Go Forth and Create

A resource to support the teaching of Computing Science using Scratch and based on the Forth Bridges.

Curricular Focus: Curriculum for Excellence Technologies

THE FORTH BRIDGES®

TRANSPORT SCOTLAND
CÒMHDHAIL ALBA

CDDV
Centre for Digital Documentation and Visualisation

UNESCO
United Nations Educational, Scientific and Cultural Organization

The Forth Bridge inscribed on the World Heritage List in 2015

THE BRIGGERS

FORTH BRIDGES FORUM

National Records of Scotland

NetworkRail

HISTORIC ENVIRONMENT SCOTLAND

ÀRAINNEACHD EACHDRAIDHEIL ALBA

UNIVERSITY OF ABERDEEN

Go Forth and Create

Curricular Focus and Level : Technologies, Second Level

Experiences and Outcomes:

- I can explain core programming language concepts in appropriate technical language. TCH 2-14a
- I can create, develop and evaluate computing solutions in response to a design challenge. TCH 2-15a

Benchmarks:

- Predicts what a complete program in a visual programming language will do when it runs, including how the properties of objects for example, position, direction and appearance change as the program runs through each instruction.
- Creates programs in a visual programming language including variables and conditional repetition.
- Identifies any mismatches between the task description and the programmed solution, and indicates how to fix them.

Resources:

Resources included in the pack:

- Go Forth and Create - Demonstration of Completed Sorting Game program outlined in plan can be viewed at https://scratch.mit.edu/projects/229829234/
- Go Forth and Create Completed Scratch Animation https://scratch.mit.edu/projects/229819192/
- Go Forth and Create Vector Resources for Scratch (link)
- Demonstration of completed program outlined in plan can be viewed at
- https://scratch.mit.edu
- http://barefootcas.org.uk
- Education Scotland - Computing Science https://bit.ly/2BULqo2
- Forth Bridges Website https://www.theforthbridges.org
- Teachers may also wish to access the Go Forth and Discover or Go Forth and Design Learning Packs which focus on social studies and engineering skills.
- Unesco World Heritage - Forth Road Bridge https://whc.unesco.org/en/list/1485/

Duration of activities:

- 1.5 hrs on Animation and Research
- 1.5 - 2.5 hrs on Creation of Sorting gaming

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Overview of Learning

The Go Forth and Create learning resources have been designed to develop knowledge and understanding of the Forth Bridges through learning in Computing Science. The resources can be used in isolation as a tool to support the Technologies Curriculum for Excellence for primary 5 learners onwards or as part of a wider interdisciplinary learning focus from second level.

Using Scratch, a visual programming language, learners can use the vector images supplied to either create an animation of their own or a sorting gaming. These graphics have been created based on the laser scanning data of the Forth Bridges.

This lesson pack will support users in creating a program using a multiple choice sorting game within Scratch. They should create a sorting program which demonstrates their knowledge of the Forth Bridges and which modes of transport can use each bridge through the use of broadcasting, loops, variables and conditions. This will develop their problem solving and critical thinking when they debug and test their solution as they go.

Pupil Objectives

- I can create a program.
- I can identify the role of variables, loops and broadcasting within my program.
- I can debug my program to meet the solution.

Introduction

Practitioners can initiate the lesson through a discussion on key landmarks across Scotland and why they are important. Focusing on the Forth Bridges, learners should research what Bridges exists in the Firth of Forth. This can also be part a wider project looking at the engineering of the bridges through the Go Forth and Design project or the history of the Forth Bridge via Go Forth and Discover project.

Learners should understand that each of the three bridges are used by different modes of travel (full details can be found via https://bit.ly/2C5KIAP) and practitioners may wish to link to the Social Studies curriculum.

