**ACTIVITY: Making digital space debris clean-up games**

**Activity idea**

In this activity, students consolidate their learning about space debris by creating an interactive model or game in Scratch.

By the end of this activity, students should be able to:

* share a digital outcome with an end user
* explain how their digital outcome models aspects of the issue of space debris
* explain how algorithms used in their digital outcome work.

**For teachers**

***Introduction/background***

Learning activities around space debris modelling, which encourage students to create digital games, includes thinking associated with nature of science (NoS) and the digital technologies curriculum.

***Space debris game design and the nature of science***

*Learning* about space debris could include the ‘Investigating in science’ and/or ‘Communicating in science’ NoS strands.

*Expressing their understanding* of space debris can occur through NoS strands and/or the digital technologies area of the technology curriculum.

Teachers can also explore the science capability ‘Interpret representations’ when making models.

TKI describes [five types of science investigation](https://scienceonline.tki.org.nz/Teaching-science/Teaching-strategies/Types-of-investigation) that align with the New Zealand Curriculum, one of which is modelling. Space debris lends itself well to investigations that involve students using their new knowledge to create digital models and simulations:

* Digital models might allow students to control variables to see what impact each variable has.
* Simulations can allow students to model a situation such as showing how the orbital speeds of space debris vary with distance from Earth.
* Models and simulations can be gamified with the addition of a reward system such as points and upgrades.

In considering what information, data and visuals to include and omit in the model or simulation, students are also engaged with the ‘Communicating in science’ strand because they will be making decisions about vocabulary, numeric and symbol systems, and conventions of science and use this knowledge to communicate about their own and others’ ideas.

***Space debris game design and the digital technologies curriculum***

The digital technologies curriculum includes the two areas of [computational thinking](https://technology.tki.org.nz/Technology-in-the-NZC/CTDT-Progress-outcomes-exemplars-and-snapshots) and [designing and developing digital outcomes](https://technology.tki.org.nz/Technology-in-the-NZC/DDDO-Progress-outcomes-exemplars-and-snapshots). In creating a digital model or simulation, students will be engaging in computational thinking. For instance, using Scratch will involve sequencing instructions for a computer to follow. These instructions will be invisible to the end user (the person interacting with the finished model or simulation) but the student creator must constantly make decisions about how the instructions work together. Producing the finished digital product results in a digital outcome that should be designed with a particular audience or end user in mind.

***Scratch game design examples***

Two Scratch games are available to share with students so they can conceptualise the kind of outcome expected:

* In the [Space Debris Remover](https://scratch.mit.edu/projects/574409914) game made in Scratch, the end user must click on space debris at the right moment to remove it from orbit.
* In the [Space Junk Deorbit](https://scratch.mit.edu/projects/626948314) game, the end user has to deorbit a satellite so it collides with the Earth’s atmosphere at the right position.

Teachers do not need to be experts in using Scratch. Your role is to introduce the issues of space debris, provide the parameters of the finished digital outcome and support students to problem solve their own solutions.

***What you need***

* Chromebooks or laptops. Scratch will work in a browser on all devices, so tablets can also be used but be aware that they have small screens. Depending on how the activity is structured, students can work on individual devices or share a device with a partner. All devices require an internet connection.
* Scratch account and email address. Students will need an account to save their work, and this requires an email account for verification purposes. Students could be supported to navigate to [Scratch](https://scratch.mit.edu/) in their browser and sign up, then check their email for the verification link. Alternatively, teachers can create a single account for the class using a teacher email address and share the login details with all students.

***What to do***

1. Learn about issues surrounding space debris with the articles [Space junk](https://www.sciencelearn.org.nz/resources/273-space-junk) and [Space debris](https://www.sciencelearn.org.nz/resources/3154-space-debris).
2. Discuss ways in which we might be able remove debris from space.
3. Allow students time to interact with the two game examples: [Space Debris Remover](https://scratch.mit.edu/projects/574409914) and [Space Junk Deorbit](https://scratch.mit.edu/projects/626948314). They might wish to search in Scratch for other examples of games based on space or debris/rubbish.
4. Ask students what they noticed and have them guess as to how these games were made. This makes it clear that students will be focussing on space debris and creating an interactive digital outcome around this.
5. Talk with your school’s digital technologies leader about next steps. Take time to gauge your learners’ experience and confidence with using Scratch. For instance, you might wish to structure the activity so that all students create the same game with you demonstrating what to do at each step (I do, we do, you do). In another approach, you might co-construct the expected outcomes and allow students to problem solve their way to those outcomes. Each approach has its pros and cons and emphasises different levels of creativity.
6. Establish a process around sharing the completed games. This requires students to publish their projects in Scratch and to share the project’s URL. You might provide a shared document for students to paste their links into against their name or use QR codes so games can be accessed from anywhere.

***Prompting questions***

Use these prompting questions while exploring students’ digital outcomes:

* Is this a gamified model or a simulation or a little of both?
* What is its purpose?
* How might this accurately or poorly demonstrate the issue of space debris and how we deal with it?
* What science concepts are present and missing from this game?
* What can we remove from this model so it is still useful?
* Which of these models is more useful to a particular audience?
* How does this representation get the message across?
* Why is it presented in this particular way?

***Extension ideas***

Students could explore how NASA uses modelling software to track and predict various parameters for space debris. These models describe, categorise and predict the movements of known space debris items:

* [LEGEND](https://orbitaldebris.jsc.nasa.gov/modeling/legend.html) is a three-dimensional, debris evolutionary model for the study of long-term debris environment projection. It covers the near-Earth space between 200 and 50,000 km altitude, including low Earth orbit (LEO), medium Earth orbit (MEO) and geosynchronous orbit (GEO) regions.
* [ORDEM 3.2](https://orbitaldebris.jsc.nasa.gov/modeling/ordem.html) uses a large set of observational data from space and the ground that reflects the current debris environment. It includes objects that range from 10 µm (that’s 0.01 mm!) to 1 m in size. New data is added all the time to make the model more accurate and up to date.