grids and Venn diagrams.
- Generate theoretical sample spaces for single and combined events with equally likely, mutually exclusive outcomes and use these to calculate theoretical probabilities.

https://www.gov.uk/government/ publications/national-curriculum-in-englandmathematics-programmes-of-study 01

BEFORE THE CLASS

This lesson is concerned with probability, and testing the likely outcomes of matching colours on two spinners that are controlled via the SAM DC Motors. The students will build spinners out of motor blocks, working with triggers and delays to allow the motors to stop on a random colour each time it is triggered.

The students will make two backgrounds for their spinners, one with three colours, and one with four colours, and the cog attached to the DC motor will both make it spin and act as the pointer.

The students will create the programme in the SAM Space to control the pointer, and they will collate the results from multiple spins to assess the probability of the two spinners landing on the same colour.

The students will:

- Design the backgrounds for their spinners.
- Design a system to control the motors.
- Collate the results and compare theoretical and experimental probability.

An example of the completed project in the SAM Space may look like this:





02 BEFORE THE CLASS Final checklist

The following contains everything you need to prepare your SAM Labs environment before commencing the project. Please ensure you read each section carefully to ensure you have a problem free lesson.

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Handy Tip: you can click on a block in the SAM space to see how much charge is left.

ADDITIONAL RESOURCES

For SAM support https://www.samlabs.com/support.

03

1

during the class Activity stages

Explain to the students that they are going to investigate theoretical and experimental probability by recording the results of two spinners generating random choices of colours.

- Q: What do you expect to happen each time we rotate a spinner?
- Q: Will it always land on the same colour?
- Q: What happens if there are two spinners?
- Q: Can we predict how likely it will be that they land on the same colour?

Ask the students to create two backgrounds, one for each spinner. The backgrounds are just A4 or even A5 pages. Divide one into four equal coloured sections, and one into three equal coloured sections. The backgrounds need colouring in so that three colours on both backgrounds are the same. Show the students an example design, but they can create their own styles.

The students will need:

- Two sheets of paper
- Ruler
- Coloured pencils

An example design might be:





Each spinner will be made of a SAM motor block with the cog from the kit fitted. If you turn the motor upside down and place it on a flat surface (such as the centre of one of the spinner backgrounds laid flat on a table!) and run the motor, it spins around in a very satisfying way.

The students need to consider how we could control the DC Motor blocks to turn the spinner. Allow the students to work in the SAM Space to solve this challenge. An example might require two DC Motor blocks

Ensure that these blocks are paired to the computer, and drag them into the SAM Space.

We could simply connect each DC motor block to a virtual button block (see Tips & Tricks, later) so that it spins when the button is pressed, and stops spinning when the button is released. However, this allows for the results to be controlled with influence by the user who is pressing the button, and they may favour particular colours.

Similarly, we could insert a toggle block between the DC Motor and the Button, so that one press would start the motor, and another press would stop it.

A better option is to insert a Delay block, which the parameters can be set to allow the motor to run for a set length of time after the button has been pressed, which will allow much less influence from the person pressing the button.



Double click both delay blocks and select a time of a few seconds for each one, they do not have to run for the same amount of time. Maybe set one motor to run for 3 seconds, and one for 5 seconds. The students can vary this.

Once the SAM Space has been completed, ensure that the cogs are attached to the DC motors, and that the students place the spinners in the centre of the backgrounds they have prepared.

Ask the students to run the test with both spinners 10 times, and record the results of the colour selected by the spinner each time. They will need to create a table for this.

Q: How many times did each spinner land on each colour?

Q: How many times did they land on the same colour?

Q: Which colour was selected the most?

Q: Which colour combination between both spinners was the most common?

6

5

Can we now predict the likelihood of getting both spinners to land on the same colour?

If the students create another table, they can work out the probability for the two spinners landing on the same colour. It should look something like this:

	Blue	Green	Yellow	Orange
Blue	Yes	No	No	No
Green	No	Yes	No	No
Yellow	No	No	Yes	No

So there are 12 possible outcomes from the spins, the theoretical probability of the two spinners landing on the same colours is:

P (winning) = 3/12 which is the same as $\frac{1}{4}$.

 $\overline{7}$

8

Ask the students to compare the results of the experimental probability test with the two spinners, to those suggested by the theoretical probability.

Q: How do the theoretical probability results compare to your experimental probability results?

Q: Can you account for this in any way?

Ask the students to report back to the class the results of their probability experiments, and discuss the class findings:

- Q: What do the results mean?
- Q: Can we accurately predict the outcomes?
- **Q:** Did each group get the same results?
- Q: Did you find any problems during this experiment?
- Q: Can you present your results using tables, graphs or Venn diagrams?
04

DURING THE CLASS **Extension activity**

Q: What would happen if each spinner had the same number of colours?

Q: What would happen if you added more colours to the spinners?

Q: Could you predict the theoretical probability of the two spinners landing on the same colours if each spinner had more colours, perhaps 5 on one and 6 on the second?

Q: Could this be expanded further?

Q: Could you consider developing the SAM space to improve how the spinner works?

Q: Can you think of a way to make the system more random? Either through a SAM solution, or through one involving the process of using the spinners?

REAL-WORLD APPLICATIONS

Being able to predict the outcome of experiments is a useful real-world application in many areas, and to be able to use the theoretical probability against experimental probability is a good skill to have. Areas that this is particularly common in include:

- Trade and financial markets
- Sports results
- Reliability of goods and components
- Predicting the weather

RECORDING THEIR WORK

Ensure the students have completed their student packs, recording their thoughts and solutions.

Other options: Create an e-book / poster / video, etc. to explain what they have done.



Quiz Champion

LABS

COMPUTER SCIENCE DESIGN & TECHNOLOGY TEACHER CHOICE (can be used in any curriculum area)

education@samlabs.com www.samlabs.com

Key information



SUBJECT

Computing, Design & Technology, Teacher Choice (can be used in any curriculum area).



KEY STAGE

Key Stage 2



OUTCOMES

- To create a system that will record how many questions are correctly answered in a quiz.
- To create a system that will announce a quiz 'winner'.

- Practise teamwork and collaborate to navigate through problems.

- Reflect on and review the process, their product and that of their peers.



LEARNING OBJECTIVES

See Curriculum Alignment (next page)



RECOMMENDED PRIOR KNOWLEDGE

.

Basic understanding of SAM, and the SAM Blocks used in the project.



GROUP SIZE

2-3 students / 2 groups of students for the competitions and extension activity.

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TIME REQUIRED

NB: This project may go over two sessions, depending on the time needed to be given to each stage, and the experience of the students.

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Suggestion for a 1 hour session:

Introduction to concept - 5 minutes. Activity Stages - 40-50 minutes. Extension activity - 10 minutes. Reflection and Plenary - 5 minutes.



MATERIALS REQUIRED

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- Computer or Tablet
- SAM Space Education app
- 1 SAM Tray
- A set of questions related to any given topic / revision theme etc.

The students may use Other SAMs if needed in their projects.