Practitioners can explain that learners will be use their programming skills to create a sorting gaming which will support the user in identifying which bridge is correct for the type of transport shown on screen. A completed example of this program can be
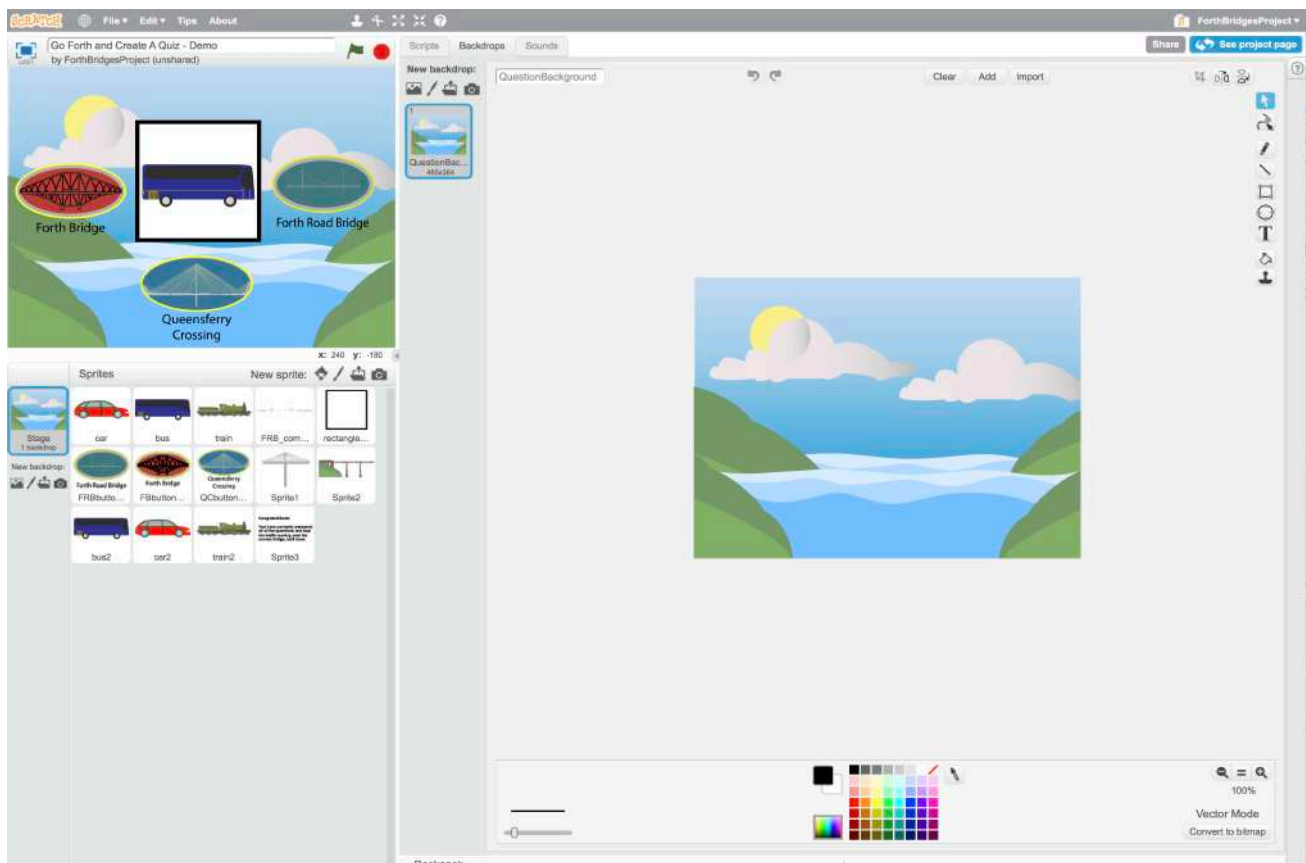
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found via and discussion around the code used should highlight existing knowledge and introduce any new aspect.

Practitioners should highlight the three key features :

- **Loops** - code which means anything within it will repeat for a set amount of time or forever. These can also be called **unconditional loops.**
- **Conditional loops** — code which **controls** anything inside it, making sure that it meets the controls it puts in place, these are also know as **if-then** of i**f-then-else** e.g. if it is sunny put sunglasses on, else (if not sunny) put sunglasses in bag.
- **Variables -** a container which can be labelled and which stores information (**data**) known as its **value.**
- **Broadcast -** a message which is sent (**broadcast**) in a program and **received** by another part of the program or sprite.

