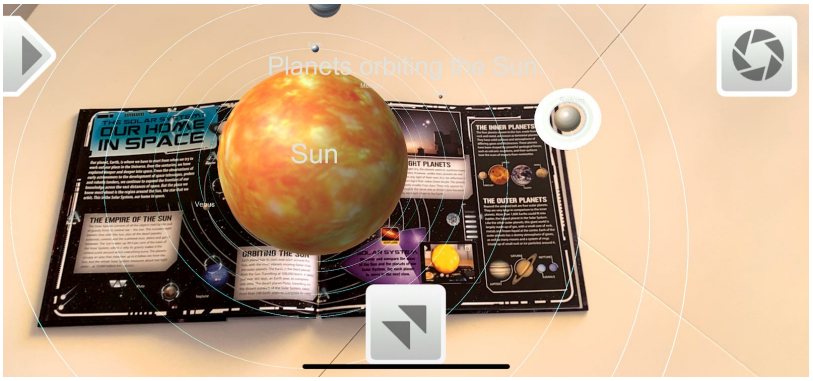
Our Solar System in AR and Code

Year level: 5-6



Summary

In this lesson, students learn about our solar system and how planets orbit around the Sun with Augmented Reality (AR). Students collect data through their AR experience and with their own research and use the information to create their own Solar System simulation using Scratch (MIT).

This project could be done individually, pairs or small groups.

Required Resources

1. Tablet/smartphone device
2. "Dive into Deep Space, Zoom Through the Universe" Book (or other AR resources and apps about the Solar System) with the "iExplore Space AR" App installed.

If you don't have access to the recommended book, you can use many of the available free AR Space resources, such as "Solar System" or "Solar System Scope". These apps could also be used in combination with the book.

3. Access to Scratch by MIT on a desktop computer/laptop.
4. Access to books or online resources about the Solar System and Planets.

Suggested steps

The following are some suggested steps to implement the lesson.

At the start of the lesson the teacher can inform the class that they will be learning about the Solar System and using their experiences in AR to gathering informationto help them create a Scratch simulation of the Solar System to show someone how planets orbit around the Sun.

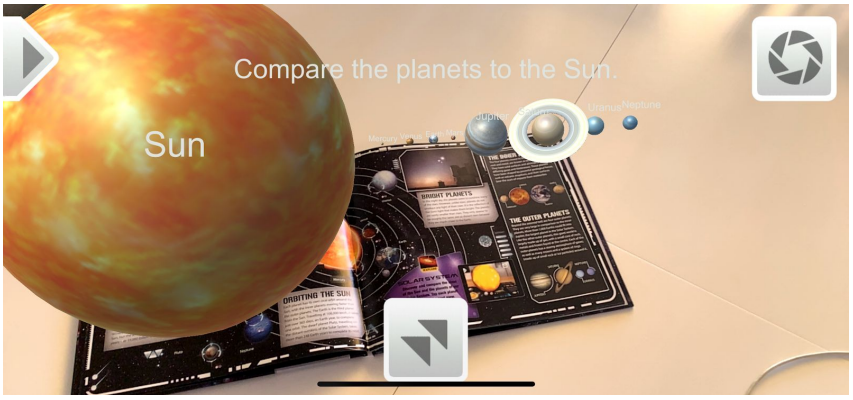
1. **Students explore the Solar System in AR**

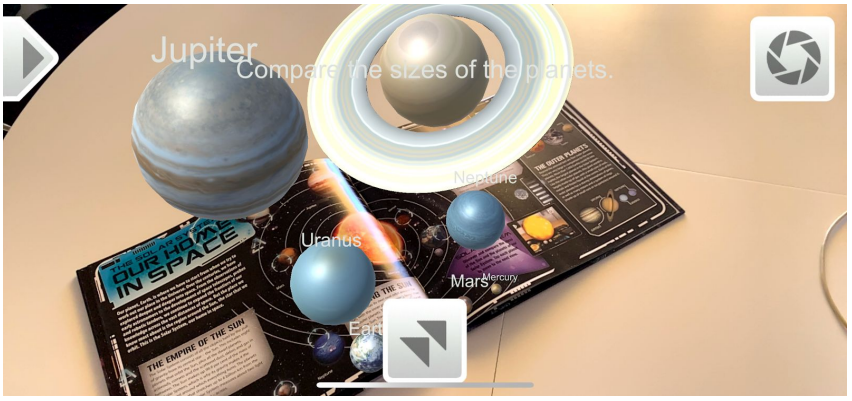
In this lesson, we are using the “Dive into Deep Space, Zoom Through the Universe” Book, as an example resource. The companion app “iExplore Space AR” is used to bring the pages to life with AR.