Curriculum alignment

NATIONAL CURRICULUM STANDARDS

Computing - Key Stage 2

- Design, write and debug programs that accomplish specific goals, including controlling or simulating physical systems; solve problems by decomposing them into smaller parts.
- Use sequence, selection, and repetition in programs; work with variables and various forms of input and output.
- Use technology safely, respectfully and responsibly; recognise acceptable/ unacceptable behaviour; identify a range of ways to report concerns about content and contact.

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Design & Technology - Key Stage 2

Design

- Use research and develop design criteria to inform the design of innovative, functional, appealing products that are fit for purpose, aimed at particular individuals or groups.

Technical Knowledge

- Understand and use electrical systems in their products (for example, series circuits incorporating switches, bulbs, buzzers and motors).
- Apply their understanding of computing to program, monitor and control their products.

https://www.gov.uk/government/ publications/national-curriculum-in-englanddesign-and-technology-programmesof-study



BEFORE THE CLASS

During this project, students will think about quizzes and quiz shows, and create and program a system that will allow the number of correct answers to a curriculum quiz to be recorded. They will then use SAM space and SAM blocks to create a system that will allow for competition, and signal when there is a 'winner'.





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CHARGE YOUR SAM BLOCKS

Even though the blocks can be used while tethered, they were designed as rechargeable devices that can be used a fair way away from your system or where they can't be plugged in. You can tell they are fully charged when they change colour from red to green.

Handy Tip: you can click on a block in the SAM space to see how much charge is left.

ADDITIONAL RESOURCES

For SAM support https://www.samlabs.com/support.

03

during the class Activity stages

During these stages, students will create a "buzzing-in" and scoring system. Each team with a set of SAM blocks will make one system.

During the quizzes, two teams will need to play against each other.

Have a discussion with the students about quizzes.

Q: What examples of quizzes do you know about?

Q: Have you seen any quiz shows on television?

Ask them what many quiz shows have in common. Draw out that the majority use a system whereby the contestants have to "buzz in" in order to answer questions. Also that contestants score points, and that the person with most points is generally the winner.

Tell the students that during this project, they will create a buzzing-in and scoring system so that they can take part in their own quizzes.

Q: What features could your system have?

Q: How might you record the number of correct answers?

Q: How might your system announce a 'winner'?

Show, or remind, the students how to connect SAM blocks using SAM Space, and give them an example of using a Light Sensor to signal a response to a question.

The example below uses a Light Sensor in button mode (see Tips & Tricks later) to illuminate an RGB LED. It also uses a Hold block to illuminate the RGB LED for a set number of seconds (in this case 2 seconds).



Send the students away to devise their own system that two contestants can use to play a quiz.

Q: How might the questioner be able to tell which contestant wants to answer?

Q: Are there other ways of creating a system like this using different SAM Blocks?

NB: they may use motors, RGB LEDs, or combinations.

After having them share their creations, tell the students that in order for the questioner to know how many correct answers have been given, they will need to introduce to their programs some form of scoring system.

Q: What might you use to keep count of the scores?

Q: Will the contestants, or someone else, be responsible for recording correct answers?

Q: Will you put a limit on the amount of correct answers, so that there is a 'winner'?

Q: How might your system show this?

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NB: Remind the students that they only have the blocks available to their team, and so the system they devise will need to use the same light for both "I want to answer!" and "This team won!" They could differentiate with different flashing patterns or colours. Also, a motor with a wheel attached makes a great visual attention grabber!

An example solution is presented below. The solution has two inputs:

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- A light sensor that the team waves a hand over to signal they wish to answer a question.
- A virtual button on the team's device that the judge presses to signal a correct answer.



The team has a signalling device made up of a motor and a light inserted into a pink block holder as follows. Note how the motor has one of the provided cogs on it to make it extra buzzy!



The Light Sensor (in button mode) detects when it is covered, and triggers the other blocks to make the motor buzz and the light turn on to indicate they want to answer.

If they answer correctly, the judge taps their virtual button which increases their counter. If their counter reaches five, their buzzy-machine will start whipping around in celebration with the light flashing.

Finally, have the students devise their own set of questions based on a current class topic. Hold a competition amongst the class, and ensure that all students experience every aspect of the project (programmers, questioners, scorekeepers, etc).

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DURING THE CLASS **Extension activity**

Students can now be challenged to make the buzzing devices more sophisticated, with extra motors, sounds playing and so on.

If you have the larger SAM kits, you will have other blocks available - can those be used to make things even more interesting?

They may need to join with other groups and use multiple computers/tablets to construct their solutions.

Can they extend their programs so that teams can play against each other, or have more than two competitors?



Super Home for the Hearing Impaired

COMPUTER SCIENCE DESIGN & TECHNOLOGY SCIENCE

LABS

education@samlabs.com www.samlabs.com

Key information



SUBJECTS

Computing, Design & Technology.

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KEY STAGE

Key Stage 3



OUTCOMES

- Create a system to control light and sound
- Understand the use of delays to control timings and outputs.
- Practice teamwork and collaborate to navigate through problems.
- Reflect on and review the process, their product and that of their peers.

RECOMMENDED PRIOR KNOWLEDGE

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Basic understanding of SAM, and the SAM blocks used in the project.



GROUP SIZE

3-4 students

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TIME REQUIRED

NB: This is Part 1 of a 2-part project. One flows into the other, but they can be taught as separate entities. Timings are approximate, depending on the time needed to be given to each stage, and the experience of the students.

Suggestion for a 1 hour session:

Introduction to concept - 5 minutes. Activity set-up - 30 minutes. Explore and modify the experiment - 10 minutes. Extension activity - 10 minutes. Reflection and Plenary - 5 minutes.

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LEARNING OBJECTIVES

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See Curriculum Alignment (next page).



MATERIALS REQUIRED

- SAM Space Education app
- 1 SAM Tray

Curriculum alignment

NATIONAL CURRICULUM STANDARDS

Computing - Key Stage 3

- Design, use and evaluate computational abstractions that model the state and behaviour of real-world problems and physical systems.
- Understand several key algorithms that reflect computational thinking(for example, ones for sorting and searching; use logical reasoning to compare the utility of alternative algorithms for the same problem.
- Undertake creative projects that involve selecting, using, and combining multiple applications, preferably across a range of devices, to achieve challenging goals, including collecting and analysing data and meeting the needs of known users.
- Create, re-use, revise and re-purpose digital artefacts for a given audience, with attention to trustworthiness, design and usability.
- Understand a range of ways to use technology safely, respectfully, responsibly and securely, including protecting their online identity and privacy; recognise inappropriate content, contact and conduct and know how to report concerns.

https://www.gov.uk/government/ publications/national-curriculum-in-englandcomputing-programmes-of-study

Design & Technology - Key Stage 3

Design

- Use research and develop design criteria to inform the design of innovative, functional, appealing products that are fit for purpose, aimed at particular individuals or groups.

Technical Knowledge

- Understand and use electrical systems in their products (for example, series circuits incorporating switches, bulbs, buzzers and motors).
- Apply their understanding of computing to program, monitor and control their products.

https://www.gov.uk/government/ publications/national-curriculum-in-englanddesign-and-technology-programmesof-study



BEFORE THE CLASS

In this project, the students will investigate and attempt to solve a problem that affects the hearing impaired, that of not necessarily knowing when someone is at the front door. Traditional door bells do not meet the needs of all aspects of our society, so we need to create a system that includes a visual notification too.