Main Activity

Through the use of the vector artwork in the Go Forth and Create online resources pack or through designing their own, learners should create a backdrop which will be the **stage** for their sorting gaming.
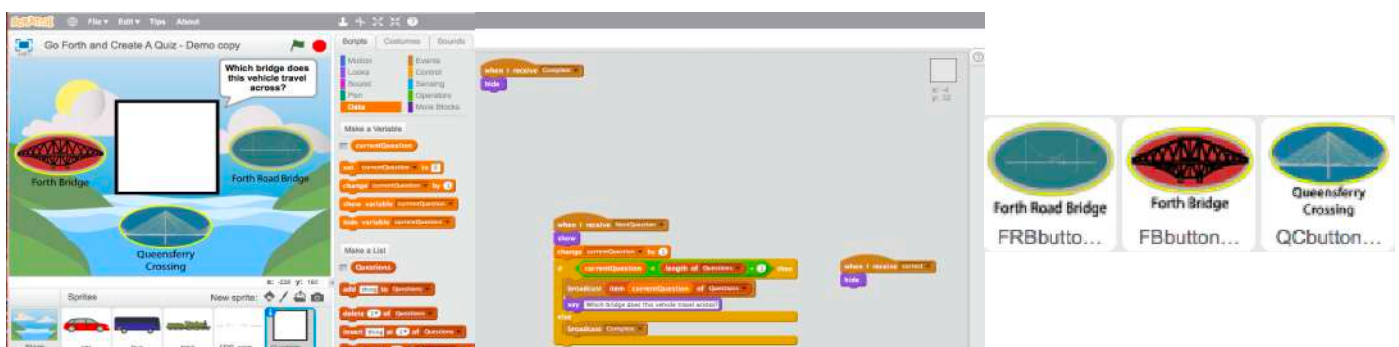
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Prior to creating their algorithm, a range of sprites should be added which represent the transport which they will be asking users to sort, the bridges to select from and a question space as seen below. At least two of each type of transport are required as one will **receive** information during the question part of the sorting gaming and the other identical sprite will **receive** information and **broadcast** as part of the animation. Learners will require a minimum of 2 cars, 2 busses and 2 trains.

At this stage, learners should also identify that they are required to create a **variable** via the data category of scripts. These **variables** will trigger an animation for the sprites if they are correct or a sound if the answer is incorrect. The name of their **variable** is how other parts of the program find it, for this activity we will use it to look for a 'question'. Learners should now add a variable called 'CurrentQuestions' this will allow them to make a list which contains all of the questions which are **broadcast** when clicked.
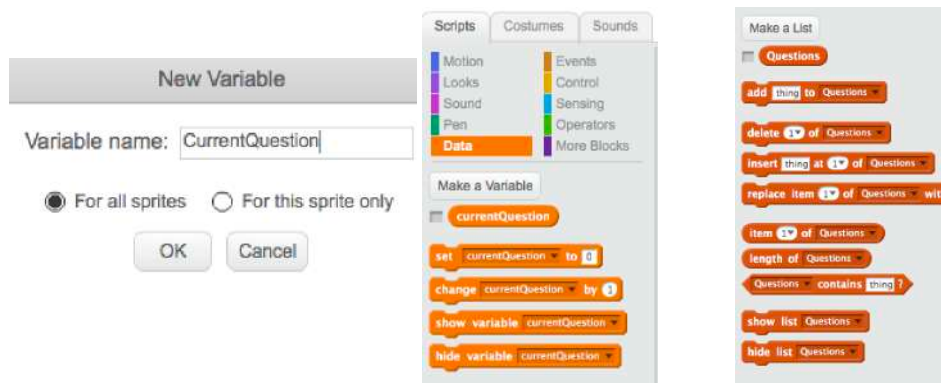

Three sprites representing each of the bridges should be added as buttons for the game in order for the user to click on and select their response to the question being asked. These sprites will **broadcast** the answer, triggering the animation to play showing that the answer was correct or alternatively an incorrect response or sound can be played. Another sprite, a simple square where the vehicle will sit on the stage, should be added which will be **broadcast** when the gaming asks a question.

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This question space should be programmed to appear when it **receives** the next question as seen in the images. The learner will then be required to use their **variable** and an **if-then-else loop**. This program will change the question to the next on their list and then **broadcast** 'hide' if it is correct. A separate line of code for each bridge button will receive this information and if correct it will play the animation of the vehicle traveling across the bridge. It will also **broadcast** to tell the sprite to hide if the sorting gaming is at an end.
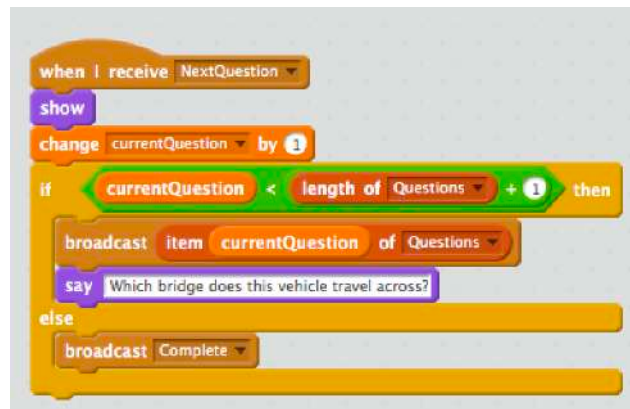
Learners will use an operator in their **loop** to contain **boolean logic blocks**, these are blocks which are true or false and in this case they are conditional. These green operators join information from the **variable** together e.g. a question with the information in the list. Here were are telling the program to ask the next question in the list until it is complete. We also identify what the question is through the use of a looks block.