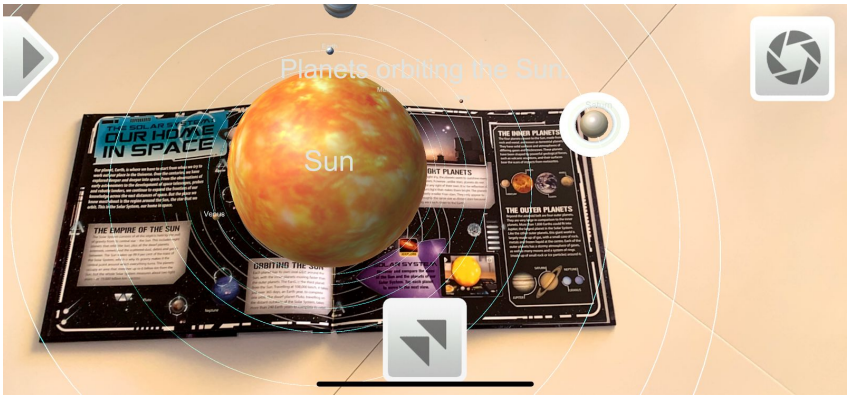
Students are organised into small groups, each with one book and one tablet/smartphone device. Students lay open the Space book on a table or the floor to the page titled “The Solar System: Our Home in Space”.

Students open the iExplore Space AR app on their tablet/smartphone device. Holding the device over the page of the book, the user waits until the AR appears (see below).

Using the arrow icon in the middle of the bottom screen, students can navigate between views, including “Compare the planets to the Sun”, “Compare the sizes of the planet” and “Planets orbiting the Sun”. Students can move around the book and zoom in and out by pinching for a better view of the content.







Using a notepad or digital document, students record as much information as they can about the Solar System using the book and the AR application, noting their observations about the size, color and speed of planets. Students can also examine other pages in the book to learn more about the Solar System, planets and Sun.

2. **Class discussion: What have we learned about the Solar System?**

Following use of the App, the teacher brings the class together to share all that they have learned about the Solar System in their AR experience. The teacher can ask students to volunteer information or pose questions to the class (see the Discussion questions for ideas). Information is recorded onto a whiteboard and shared with the students for reference.

3. **Solar System Data Collection**

In preparation for their Scratch animation, students collect data about the Solar System for their project. Using a spreadsheet, students create a table with the planet names and variables (e.g. diameter, orbital period, rotation period, number of moons, distance from Sun) to collect about the Solar System. Students enter in the data as they come across it in their research.

Note: The variables in the spreadsheet could be provided by the teacher or collectively determined by the class based on what they identify as information needed to model planets orbiting the Sun. An example of the types of data that could be collected can be found below (from source: https://www.windows2universe.org/our_solar_system/planets_table.html).

Planets - Data Table

Like 11

Dwarf Planets are listed in a separate table below.

	Mercury	Venus	Earth	Mars	Jupiter	Saturn	Uranus	Neptune
diameter (Earth=1)	0.382	0.949	1	0.532	11.209	9.44	4.007	3.883
diameter (km)	4,878	12,104	12,756	6,787	142,800	120,000	51,118	49,528
mass (Earth=1)	0.055	0.815	1	0.107	318	95	15	17
mean distance from Sun (AU)	0.39	0.72	1	1.52	5.20	9.54	19.18	30.06
orbital period (Earth years)	0.24	0.62	1	1.88	11.86	29.46	84.01	164.8
orbital eccentricity	0.2056	0.0068	0.0167	0.0934	0.0483	0.0560	0.0461	0.0097
mean orbital velocity (km/sec)	47.89	35.03	29.79	24.13	13.06	9.64	6.81	5.43
rotation period (in Earth days)	58.65	-243*	1	1.03	0.41	0.44	-0.72*	0.72
inclination of axis (degrees)	0.0	177.4	23.45	23.98	3.08	26.73	97.92	28.8

4. **Designing a Scratch Animation of the Solar System**

Using a storyboard approach, students plan out the various pages of their Scratch project and the elements (or sprites) that they will require (e.g. planets, information) and determine how/if users will interact with the animation (for example by clicking on a planet, it can bring up information about it).