The students will:

- Plan the requirements for such a system
- Design a system to work as an audible and visual door notification device
- Develop their ideas for other uses within the home

An example of the completed project may look like this:





02 BEFORE THE CLASS Final checklist

The following contains everything you need to prepare your SAM Labs environment before commencing the project. Please ensure you read each section carefully to ensure you have a problem free lesson.

DOWNLOAD THE APP

You can download the SAM Education app for OSX or Windows at **https://www.samlabs.com/app**.

SAM LOG IN

Create a SAM account if you don't already have one. SAM accounts are free and allow you to save your inventions to the cloud and download and modify them later, you can even share them with others.

CHARGE YOUR SAM BLOCKS

Even though the blocks can be used while tethered, they were designed as rechargeable devices that can be used a fair way away from your system or where they can't be plugged in. You can tell they are fully charged when they change colour from red to green.

Handy Tip: you can click on a block in the SAM space to see how much charge is left.

ADDITIONAL RESOURCES

For SAM support https://www.samlabs.com/support.

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during the class Activity stages

Explain to the students that they are going to create a device to support the hearing impaired, and how they may not know if someone is at the front door. Ask them to consider what the problems might be, and how they could attempt to solve this problem with the use of SAM Blocks.

Q: How do we usually know if a visitor is at the front door, and how may this be a problem for hearing impaired people? What solutions could you offer?

The students will establish that as well as an audible doorbell type system, they will need to include a visual indicator, which can be in the form of a flashing light. Open SAM Space and introduce the students to the

- following blocks:
- Light sensor: acts as a hand-wave activated button (see "Tips and Tricks", later)
- DC Motor Block: for making a spinny-buzzer (see "Tips and Tricks", later)
- RGB LED

Ensure that each block is paired to the computer.

To control these, we're going to need two more software blocks:

- Hold
- Interval

Challenge the students to start planning and creating their systems using these blocks.

Q: How do you want the buzzer to respond? Should it make one long sound, or several short sounds? What about the RGB LED - should it flash?

To build a solution, drag a light sensor and Hold block to the SAM Space and connect the two together. Set the Light sensor to Button mode.

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INPUTS	CONNECTIONS	OUTPUTS
LIGHT SENSOR	Hold hours mins secs 00 00 00 remove Disconnect	· · · · · · · · · · · · · · · · · · ·

Edit the Hold block's parameters and set it to 10 seconds. Now, when a hand is waved over the light sensor, the hold block will send an output signal for the configured 10 seconds. If you want to change the length of time that the RGB LED is lit up, then alter the parameter on this Hold block.

If we now connect the RGB LED to the output of the delay block, it will illuminate for 10 seconds every time the light sensor is tapped. However, we can add another block that will make the RGB LED flash instead of just light up.

Add the Interval block to the SAM space and double click it to edit the parameters, with a setting of 500ms. If you want to change the speed of the flashing RGB LED, experiment with different delay settings. Maybe try 1 second?



Now we can connect the RGB LED to the end of this sequence.

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Double clicking on the RGB LED will allow you to change the parameters, and here you can set the colour of the light.

INPUTS	CONNECTIONS	OUTPUTS
		RGBLED
		Brightness
	· · · ·	
	· · ·	RGBLED

We're nearly there! Now we need to add our spinny buzzer (see Tips and Tricks later). As with the RGB LED, we can control the length of time the the motor spins with a Hold block.



Double click the Hold block and set the parameters to 2 seconds, which will be how long the motor will spin for. Edit this parameter if you want to change the length of time that the motor spins.



Finally connect the Motor block to the delay.

Now you're ready to test the system, and adjust an parameters as necessary.

Q: Does it work? What were your difficulties in designing this system?

Q: What does changing the parameters do, does it make the system more effective or user friendly?

Q: Is there anything you can change to the system?

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Extension activity

Encourage students to think further about their design. Are there any other SAM blocks we could use in this system to enhance the functionality of the door notification system? If you have access to a SAM Button, the system could be extended with a button that one presses to deactivate the buzzer.

Are there any other ways in which the system could be developed or expanded?

Q: Could this be expanded further?

Q: Are there any other uses for this type of system around the home?

Q: Could the system be developed to meet these different needs, such as home security?

REAL-WORLD APPLICATIONS

This system could be developed to work as it was intended, as a commercial product, serving as a door notification system for the hearing impaired. The system could be developed further for other uses around the home, such as home security.

RECORDING THEIR WORK

Ensure the students have completed their student packs, recording their thoughts and solutions.



Super Light Logging

LABS

COMPUTER SCIENCE DESIGN & TECHNOLOGY SCIENCE

education@samlabs.com www.samlabs.com

Key information



SUBJECTS

Computing, Science, Design & Technology.

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KEY STAGE

Key Stage 3



OUTCOMES

- Capture and log data over time.

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- Create a variable data source with automation.
- Practice teamwork and collaborate to navigate through problems.
- Reflect on and review the process, their product and that of their peers.

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LEARNING OBJECTIVES

See Curriculum Alignment (next page).

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RECOMMENDED PRIOR KNOWLEDGE

Basic understanding of SAM, and the SAM blocks used in the project.

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GROUP SIZE

3-4 students

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TIME REQUIRED

Suggestion for a 1 hour session

Introduction to concept - 5 minutes. Activity set-up - 15 minutes. Explore and modify the experiment - 15 minutes. Present the outcomes - 10 minutes. Extension activity - 10 minutes. Reflection and Plenary - 5 minutes.



MATERIALS REQUIRED

- SAM Space Education app
- 1 SAM Tray

Curriculum alignment

NATIONAL CURRICULUM STANDARDS

Computing - Key Stage 3

- Design, use and evaluate computational abstractions that model the state and behaviour of real-world problems and physical systems.
- Understand several key algorithms that reflect computational thinking(for example, ones for sorting and searching; use logical reasoning to compare the utility of alternative algorithms for the same problem.
- Understand a range of ways to use technology safely, respectfully, responsibly and securely, including protecting their online identity and privacy; recognise inappropriate content, contact and conduct and know how to report concerns.

https://www.gov.uk/government/ publications/national-curriculum-in-englandcomputing-programmes-of-study

Design & Technology - Key Stage 3

- Understand and use the properties of materials and the performance of structural elements to achieve functioning solutions.
- Understand how more advanced electrical and electronic systems can be powered and used in their products [for example, circuits with heat, light, sound and movement as inputs and outputs].
- Apply computing and use electronics to embed intelligence in products that respond to inputs [for example, sensors], and control outputs [for example, actuators], using programmable components [for example, microcontrollers].

https://www.gov.uk/government/ publications/national-curriculum-in-englanddesign-and-technology-programmesof-study

Science - Key Stage 3

- Analysis and evaluation
- Present observations and data using appropriate methods, including tables and graphs.
- Interpret observations and data, including identifying patterns and using observations, measurements and data to draw conclusions.
- Present reasoned explanations, including explaining data in relation to predictions and hypotheses.
- Evaluate data, showing awareness of potential sources of random and systematic error.
- Identify further questions arising from their results.

https://www.gov.uk/government/ publications/national-curriculum-in-englandscience-programmes-of-study 01

BEFORE THE CLASS

During this project, the students will explore creating a data source and focus on developing their understanding of standardised testing, and modifying environments that might affect the outcomes.