Next, the learner will program each of the game buttons to **broadcasting** information and **receive** information from other sprites. The button sprite should hide if the sorting game is complete. This process should also be repeated telling it to hide if a different bridge animation is going to play or to show if it **receives** a new question which is being **broadcast** by another sprite.

It is essential that when the sprite is programmed it contains an **if-then-else loop**. This tells the program that if the sprite's name starts with a C e.g. for cars, then it should **broadcast** an animation showing the car crossing the Queensferry Crossing or **else**, it should **broadcast** an incorrect noise.
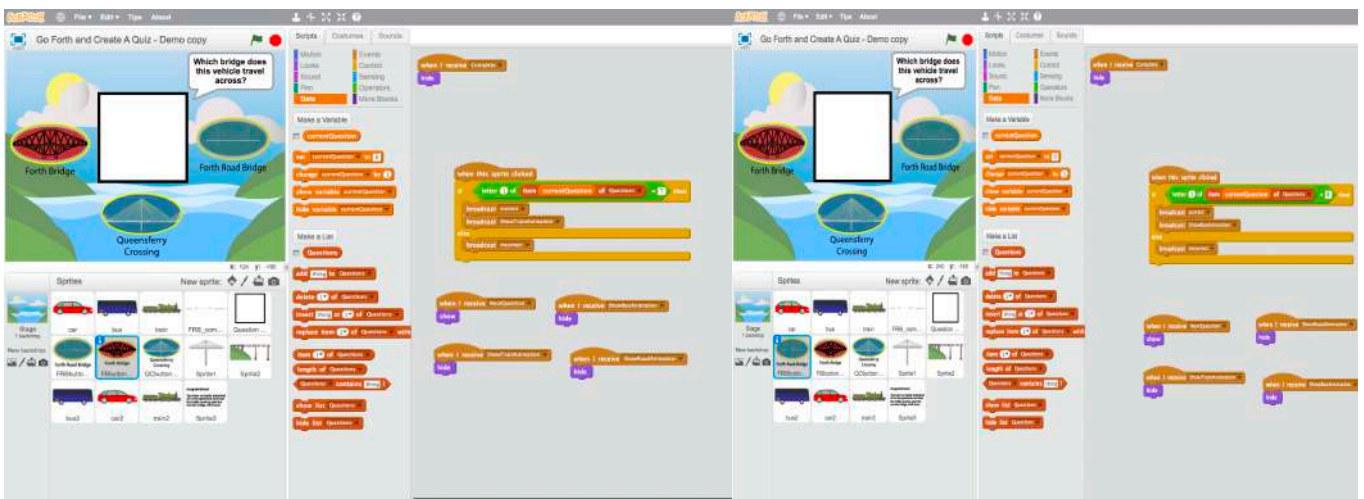
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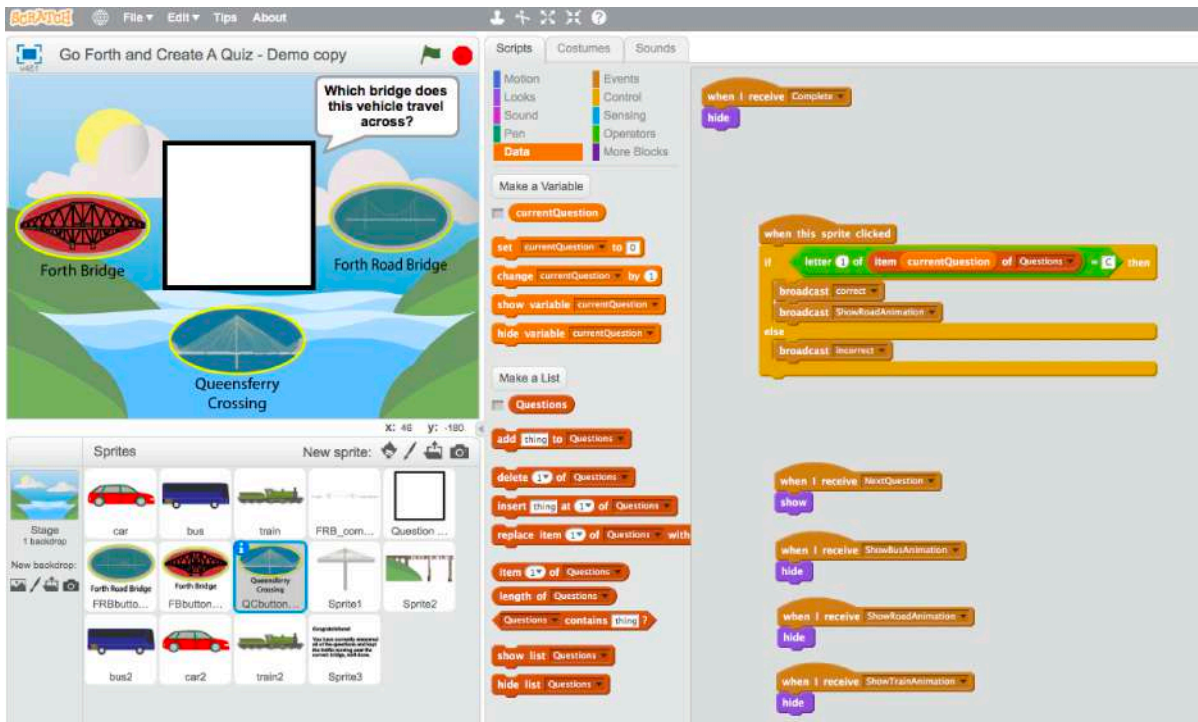
Practitioners should highlight that a **broadcast** command can communicate with any other line of code which has corresponding **receive** script. It is also useful to highlight the pattern and decomposition computational thinking concepts which their program is using as their algorithm runs.

