Journey into space

Primary: (ages 7 – 11) science and mathematics

This a series of lessons which may be used independently or in sequence. They share the common theme of space exploration. Students work with previous knowledge of science and mathematics to plan a space expedition. They discover the solar system, imagine other planets and the aliens that inhabit them, and design space ships for their own travel. Throughout the lessons, students engage in geometric and mathematic operations and the project can also cover multiple other subjects, with children exploring different topics through different exercises.

Time allocation	1-2 lesson periods for each of the 4 lessons
Subject-content	Explore the nature of the solar system, its planets and their moons Understand the difference between orbiting and rotation Draw, measure, combine plane figures to produce 3-D solid shapes Develop spatial perception and use mathematical vocabulary to describe position, direction, and movement
Creativity and critical thinking	This unit has a **creativity** focus: • Generate ideas for an alien, alien habitat, and spaceship • Interpret, appraise, and improve designs, consider different perspectives and reflect on novelty of proposed solutions
Other skills	Collaboration
Key words	Solar system; planets; geometry; 3-D shapes; plane figures; perimeter; height; length; measures; movement; orbit; rotation; space travel; spaceships; meditation

Products and processes to assess

Students collaboratively produce a model of the solar system, alien communities, a spaceship design, and a model spaceship whilst completing small research tasks and appraising and improving their own work and the work of others. At the highest levels of achievement, they are willing to explore and challenge a variety of ideas and perspectives. They show good awareness of areas of personal novelty and risk in their work and can successfully reflect on steps taken, the benefits of their collaborations, and the strengths and weaknesses of their final outputs.

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Teaching and Learning plan

This plan suggests potential steps for implementing the activity. Teachers can introduce as many modifications as they see fit to adapt the activity to their teaching context.

Step	Duration	Teacher and student roles	Subject content	Creativity and critical thinking
1	1-2 lesson periods	*The solar system* Location: outdoors or in the gym in bad weather conditions 1. Using their own bodies, children create the solar system (in the correct order: Mercury, Venus, Earth, Mars, Ceres dwarf planet, Jupiter, Saturn, Uranus, Neptune, dwarf planets: Pluto, Haumea, Makemake, Eris. There are 13 planets, out of these, 5 are dwarf planets, plus the Sun. Larger planets (Jupiter, Saturn) can be represented by more than one child, they can work in small teams. The moon(s) of planets can be formed by more children. All planets have moons except Mercury and Venus. 2. After the class has formed the solar system, they can be asked to clarify the difference between orbiting and rotation, and the location and role of the Sun. This can also be an opportunity to remind students about never looking directly at the sun and for learning about how the sun appears to rise and set due to the rotation of the Earth, as appropriate. 3. Next the orbits of each planet can be drawn on the ground, or if in the gym, duct tape or masking tape can be used to indicate the paths. 4. Children work with the drawn or taped solar system. The teacher provides information on the diameter of each planet, rounding to thousands for simplicity. Students select a ball to represent each planet based on the relative size of the given planet and place the ball in the solar system. 5. The teacher may at this point ask the students to write down or explain 1-2 key things they learned in the lesson or that surprised them today.	Learning about the nature of the solar system and its planets and their moons Difference between orbiting and rotation The role and location of the sun Day and night and the rotation of the Earth Developing spatial perception Distances and proportions Measurement of diameters and circumferences Performing simple calculations using large numbers	Feeling, observing, and describing relevant experience and information Making new connections e.g. between physical space and the solar system Identify alternative explanations about the position and rotation of the planets

		Possible meditation exercise to close Children lie down on the ground, their heads touching. They breathe slowly, and they close their eyes. They are asked to imagine they are travelling around space. What are they travelling in? Is there somebody with them? What do they feel? Do they land somewhere? Where? How long do they have to travel to get there? What do they find there and what is interesting about it? Do they wish to go back to Earth? Who would they hug first upon their return?		
2	1-2 lesson periods	*A space full of aliens* *1. Create an alien* Each group is asked to create an alien. They have full freedom to do so but they are only given around half an hour (as appropriate to context). They can use whatever tools they want and have available to them (e.g. clay or play-doh, textile, wire, sticks, branches, leaves, paper, duct tape, pebbles, glue gun, etc.) They should consider the internal and external characteristics of their alien. They will later expand and justify these features. Comment: the topic of geometric shapes can be raised here, e.g. how solid shapes can be constructed from planes *2. Where could these aliens live?* Students are asked to pick a planet and complete 5 minutes of research (using the internet/books/hand-outs as available) on the question "Can this planet support life? Why/why not?" before reporting back to their group about what they found out and why this information comes from a source they can trust (or whether there are any reasons to doubt its trust-worthiness). The group then discusses where the alien they have created could live. As appropriate they can be encouraged to try to think of some novel, unusual, or radical ideas for this. *3. Alien community and habits* Students are asked to imagine that they have found a place for their alien to live. They discuss in their groups what the alien's community might look like, how many of them live in a community, who they live with, what their habits are. What do they eat? How do they behave with each other? Can students think of any extra features their aliens would need to make this possible? What would the aliens need on their planet/the place they live? How is this	Researching planets and the conditions for life Communicating what they have learned about whether planets in our solar system can support life to their peers Considering community and living together	Generating and playing with unusual and radical ideas for an alien Critically evaluating research sources and proposed solutions Generating and playing with unusual or radical ideas for alien community and habitats Reflecting on steps taken to solve a problem