They will create a variable light source that can be automated to increase in brightness at regular intervals. They will also use a light sensor to measure the light levels and how these change over time, including recording and logging the data. The students will also be given the opportunity to explore working with the light in different conditions, and assess how this affects the data that is logged.

The students will:

- Hypothesise as to what they expect the results might look like.
- Design and build a system to increase light levels, and log the results.
- Investigate the data produced.
- Present their findings.

Below is an example of what the final solution may look like:





02 BEFORE THE CLASS Final checklist

The following contains everything you need to prepare your SAM Labs environment before commencing the project. Please ensure you read each section carefully to ensure you have a problem free lesson.

DOWNLOAD THE APP

You can download the SAM Education app for OSX or Windows at **https://www.samlabs.com/app**.

SAM LOG IN

Create a SAM account if you don't already have one. SAM accounts are free and allow you to save your inventions to the cloud and download and modify them later, you can even share them with others.

CHARGE YOUR SAM BLOCKS

Even though the blocks can be used while tethered, they were designed as rechargeable devices that can be used a fair way away from your system or where they can't be plugged in. You can tell they are fully charged when they change colour from red to green.

Handy Tip: you can click on a block in the SAM space to see how much charge is left.

ADDITIONAL RESOURCES

For SAM support https://www.samlabs.com/support.

03

during the class Activity stages

Explain to the students that they are going to create a variable light source in this experiment to create a controlled environment. The light will run a sequence from very dim to very bright over a period of time. They will also build a means of testing how bright the light is and log the data under different conditions.

Q: Why is it important to have an automated controlled environment to measure the data?

Q: How might this be useful when exploring different conditions or environments?

Q: What type of things could vary the brightness of the ambient light?

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Once the students have an understanding of why it is important to run this experiment in a controlled manner, so the settings remain constant as they change the conditions or environment, we can start building in the SAM Space. Open the SAM Space and introduce the students to the following blocks:

- Button (a virtual one if you have no physical available; see "Tips and Tricks" later)
- RGB LED
- Light sensor

Ensure that these are paired to the computer.

We need to create an automated system that will control the brightness of the RGB LED. To do this we need three more blocks:

- Counter
- Compare, with the comparison set to "< 90"
- Delay, with the delay set to 5 seconds.

Connect these together as below, this will allow us to press the button block, which starts the system automatically brightening the RGB LED.



Pressing the button will make the counter increase its value. The counter's value (now 1) is then sent to the RGB LED, which lights it up very dimly.

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While you can press the button to further increase the counter (and thus the brightness), the system will now do it automatically.

The counter's value is sent to the comparison block. If it is less than 90, the comparison will pass it on to the interval block. While the interval block is receiving a value it will continue to update the counter every 5 seconds.

This increases the counter (brightening the light), and keeps the whole loop running until the counter reaches 90.

At that point, the comparison block will stop sending the value on to the interval block, and the LED will stop getting brighter, and the counter will not be updated. The loop will stop.

We now need to add the Light Sensor block to capture the brightness and log the data. Connect the blocks as below:





Double click the Log Block to edit the parameters and set it to log the data once every 5 seconds, which should match the changes in brightness of the RGB LED.

Using the red controller chassis in your kit, fix the RGB LED block and the Light Sensor block facing each other. Start with the two blocks at a distance of about 2cm apart.

Press the button to start the automated loop, and the RGB sensor should illuminate. You will see on the screen that the Light Sensor block is giving you a numerical read-out that correlates with the brightness of the RGB LED.

Double clicking on the log block will allow the students to email themselves the data as a CSV file (comma separated values) which should be easily opened in any spreadsheet application, such as Microsoft Excel.

Ask the students to review and examine the data.

Q: Does the data match what you expected (ie. the light sensor increased its value as the RGB LED got brighter)?

Q: How can you present this data in a way that is easy to read?

Direct the students to repeat the experiment several times, but to change the distances between the light sensor block and the RGB LED block. They need to plan this in a logical way and ensure that they measure the distances to keep the logs accurate.

Q: What happened to the light levels as the distances between the blocks increased? Can you suggest any explanations for these changes?

Q: What part might ambient light play in the experiment?

Ask the students to consider the control of the environment in which they are running the experiment, which might explain any inconsistencies in the data that they are recording.

Q: How could you control the environment further to ensure that the test results are comparable?

Q: Could you provide the same conditions every time, irrespective of ambient light in the room?



Ask the students to prepare and present their findings for peer discussion. This may involve creating graphical representation of the logged data.

Q: What could you have done to develop the environment for your experiment further?

Q: How might this have helped with the results?



DURING THE CLASS **Extension activity**

Encourage the students to think about different environmental conditions for the experiment. They will have already considered placing the blocks in a sealed dark environment, such as a cardboard box, but what other things could they test that might change the results?

Q: Changing the size of the cardboard box, does a large environment give different results to a very small closed environment?

Q: What about the colour inside the box, does a white box effect the results differently to a black box?

Q: What about placing coloured pieces of transparent plastic (filters) in front of the RGB LED?

Q: Could you change the environment in any other way?

Q: Could this be expanded further?

Q: Could we measure different light sources?

- Q: What happens if we use two RGB LEDS?
- Q: Could we measure the light in other areas, rather than creating our own?

Q: What is the ambient light level in the rooms we work in, and does this vary throughout the day?

REAL-WORLD APPLICATIONS

Understanding the need for creating experiments in controlled environments is fundamental to a lot of disciplines, and being able to log the data accurately helps with things such as product design and testing.

RECORDING THEIR WORK

Ensure the students have completed their student packs, recording their thoughts and solutions.

Other options: Create an e-book / poster / video, etc. to explain what they have done.



Super Selfie. A light activated selfie camera

COMPUTER SCIENCE DESIGN & TECHNOLOGY

LABS

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Key information



SUBJECTS

Computing, Design & Technology.

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RECOMMENDED PRIOR KNOWLEDGE

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Basic understanding of SAM Space and the SAM Blocks used in the project. Basic understanding of a computer webcam.

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KEY STAGE

Key Stage 2



OUTCOMES

- To make a camera that assists the user in taking a picture.

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- To take the very best selfie and do great things with it.
- Practise teamwork and collaborate to navigate through problems.
- Reflect on and review the process, the product and that of their peers.



LEARNING OBJECTIVES

See Curriculum Alignment (next page).



GROUP SIZE

2-3 students

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TIME REQUIRED

Suggestion for a 1 hour session:

Introduction to concept - 5 minutes. Activity Stages - 40-50 minutes. Extension activity - 10 minutes. Reflection and Plenary - 5 minutes.