This process should be repeated for each of the Forth Bridge button sprites as can be seen in the images below. The operator and data script should change to reflect the initial of transport travelling over the appropriate bridge. E.g. Forth Bridge = T for train and Forth Road Bridge = B for Bus.
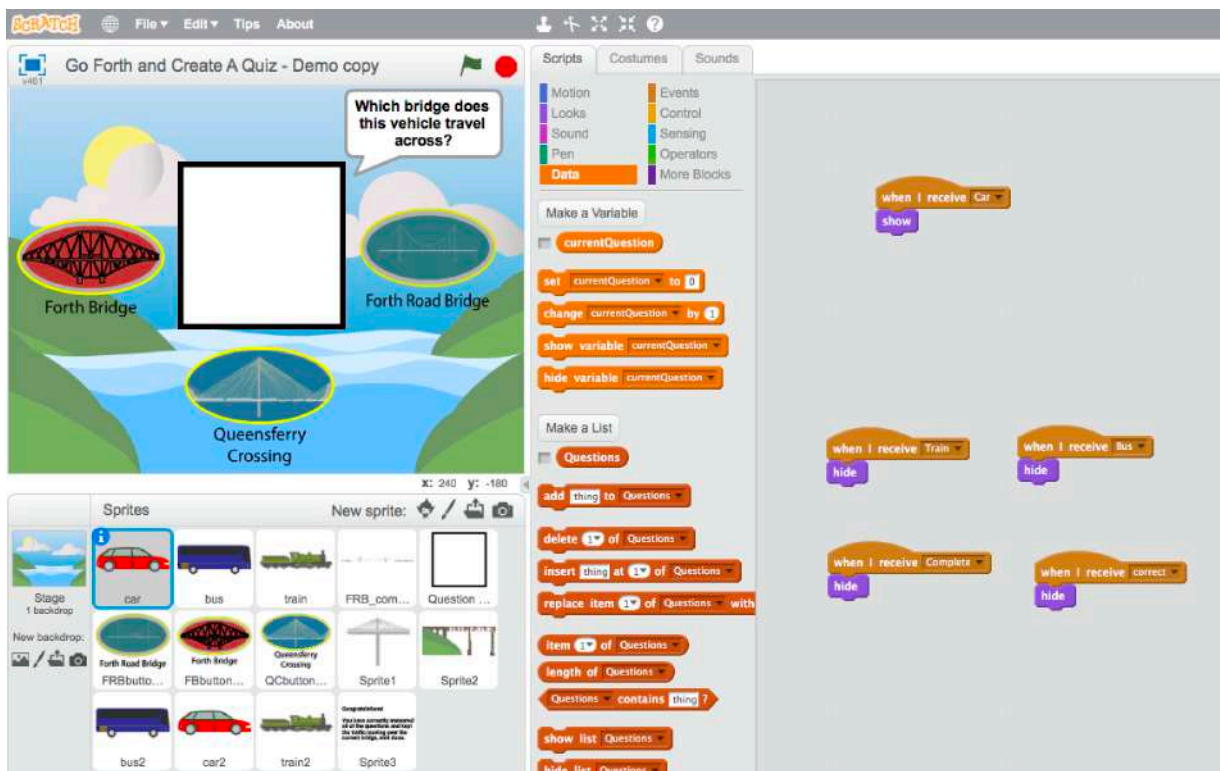
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The animations will be broadcast by the vector images of the bridges which are also sprites. These only have two scripts and each one will reflect the transport which will cross the bridge as well as a separate '**hide**' script.