5. **Implementing a Scratch Animation of the Solar System**

Students select their solar system background and create sprites for their Solar System (students could create their own using the paint tools or search and import one from the Internet).

Students use the data they have collected to calculate and represent the following elements in their project:

- Determine the starting placement of the planet on the Cartesian Plane (x, y axis) relative to the distance from the Sun.
- The size of the planet relative to the other objects in the Solar System.
- How long it takes the planet to oribit the Sun and the movement of the planet around the Sun.

As students are making their calculations it can be helpful for them to document these in a workbook or to sketch out the Solar System on paper and annotate calculations for the various planets.

Once students have created scripts in Scratch to make planets orbit around the Sun, they can extend their project to include information about planets and/or user interaction.

There are many resources available for creating Solar Systems in Scratch. We can recommend some of the following as a starting point or for inspiration:

- *Scratch Solar System Simulation by The Teacher Bible* *https://www.youtube.com/watch?v=SRibjLJ_VzQ*
- *Solar System + Makey Makey Playlist by Glenn Malcolm* *https://www.youtube.com/playlist?list=PLe9OgGEy3WCOk5z78JsVnIie72aZ_v9r1*

You can also look at the code used in other Scratch projects for ideas on how the Solar System operates but we recommend that this project should be a problem students need to solve on their own and with mathematics.

Discussion

- What are the “inner planets” of our Solar System? What are the “outer planets”?
- What is the importance of the Sun to the Solar System?
- What makes planets appear bright in the night sky?
- What is an orbit? How do planets orbit the sun and what appears to be the difference in the way planets orbit?
- What data do we need to create a project about planets orbiting the Sun in Scratch?
- What information could we present to a user about the Solar System in a digital project so they can learn?

Why is this relevant?

Virtual Reality can enhance learning by placing students in an immersive experience they would otherwise never experience. In this activity, students are engaged in *using* digital technology but are also thinking about how the technology has been designed to tell them a story and to evoke emotion and how it complements their understanding of Anne’s story through the integration of media.

The Science curriculum for Year 5 includes content descriptors relating to learning about the Solar System. This lesson allows students to learn about the Solar System using interactive AR content. Students use problem-solving skills and mathematics to develop a working simulation of the Solar System.

Assessment

The following is a sample checklist of skills and knowledge that students could be asked to demonstrate through their digital project based on content descriptors.

Objective	Yes / No / Partially	Comments
Digital Technologies Justifies and explains their selection of digital technologies for their interactive solution and how it meets their goals. Takes into account safety, social contexts and legal responsibilities in terms of using and sharing information in their project. Plans and manages projects using an iterative and collaborative approach.		
Science Accurately presents the relative distance of planets in the solar system in relation to the sun and one another. Accurately models the relative size of planets in the solar system in relation to the sun. Correctly identifies the planets of the solar system. Accurately represents how long they take to orbit the sun in comparison to one another. Communicates scientific ideas using multimodal information.		

For further advice, examples and support around assessment please visit the Digital Technologies Hub at digitaltechnologieshub.edu.au/teachers/assessment.

Curriculum links

Links with the Digital Technologies curriculum area

Year band	Strand	Content description
Years 5-6	**Knowledge and Understanding**	Acquire, store and validate different types of data, and use a range of software to interpret and visualise data to create information (ACTDIP016) Design a user interface for a digital system (ACTDIP018)

		Design, modify and follow simple algorithms involving sequences of steps, branching, and iteration (repetition) (ACTDIP019) Implement digital solutions as simple visual programs involving branching, iteration (repetition), and user input (ACTDIP020)

Links with Science curriculum

Year band	Learning area	Content description
Year 5	**Science - Earth and Space Sciences**	The Earth is part of a system of planets orbiting around a star (the sun) (ACSSU078)
	Science - Processing and analysing data and information	Construct and use a range of representations, including tables and graphs, to represent and describe observations, patterns or relationships in data using digital technologies as appropriate (ACSIS090)
	Science - Communication	Communicate ideas, explanations and processes using scientific representations in a variety of ways, including multi-modal texts (ACSIS093
Year 6	**Science - Processing and analysing data and information**	Construct and use a range of representations, including tables and graphs, to represent and describe observations, patterns or relationships in data using digital technologies as appropriate (ACSIS107) Communicate ideas, explanations and processes using scientific representations in a variety of ways, including multi-modal texts (ACSIS110)