MATERIALS REQUIRED

- SAM Tray
- Scissors, cardboard, coloured paper, glue.
- SAM Space Education app
- Smartphones or tablet for trying out making selfies. Make sure the control device you are using has access to a camera.

Curriculum alignment

NATIONAL CURRICULUM STANDARDS

Computing - Key Stage 2

- Design, write and debug programs that accomplish specific goals, including controlling or simulating physical systems; solve problems by decomposing them into smaller parts.
- Use sequence, selection, and repetition in programs; work with variables and various forms of input and output.
- Use technology safely, respectfully and responsibly; recognise acceptable/ unacceptable behaviour; identify a range of ways to report concerns about content and contact.

https://www.gov.uk/government/ publications/national-curriculum-in-englandcomputing-programmes-of-study

Design & Technology - Key Stage 2

Design

- Use research and develop design criteria to inform the design of innovative, functional, appealing products that are fit for purpose, aimed at particular individuals or groups.

Technical Knowledge

- Understand and use electrical systems in their products (for example, series circuits incorporating switches, bulbs, buzzers and motors).
- Apply their understanding of computing to program, monitor and control their products.

https://www.gov.uk/government/publications/ national-curriculum-in-england-design-andtechnology-programmes-of-study

PROGRESSION PATHWAYS / COMPUTATIONAL THINKING CONCEPT

Programing and development

- Creates programs that implement algorithms to achieve given goals. (AL)
- Uses post-tested loop e.g. 'until', and a sequence of selection statements in programs, including an if, then and else statement. (AL)

Hardware and Processing

 Knows that computers collect data from various input devices, including sensors and application software (AB)

Computational Thinking Concept: AB = Abstraction; DE = Decomposition; AL = Algorithmic Thinking; EV = Evaluation; GE = Generalisation

https://community.computingatschool.org. uk/resources/2324



BEFORE THE CLASS

During this project, students will explore the features of a range of SAM Blocks in order to create and program a selfie camera.

They will work together to discover how best to configure and program the blocks through a series of short activities.

They will then create their own system to take the best selfie in optimum lighting conditions.



Below is an example solution to the final challenge:



02 BEFORE THE CLASS Final checklist

The following contains everything you need to prepare your SAM Labs environment before commencing the project. Please ensure you read each section carefully to ensure you have a problem free lesson.

DOWNLOAD THE APP

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SAM LOG IN

Create a SAM account if you don't already have one. SAM accounts are free and allow you to save your inventions to the cloud and download and modify them later, you can even share them with others.

CHARGE YOUR SAM BLOCKS

Even though the blocks can be used while tethered, they were designed as rechargeable devices that can be used a fair way away from your system or where they can't be plugged in. You can tell they are fully charged when they change colour from red to green.

Handy Tip: you can click on a block in the SAM space to see how much charge is left.

ADDITIONAL RESOURCES

For SAM support https://www.samlabs.com/support.


during the class Activity stages

DEFINE A SELFIE

Q: What is a selfie? What does it mean? Have you ever taken a selfie?

Use a tablet to take a selfie with you and the class in the shot.

Using the students' devices, ask the students to work in pairs or threes and to take some selfies. Encourage the students to move around the room and to take selfies in different areas to explore where the best conditions are for taking photographs (if the devices permit).

Bring the students back together and give them some time to flick through their pictures and ask them to select the one they think is the best. Give the criteria or ask them to explain their reasons for their choices. Show some through the projector if possible. Discuss the pros and cons of taking photos in this way (instant / fun / arms in the way / not always framed well etc.).

* Focus on light. Show some examples of selfies taken where it was too dark or where the light was behind the subject, making it too light.

Q: Some photos don't work, due to lighting. Why? What is the position of the light in those photos?

Get students to look at the position of the windows and lights in the room and ask if there is a correlation between where light is coming from and good / bad pictures.

Ask the students to complete the section 1 of their activity log – *What makes a good photo*.

2) BUILD A SELFIE CAMERA WITH SAM SPACE

Introduce the idea of taking selfies using a remote shutter.

Q: Have you ever used a selfie-stick?

Open SAM Space on your computer. Use a Virtual Button (see Tips and Tricks, later) and Camera blocks, such that pressing the button will take a photo using the device's camera.

Ask the students to work in the same groups toreate a program in SAMSpace that takes a selfie when they press the button. Encourage the students to remember where the lighting was good.

Ask the students to complete the section 2 of their activity log – Using the Virtual Button as a remote shutter.

Note: If you have a larger SAM kit, such as the Team or Classroom kit, you can use one of the physical button blocks to demonstrate the remote shutter.



3) INTRODUCE LIGHT TO THE GRAPH

Q: How would you use programming to make sure that a picture could only be taken if the light level was good enough?

Introduce the Light Sensor, and the Filter block. Demonstrate how they work. Make sure the students understand that we can 'filter' the reading coming from the Light Sensor so we can control which actions are triggered. For example, we might trigger the RGB LED block to illuminate when a certain level of light is recognised by the sensor. Use this as an example to show output.

Discuss with the students how they might use programming to make sure that a picture could only be taken if the light level was good enough. **Q:** How could you use SAM to find out whether the light is appropriate? How might this be useful when taking a selfie?

Draw out the response that if a selfie could ONLY be taken when the light levels were good enough, we would get better pictures.

Get the students to experiment with the Light Sensor and the Filter block in SAM Space. Remember to set the Light Sensor to "Sensor" mode (see Tips and Tricks, later). Ask them to find the Filter settings that work for them (they may all be different, as light levels in the room may vary).

Ask the students to complete the section 3 of their activity log – *How can* we use the light level measurement to make sure we get the right level for the photo?



4 CHALLENGE

Now that the students have experimented with blocks in SAM Space and the Light Sensor, set them the challenge.

To create and program a selfie-taking camera system that uses a remote shutter, but will only take pictures when the light conditions are good enough.

Encourage the students to experiment with their programming, and to keep taking selfies until they are happy with the results.

Ask the students to complete the section 4 of their activity log – *Challenge*.





DURING THE CLASS **Extension activity**

The students have built and programmed a system that responds to the ideal conditions for taking a selfie, it ensures the light level is correct before the space bar can be pressed to take the picture.

Ask the students if it would be useful to have some sort of indicator so that they knew when to press the space bar.

Introduce the RGB LED and the AND command. Demonstrate how, by using the AND command, the LED will light up when the light levels are ideal, and that this will indicate when to press the 'shutter'.

Ask the students to experiment and come up with their own solution.

Q: Could this be expanded further?

TWITTER

This technology could be expanded using a Tweet out block connected to the camera block and perhaps used at events.

If you have access to Twitter and have associated an account with your SAM Space Education app, send the output from the camera out to Twitter, complete with a message of your choice.



What do you need to know?

All modern photography uses some form of digital sensor, whether this in a smartphone, a digital SLR as used professional photographers or even the webcam attached to your computer.



Each type of camera system uses a sensor to capture the image, a lens to focus the image on the sensor and a trigger to tell the camera when to capture the image. Additionally cameras may have some kind of lighting unit known as a flash that provides extra lighting when the image is captured.