The learner should now program each sprite which will be used as a vehicle. Firstly, select the sprite vehicle which will be on the stage during the questioning e.g. 'car'. This sprite will only **receive** information from the code within the other aspects of the games. They should only have the car **show** when it is signed to **receive** 'car' and **hide** when it revolves all other types of transport.

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Once the sprite being used in the question has been programmed, a duplicate sprite should be coded for example we will use the Sprite called 'Car2'. When the user clicks the flag to start the sorting gaming this sprite should hide.

The learner should then program 'Car2' to receive the broadcast from the button which tells it to play the car animation. Scratch will require the pupil to identify and use the **x-y coordinates** of where the learner wants their sprite to be placed on the stage when they are programming the animations.
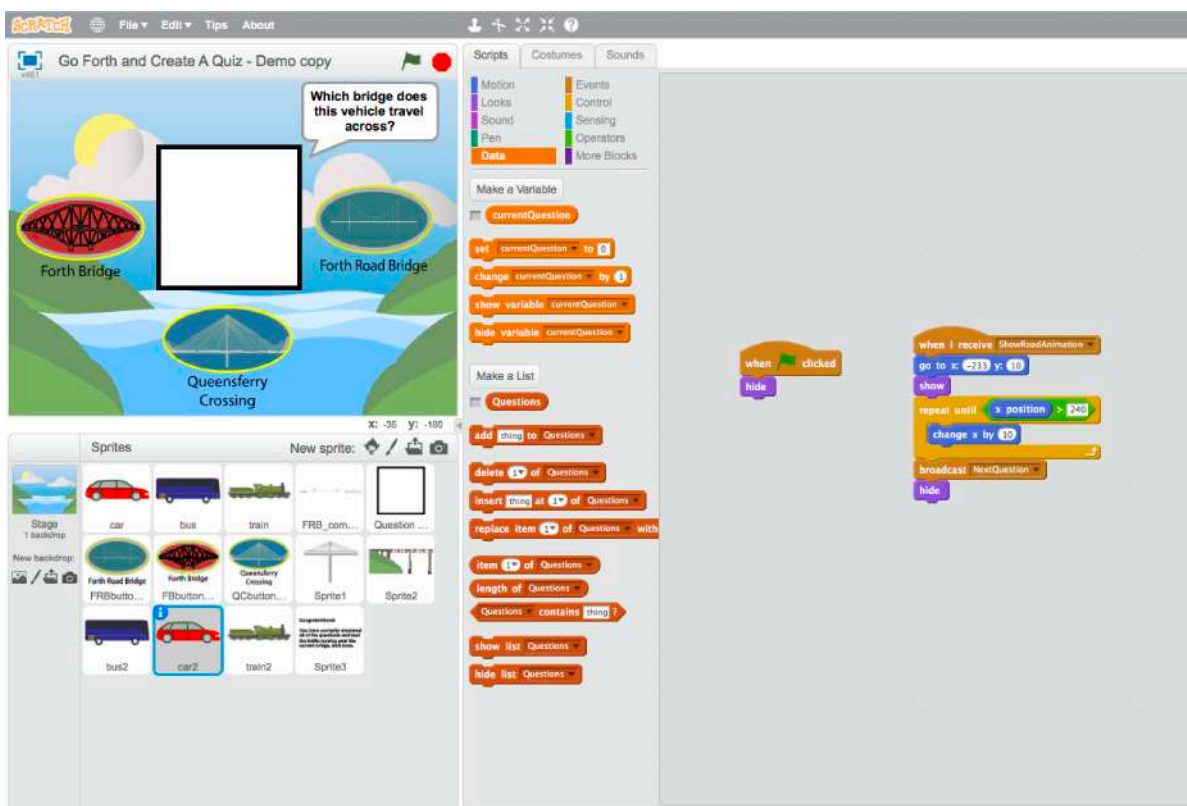
To avoid errors, programmers tend to be concise in the writing of the their scripts, learners can therefore include a loop so that the sprite keeps moving until it reaches the end of the screen at which time it **broadcasts** that the questions should be asked again and it should hide.