THE SENSOR

Generally the more expensive and higher quality the camera, the larger the sensor is and the more pixels it contains. If you imagine the pixel to be a tiny dot that can be turned into any colour, then the more dots you have the higher the resolution of the image, i.e. the more lifelike it is.

However the more pixels you squeeze into a smaller space the more likely it is that there interference between them and the image quality will become degraded.



THE LENS

The lens is a precision piece of glass designed to focus the image onto the sensor, making sure that you capture a sharp image. On more expensive lenses you find multiple lenses or elements that combine together to focus without causing distortion. Lenses have 2 parameters that are used to describe them, speed (or f stop) which is an indication of how much light they allow to pass through – the smaller the number, the more light goes through and focal length which is an indication of the magnification of the lens – the bigger the number, the greater the magnification.



THE TRIGGER

With almost all cameras nowadays being digital the trigger is basically software controlled and tells the camera when to actually capture the image and save the image to disc. When you activate a camera on a mobile phone or tablet it will be capturing images constantly, when you click the trigger the current image will be saved to disc or memory. Professional cameras tend to have a physical button that can be pressed, but are still software controlled allowing the photographer to control them remotely from another device.



THE FLASH LIGHT

This is a component that emits a brief, bright light to illuminate the subject being photographed mobile phones and some tablets have them built in and on professional cameras they are optional extras that can either be mounted directly on the camera or placed elsewhere and triggered remotely.





Twitter Battle

COMPUTER SCIENCE



This Lesson Plan has Twitter content. Not suitable for children under 13 years of age.

education@samlabs.com samlabs.com/education

Key information



SUBJECTS

Computing.



RECOMMENDED PRIOR KNOWLEDGE

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Basic understanding of SAM, and the SAM blocks used in the project. Basic understanding of Twitter.

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KEY STAGE

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Key Stage 3



OUTCOMES

- To explore and record cultural trends using automated logging of hashtags or twitter ID's.
- Use automation to analyse and log social media.
- Practice teamwork and collaborate to navigate through problems.
- Reflect on and review the process, their product and that of their peers.

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LEARNING OBJECTIVES

See Curriculum Alignment (next page).



GROUP SIZE

2-3 students

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TIME REQUIRED

Suggestion for a 1 hour session:

Introduction to concept - 5 minutes. Activity Stages - 40 - 50 minutes. Extension activity - 10 minutes. Reflection and Plenary - 5 minutes.



MATERIALS REQUIRED

- Computer or Tablet
- SAM Space Education app
- SAM RGB LED
- Any other SAMs the students may need

Curriculum alignment

NATIONAL CURRICULUM STANDARDS

Computing - Key Stage 3

- Design, use and evaluate computational abstractions that model the state and behaviour of real-world problems and physical systems.
- Understand several key algorithms that reflect computational thinking [for example, ones for sorting and searching.
- Understand the hardware and software components that make up computer systems, and how they communicate with one another and with other systems.
- Undertake creative projects that involve selecting, using, and combining multiple applications, preferably across a range of devices, to achieve challenging goals, including collecting and analysing data and meeting the needs of known users.
- Understand a range of ways to use technology safely, respectfully, responsibly and securely, including protecting their online identity and privacy; recognise inappropriate content, contact and conduct and know how to report concerns.

https://www.gov.uk/government/ publications/national-curriculum-in-englandcomputing-programmes-of-study

PROGRESSION PATHWAYS / COMPUTATIONAL THINKING CONCEPT

Programing and development

- Creates programs that implement algorithms to achieve given goals. (AL)
- Declares and assigns variables. (AB)
- Uses post-tested loop e.g. 'until', and a sequence of selection statements in programs, including an if, then and else statement. (AL)

Hardware and Processing

- Selects, combines and uses internet services. (EV)
- Information Technology
- Collects organises and presents data (AB)

Computational Thinking Concept: AB = Abstraction; DE = Decomposition; AL = Algorithmic Thinking; EV = Evaluation; GE = Generalisation

https://community.computingatschool.org. uk/resources/2324

https://community.computingatschool.org. uk/resources/2324

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BEFORE THE CLASS

During this project, students will create a system that will monitor Twitter feeds, and compare one Twitter user with another.

This project will get students thinking 'outside of the classroom' and will give them an insight into how things 'trend' on social media. It will allow them to work with a multitude of topics from Sports and celebrities to news and current events. During the project, students will:

- Discuss the basics of Twitter, Hashtags (#) and Twitter IDs (@).
- Determine the subject/s they wish to monitor (this can be anything from celebrities to football teams, fashion to news).
- Peer review their results.
- Reflect on: strengths, weakness, difficulties and suggested modifications.
- Think of other ways this system can be used.

OUTPUTS **INPUTS** CONNECTIONS 002 COLOUR COUNTER TWEET IN HOLD Tweet in <> RGB LED =100 through a Counter and Color Discover how popular a COMPARE particular topic from twitter is.) XOF Keep track of how many times it gets mentioned. LOGIC XOR SOUND PLAYER RGB LED =100 Tweet in <> Soundplayer through COMPARE Compare and Logic XOR. Once your topic of choice reaches 100, the soundplayer will make a noise of your choosing. HOLD 004 TWEET IN COUNTER COLOUR

Below is an example solution to the final challenge:



02 BEFORE THE CLASS Final checklist

The following contains everything you need to prepare your SAM Labs environment before commencing the project. Please ensure you read each section carefully to ensure you have a problem free lesson.

DOWNLOAD THE APP

You can download the SAM Education app for OSX or Windows at **https://www.samlabs.com/app**.

SAM LOG IN

Create a SAM account if you don't already have one. SAM accounts are free and allow you to save your inventions to the cloud and download and modify them later, you can even share them with others.

CHARGE YOUR SAM BLOCKS

Even though the blocks can be used while tethered, they were designed as rechargeable devices that can be used a fair way away from your system or where they can't be plugged in. You can tell they are fully charged when they change colour from red to green.

Handy Tip: you can click on a block in the SAM space to see how much charge is left.

ADDITIONAL RESOURCES

For SAM support https://www.samlabs.com/support.

O3 Activity stages

Tell the students that by the end of today's project, they will have created and programmed a system that will track what is happening on Twitter. Their system will also determine who tweets more than others, and also track the activity of trending topics.

Q: Have you used Twitter before?

Describe what Twitter is in 140 characters!

Q: If you use Twitter, who do you follow?

Q: Are there any topics or feeds you follow?

Show the students a simple program on SAM Space which will count the number of times a user Tweets, or the number of 'hits' a topic receives.

NB: A user will have the prefix '@', eg @samlabs A hashtag (#) prefix is used to categorise tweets by keyword, eg #worldmentalhealthday

A very useful website to see what is 'trending' on Twitter (getting most mentions by using the hashtag) is: https://www.trendsmap.com/

The example below uses the Tweet In block and a counter. Set the Twitter user or hashtag by double clicking on the Tweet In block.

NB: You will need to associate a Twitter account with SAM before this step. This can be done by double clicking the Tweet in block if you haven't associated an account already. Note that children under the age of 13 may not use Twitter.



Send the students off in small groups to create their own counters, monitoring both Twitter users and hashtags.

Get them to take it in turns to follow a specific user in the Tweet In block and see how many times they tweet in 2 minutes. Now get them to do the same with hashtags. Try to make sure they monitor the same 'type' of user (e.g. @ EdSheeran Vs @eminem)

Stop the students and tell them that they can add more Tweet In blocks to their programs and see in real time who is 'winning'. Have them create a program that tracks additional users or hashtags.

Q: From monitoring your specific topic/user, what are your observations?

Q: How could you improve your program?

Bring the students back together and ask them for ideas about the questions above. Draw out that it would be useful to have some sort of visual or auditory indicator to see who was 'in the lead'.



The example above uses two Tweet In blocks (set to 2 different Twitter users/hashtags). Each time one of the users sends a tweet, it registers on the counter, which causes its colour block to change the RGB LED to the corresponding colour (the top one illuminates it green, the bottom one red). This means that the colour should be constantly changing depending on who is tweeting, and will spend most of its time the colour of the winning tweeter/hashtag. Send the students to create their own Twitter battle using an indicator.

NB: Students could use the RGB LED, two motors (spinning faster the more tweets arrive), the sound player, etc. They can use the chassis supplied in their trays to hold the blocks they use as indicators.

Q: What did you use for your indicator, and why?

Q: Did you try anything else?

Q: How does this help you track the Twitter activity?

For the final challenge, tell the students that they will need to create a program that not only counts the tweets in a battle, but that will announce a 'winner' when the amount of tweets reaches a certain number.

The example below:

- Uses two Tweet In blocks (set to 2 different Twitter users/hashtags). Each time one of the users sends a tweet, it registers on the counters and changes the RGB LED to the corresponding colour (the top one illuminates it green, the bottom one pink).
- Uses Compare blocks to tell the Counters to reach a certain number (in this case the number is 100). Set the number by double clicking on the block and changing the parameter to = then input the number you want to stop counting at.
- Sends a signal when the Counter reaches 100 to: Hold the RGB LED on the colour that 'wins' (you can set the Hold time by double clicking the Colour block).
- The first Counter to reach 100 also sends a signal to the XOR block (or gate. This block, when receiving the 'winning signal' from EITHER Counter, will then play a chosen sound, indicating the end of the battle.

You could show this example to the students and encourage them to change aspects of it to suit their particular battles, or go through new concepts introduced in the solution and have them create their own from this knowledge.





DURING THE CLASS **Extension activity**

Consider creating a match board and battle different teams or celebrities. Look at ways to enhance the battle machine. Even consider battling different subjects for example Football vs Music.

Add logic and more inputs to determine the answers to more complex questions for example Manchester United and Wayne Rooney or Ed Sheeran and Taylor Swift.

Q: Could this be expanded further?

Discuss what the battle results mean, how we access information, and how methods of communication have evolved. Are particular entities heavier users of social media? Does a football team use twitter more than pop star? Which pop star is the most talked about? Which pop star talks most about themselves, etc.

RECORDING THEIR WORK

Students could use a mix of screen shots, writing and tables to record their work.



What do you need to know?

Make sure you have registered a Twitter account and paired it with SAM Space before the session.

It is a good idea to see what is trending on any particular day. EG the Throwback Thursday hashtag is a good one to monitor on Thursday (#TBT).



What Happens in the Dark?

COMPUTER SCIENCE DESIGN & TECHNOLOGY

LABS

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Key information



SUBJECTS

Computing, Design & Technology.

KEY STAGE

Key Stage 3



OUTCOMES

- To capture and log data over time.

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- To use automation to perform repetitive tasks.
- Practice teamwork and collaborate to navigate through problems.
- Reflect on and review the process, their product and that of their peers.

RECOMMENDED PRIOR KNOWLEDGE

Basic understanding of SAM, and the SAM Blocks used in the project.

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GROUP SIZE

3-4 students

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TIME REQUIRED

This project needs to go over two sessions, as the program needs to be set up in the first session, left over night, and the outcomes reviewed in the second session.

Session 1:

Introduction to concept - 10 minutes Activity Stages - 40 - 50 minutes Extension activity - 10 minutes Reflection and Plenary - 5 minutes

Session 2:

Introduction and recap - 10 minutes Collect and analyse the data - 25 minutes Present the outcomes - 10 minutes Extension Activity - 10 minutes Reflection and Plenary - 5 minutes



MATERIALS REQUIRED

- SAM Space Education app
- 1 SAM tray

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LEARNING OBJECTIVES

See Curriculum Alignment (next page)

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Curriculum alignment

NATIONAL CURRICULUM STANDARDS

Computing - Key Stage 3

- Design, use and evaluate computational abstractions that model the state and behaviour of real-world problems and physical systems.
- Understand several key algorithms that reflect computational thinking [for example, ones for sorting and searching]; use logical reasoning to compare the utility of alternative algorithms for the same problem.
- Understand a range of ways to use technology safely, respectfully, responsibly and securely, including protecting their online identity and privacy; recognise inappropriate content, contact and conduct and know how to report concerns.

https://www.gov.uk/government/ publications/national-curriculum-in-englandcomputing-programmes-of-study

Design & Technology - Key Stage 3

- Understand and use the properties of materials and the performance of structural elements to achieve functioning solutions.
- Understand how more advanced electrical and electronic systems can be powered and used in their products [for example, circuits with heat, light, sound and movement as inputs and outputs].
- Apply computing and use electronics to embed intelligence in products that respond to inputs [for example, sensors], and control outputs [for example, actuators], using programmable components [for example, microcontrollers].

https://www.gov.uk/government/ publications/national-curriculum-in-englanddesign-and-technology-programmesof-study

Science - Key Stage 3

Analysis and evaluation

- Present observations and data using appropriate methods, including tables and graphs.
- Interpret observations and data, including identifying patterns and using observations, measurements and data to draw conclusions.
- Present reasoned explanations, including explaining data in relation to predictions and hypotheses.
- Evaluate data, showing awareness of potential sources of random and systematic error.
- Identify further questions arising from their results.

01

BEFORE THE CLASS

This project focuses on designing and creating a flexible logging system using a range of SAM Blocks that will automate the process of recording light levels overnight, so that the rate of light change at dawn and dusk can be explored. The system will be set up to take a reading every 15 minutes so the data can be examined and presented in various ways.

The students will:

- Hypothesise as to what they expect the results might look like.
- Design and build an automated system that will record light values.
- Investigate the data produced
- Present their findings

Below is an example of what the SAM space could look like.

Note: As we'll be leaving the SAM Space set up overnight to log the data, it is advisable to keep the sensor plugged in to a power source to ensure that it doesn't run out of battery before the project has ended.





02 BEFORE THE CLASS Final checklist

The following contains everything you need to prepare your SAM Labs environment before commencing the project. Please ensure you read each section carefully to ensure you have a problem free lesson.

DOWNLOAD THE APP

You can download the SAM Education app for OSX or Windows at **https://www.samlabs.com/app**.

SAM LOG IN

Create a SAM account if you don't already have one. SAM accounts are free and allow you to save your inventions to the cloud and download and modify them later, you can even share them with others.