Now repeat this process for the bus and train sprites, right clicking on the script will cause that group or block to run and allow the learner the opportunity to debug their work as they go.

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Finally, you may wish to let the user know that they have reached the end of the list of questions by correctly stating which bridge each mode of transport will cross. This can be done in one of two ways. You can create another stage and tell the program to switch the backdrop or you can create another sprite which will show when the last question and animation **broadcasts** that it is complete.
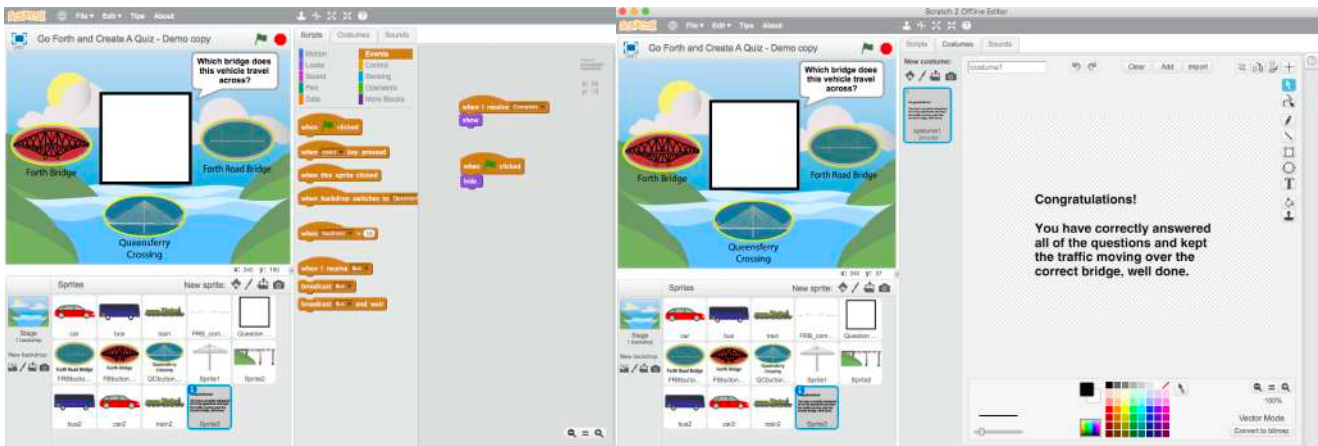
Plenary

At the end of the activity;

- Discuss which computational thinking approaches they needed to use to create their algorithm and what affect they had.
- Discuss how else can the learners can apply the broadcast script into other computing science actives e.g. making a board game, quiz or it can be used to convey information in an animation.
- Ask learners to suggest an alternative way of programming the vehicles to cross the bridge e.g. rather than use the initials of the modes of transfer in the operators, how could they have changed their algorithm using change of backdrop and costume?
- Discuss what other programs that learners could create around the Forth e.g. tour guided animations, etc.
- Discuss what, if any, difficulties learners had when creating their sorting game and how they debugged their algorithm to have a working program.

Assessment Opportunities

- Observe and review completed sorting activity created using Scratch or in paper format if algorithms were planned out prior to working on a computer.
- Learners can apply their knowledge to a different project using the broadcast and receive messages to create a different sort of activity.

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Curriculum Links

Literacy

- Using what I know about the features of different types of texts, I can find, select and sort information from a variety of sources and use this for different purposes. LIT 2-14a

Technologies

- I understand the operation of a process and its outcome. I can structure related items of information. TCH 2-13a

- I can extend and enhance my design skills to solve problems and can construct models. TCH 2-09a
- I can extend my knowledge and understanding of engineering disciplines to create solution. TCH 2-12a

Social Studies

- Having explored the ways journeys can be made, I can consider the advantages and disadvantages of different forms of transport, discussing their impact on the environment. SOC 2-09a
- I can consider the advantages and disadvantages of a proposed land use development and discuss the impact this may have on the community.SOC 2-08b

Extension and Further Resources

An additional completed Scratch project which uses moving transport and changing backdrops to create a constantly moving animation could be created, an example of a completed version of this via https://scratch.mit.edu/projects/229819192/ .

Alternatively, practitioners may wish to encourage learners in designing their own games or animation, resources to support this can be found via https://scratch.mit.edu/users/ForthBridgesProject/

To further extend learning around the Forth Bridge, you may wish to investigate and use some of the other materials from the Go Forth Bridges Project including:

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Go Forth and Discover

   Resources to support understanding and research around the history of The Forth Bridge and the life of a young person who built it.