CHARGE YOUR SAM BLOCKS

Even though the blocks can be used while tethered, they were designed as rechargeable devices that can be used a fair way away from your system or where they can't be plugged in. You can tell they are fully charged when they change colour from red to green.

Handy Tip: you can click on a block in the SAM space to see how much charge is left.

ADDITIONAL RESOURCES

For SAM support https://www.samlabs.com/support.

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during the class Activity stages

Explain to the students that they are going to explore what happens to light levels at dawn and dusk, and look for unexpectedly bright periods overnight. We are going to build an automated system to help us find out more details.

Q: What do you think happens to light levels at various parts of the night?

Q: Can you think of anything that might cause unexpected bright periods?

Q: Why do we need to build a system that automates recording the light levels?

Once the students have established their expectations about how light levels change overnight, we can start exploring the SAM Blocks that will help us to monitor these two factors. We will be working with the Light Sensor.

Q: What external factors could influence the results collected by the sensor?

Open the SAM Space and introduce the students to light sensor blocks. Connect the block to a Log block (which you can find in the behaviours section). The log block writes all values that it receives to a simple text file.





Double clicking the log block allows you to set how often readings are recorded from the sensors connected to it. Ask the students to consider how often a reading should be taken, but every 15 minutes is a good option. Double click the log block to set this parameter.

- Q: How often should a sensor's reading be saved?
- Q: How much data will this create if you left it running overnight?
- Q: Is this manageable?
- Q: Is there enough data to draw useful conclusions?

Now, we want to build a system that will let us keep track of the progress of the data collection. We'll build a counter that will count upwards overnight. In the morning we will be able to tell that the system ran all night by the value on the counter.

Add the following SAM Blocks and connect them together as follows: Time Trigger, Counter, Compare, Delay.



We need to edit the parameters of these blocks so that the counter can count up to some value less than 100 in about 9 hours, and then stop. If it goes over 100, it will "roll over" back to zero! You can do this by double clicking on each block and adjusting their values accordingly.

Delay block - set the delay time to 15 minutes Compare block - set this to a value of <58 (we'll explain why in a moment) Time Trigger - set this to start an hour before dusk.

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When the Time Trigger block reaches 5pm, it will output a '1', which will be registered on the Counter block. This will cause the comparison block to trigger the delay block (1 being less than 58). After 15 minutes, the Delay block will send a signal to the counter, which will add an increment to the counter (setting it to 2). The loop will then continue. This loop will allow us to check the overnight progress of our log, with the counter increasing by a value of one every 15 minutes, which will match our logged data.

We set a value of < 58 so that the counter will stop when it reaches 58. If the block counts to 58 in 15 minute intervals, that will give us about 14.5 hours. If the counter block contains the number "58" in the morning, we'll know the system ran correctly all night.

Q: Based on the time intervals for logging your data, what values do you need to set the parameters to so that the data is logged throughout the night?

Note: as we suggested earlier, it is a good idea to ensure that the sensor block is connected to a power source so that it lasts throughout the night. Similarly, the computer needs to be plugged into a power supply too, and all energy saving options that might cause the computer to 'sleep' need to be disabled.

The light sensor block can be positioned somewhere appropriate overnight. Placing it into the red controller in the students tray can make it easier to find in the morning!

In the morning, use the Log Block's configuration popup to email the data as a CSV file (comma separated values). This file should open in most spreadsheet applications, such as Microsoft Excel, for the data to be viewed and analysed.

Q: Is there a correlation between the data recorded from the light sensor and the times recorded in the log file?

Q: Is this what you expected, or different?

Ask the students to present their findings to their peers for discussion.



DURING THE CLASS **Extension activity**

If some groups complete the task, they can be challenged further. Encourage the students to consider presenting their data as a graph, asking them to think about visual ways of displaying the data.

Q: Are there other ways you could present the data?

Q: How could you show the data from multiple nights side by side, over time to make it easy to spot the correlations?

- Q: Could this be expanded further?
- Q: Could we repeat the task and put loggers in different areas of the school?
- Q: Are some areas lighter than others over night?
- Q: Why might this be?

RECORDING THEIR WORK

Ensure the students have completed their student packs, recording their thoughts and solutions.

Other options: Create an e-book / poster / video, etc. to explain what they have done.



SAM Tips & Tricks

The following sections describe how to do really useful things with SAM Labs that you can use in your solutions.

SPINNY-BUZZER

If you need a Buzzer Block, but you only have a motor

A loud buzzy buzzer is often needed in your projects to alert you that something's happened. However, the SAM Trays don't have buzzers... What to do?!

Take a SAM motor block from your tray, and fit one of the included cogs onto it. Then, place it upside down on a desk like so:



Use the following SAM code, with the "Hold" block set to how long you want your buzzer to sound.



If you press the button on your tablet, you'll get a fantastic spinny buzzer! For added effect, fit the motor into the pink chassis in your tray and also include a flashing LED light.

If you need the buzzer to be triggered by something other than a button (such as a timer, or a counter) then just hook the Hold block up to the output of whatever needs to trigger the buzzer, instead of the button as shown above.

LIGHT SENSOR AS A BUTTON

If you need a button, but your SAM Tray only contains a light sensor

Each SAM Tray contains a light sensor rather than a button. This is because light sensors are super useful for all sorts of fun things, whereas a button is a bit single purpose!

Sometimes, though, you just need a button to make something happen. So what do you do?

Use a light sensor! With the latest version of the SAM Space App, the light sensor will simulate a button by default.

So, drag your light sensor to the canvas. Whenever you tap the light sensor (blocking out its light), it will behave just like a button that's been pressed! It shows this by showing "True" or "False" above it, depending on if it's "pressed" or not.

With a program like the following, when you put your hand over the light sensor you'll see the counter click up:



LIGHT SENSOR AS A LIGHT SENSOR

For when you want your creation to react to changing light levels

As the above section describes, the light sensor will by default act like a button - when you cover it, it'll behave like a button that's been tapped, and output a "true" value.

In some cases, though, you do want a light sensor!

In this case, do the following:

- Tap the light sensor block in SAM Space (or click it in the Windows version)
- Tap the cog icon
- Use the dropdown to choose the "sensor (0 100)" option
- Tap "Done"

The light sensor will now output values of 0 to 100, where 0 is dark and 100 is the maximum.

VIRTUAL BLOCKS

If you need a button, but you don't have any physical input blocks

Some activities need more than one way to input into the system. Each SAM Tray only contains one input device, however - the light sensor! What do you do if you need a button, but you're already using the light sensor for something else!?

Use a Virtual Button and interact with it through the app, of course!

Scroll to the "Sleeping Blocks" section of the toolbar in SAM Space, and drag one of the "wireframe" style buttons on to the canvas. You'll see the button will have a little virtual button hovering above it - if you press that, that will "press" the button for you, and your program will work.

For example, the following SAM code shows a sleeping button connected to a sleeping light:



You see the green blob above the button? Hold it! You'll see the light light up as follows:



You can use both the sleeping button and slider in this way, just as if they were real blocks.