Go Forth and Design

   Resources to support the design and engineering aspects of the Forth Bridges and developing an understanding of simple Computer Aided Design (CAD) based software.

Schools can also access the Go Forth, See and Hear 360° Audio and Video files via the Forth Bridges Forum https://www.theforthbridges.org. These can be used with VR headsets such as Google Cardboard, etc to further develop learners understanding and awareness of the design, scale and function of the three Forth Bridges prior to or instead of visiting them, ensuring all learners can share in an experience.

An AR App, Go Forth and Explore, is also available for download from the Google Play (https://play.google.com/store/apps/details?id=com.simvis.frblbm) and Apple App stores (https://itunes.apple.com/gb/developer/centre-for-digital-documentation-visualisation-llp/id1234262814?mt=8). This location based image app will allow learners to see back through time to when the bridges were being built when standing in specific locations around the Forth Bridge and Forth Road Bridge.

Practitioners may wish to develop links with partner organisations and third parties, several of whom have supported in the creation of these resources, to further research specific workers, the engineering of the bridge, the science behind the materials used, etc.

National Records of Scotland

National Records of Scotland collects, preserves and produces information about Scotland's people and history and makes it available to inform current and future generations. We provide a flexible service with workshops and online resources designed to support a wide range of Scottish curriculum areas to help pupils connect with Scotland's history, heritage and culture from Robert the Bruce to the results of the 2011 Census.

Go Forth and Create

We are delighted to see records from our collections used in a creative and innovative way in the Forth Bridges game. We very much look forward to introducing young learners to this exciting new topic. For more information about the services we provide you can visit the Services for Schools section of our website or contact our learning team at education@nrscotland.gov.uk

The Briggers

The Briggers is a Forth Bridge research group based in South Queensferry beside the bridge. Initially they were responsible for identifying the names of the 73 men and boys who died constructing the Forth Bridge. Their research continues into the history of the bridge and the people who made and maintain it.

The Briggers give Forth Bridge talks to adults and school children and consultancy to bridge related projects. They also hold a significant archive of images and Forth Bridge related material. Their book, "The Briggers," written by Edinburgh author and historian, Elspeth Wills and based on their research, tells the story of the Forth Bridge.

Briggers contact: mail@briggers.com   Briggers website: www.briggers.com

Historic Environmental Scotland

Historic Environment Scotland (HES) is the lead public body for Scotland's historic environment and a charity dedicated to conserving and presenting Scotland's places now and in the future. We care for over 300 prehistoric sites, castles, abbeys and industrial buildings spanning 5,000 years of Scotland's history and culture. We are Scotland's largest operator of paid tourist attractions.

The HES Learning & Inclusion Team support access to our historic sites and deliver programmes which use these special places in creative ways to support learning and wellbeing for diverse audiences.

From Edinburgh Castle to the Antonine Wall our sites are a rich national resource for learning. As well as telling Scotland's story these special places can provide inspiring and meaningful experiences, safe environments in which to learn and routes to our national culture. They provide excellent settings for exploration, discovery and inspiring creativity.

We can support schools and learning groups through:
• free Education Visits with a learning or wellbeing remit
• travel grants to support visits from Scottish schools

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- advice and support to enable visits for groups with additional support Needs
- access to archives and digital resources containing millions of photographs, drawings and plans relating to national and local culture and heritage
- support from our Learning Officers who work in partnership to deliver activities and projects to support learning, creativity and wellbeing linked to our sites and collections

To find out more visit our website www.historicenvironment.scot/hes/learn

SCDI's Young Engineers and Science Clubs Scotland
SCDI's Young Engineers and Science Clubs Scotland (YESC) programme supports learners aged 3-18 and their teachers with a range of innovative STEM projects, developed with our industry partners. Our interdisciplinary projects, accompanied by resource kits and teacher CPD courses, support teachers to tackle challenging STEM concepts through engaging activities; while our annual STEM challenge gives Clubs a practical challenge to explore a topical theme.

In 2016, our Go Forth! challenge with Morrison Construction tasked teams to use a kit of lollipop sticks, cable ties and string build a suspension or cable stayed bridge to commemorate the Queensferry Crossing.

Find out more or come along to our national Celebration of STEM event at the end of term: http://www.yecscotland.co.uk/

DYW
The Developing Young Workforce (DYW) career pathways which can be linked to the Go Forth projects include Engineers, Civil Engineers, Historians, Archivists, Digital Documentation Teams, Games Companies, etc. many of whom have links with the STEM Ambassadors program who offer a free service to schools and teachers. https://www.stem.org.uk/stem-ambassadors