		different or similar from how humans and/or animals live together on Earth? This can also be used to introduce concepts such as habitat, species, ecosystem etc. relevant to context and local curricula. The session can end with each group feeding back to the whole class and the teacher asking students to reflect on what they have learned about the planets in our solar system and encouraging students to give examples of when they generated unusual idea/s, made new connections, or came up with original and novel solutions etc.	Concepts such as habitat, species, ecosystems, as appropriate to local curricula	
3	1-2 lesson periods	*Designing plane figure spaceships* 1. Introduction: Students work in groups; each group gets a piece of string, and they use it to form a series of plane figures. Group members take it in turns to draw and label the figure that has been formed with the string on a piece of paper 2. Each student engages in 5-minutes of research to find out about space travel and spaceships before communicating the results back to their peers. Resources can include books, internet and print-outs, as appropriate to context. 3. Students continue to work in the same groups. They need to design, draw, and label a plan for a spaceship on paper, using plane figures and measures. Then they give their plan to another group (e.g. clockwise). The next group needs to discuss and improve the plan/design as they deem appropriate. The teacher can prompt as needed here, by for example, asking students to use the information and examples they have found in their research about space travel, or to consider how they can add design elements that are unusual or radically different to the examples they have found. As appropriate to context and level, the teacher can also prompt further use of mathematical knowledge by challenging students to, for example, make their designs twice/half as big, compare and classify the geometric shapes they are using, or identify lines of symmetry etc. The final designs can be used in the final possible lesson below.	Creating, recognizing, replicating, and labelling plane figures Researching space travel and spaceships Using geometric shapes and perimeter and understanding the properties of shapes Applying knowledge gained from research Comparing and classifying geometrical shapes Measuring the perimeter of simple 2-D shapes Using simple fractions, relating simple fractions to measures,	Making connections between plane figures, 3d solid shapes, and space travel Generating and communicating ideas for a spaceship design to their group Interpreting plans and considering different perspectives on the design of their spaceship Reviewing, appraising and improving plans and designs Reflecting on the novelty of the solution and its possible consequences

		4. Evaluation lines cool-down exercise: The class goes out to the corridor, and 3 lines are marked (e.g. with a string taped to the floor). Each line is for one of the three categories, such as: - this is what I learnt - this is what I would do differently - this did not make any sense/this is what I didn't understand Everybody gets 3 post-it notes. They can write down their opinions, thoughts, then they place the post-its onto the lines (or in between the lines). This provides a graphic representation of their reflection on the lesson. The teacher may also choose to ask students to reflect on how they used creativity and critical thinking skills in the lesson and what is new or unusual about their spaceship and why.	and identifying lines of symmetry Creating and improving designs and plans	
4	1-2 lesson periods	*Space travel in a different way* Students work in the same groups as in the previous lesson period. They receive a plan for a spaceship from another group and are tasked with creating this spaceship from recycled materials, cardboard, and objects (or if this is a standalone lesson, then students can start by agreeing a group design under timed conditions to make sure enough time is reserved for construction). They may need to adapt the design and measures depending on what is possible with the materials they have but they should try to keep at least some resemblance between the design and the spaceship they create. They can be encouraged to work together to brainstorm ideas for how they can overcome any problems they encounter whilst transforming the design they are working with into a model reality. They can use glue, tape, and/or string to attach different pieces. They can also be prompted to notice how they are combining plane figures to create 3D solid shapes and to make sure that everyone in the group always has something to do. If some groups finish early or the teacher wishes to extend this activity, students can be asked to imagine new means of travel on new planets (rather than between planets). They can brainstorm ideas for transport under different conditions. What if there was no gravity? What if the surface of the planet was covered in ice or fire? Alternatively, students can be asked to plan a route for their spaceship through the solar system.	Considering recycling and environmental protection Applying knowledge about space travel and spaceships Interpreting plans and designs, drawing plane figures Using and applying measures Combining plane figures to create 3D solid shapes The solar system Using mathematical vocabulary to describe position, direction and movement	Envisioning and producing a new prototype for a spaceship Reviewing and adjusting and considering strengths and weaknesses of their designs Generating radical ideas for how to transform their designs into a reality Appraising the spaceships of themselves and others

	Spaceship exhibition and evaluation. Post-its and pens are placed by all the finished space ships. The class observes each spaceship and each group writes down what they like and/or what they would change about each space ship and why. *Reflection* The activity can finish with some written or oral reflection on questions such as: What plane figures did you use to create the spaceships? What did you change about the design of the spaceship in order to create the model and why? What did you learn about working with other groups to improve ideas? What did you learn about our solar system and space travel? Do you think your spaceship would work if we made a life-sized one? Why/why not? What is an example of one new idea you generated during this project? As appropriate to the context, students can also be asked to evaluate themselves according to the creativity and critical thinking rubric given on p 6.	Reflecting on the steps taken to solve the problem Evaluating the extent to which they used creativity and critical thinking skills in the project

Resources and examples for inspiration

Web and print

- Computer, books, hand-outs as possible research tools

Other

- Lesson period 1: Sidewalk chalks or masking tape (to mark the orbits of the planets) and balls of different sizes
- Lesson period 2: Clay or play-doh, textile, wire, sticks, branches, leaves, paper, duct tape, pebbles, glue gun, etc.
- Lesson period 3: String, tape, post-it notes, paper and pencils
- Lesson period 4: A variety of re-cycled materials, cardboard, and objects, different glues and tapes, strings, post-it notes, stationery

Opportunities to adapt, extend, and enrich

- The project could be extended into other domains by asking students to explore the history and science of space travel or to write stories/plays/music/news reports and/or draw/paint pictures about space travel and the solar system or featuring the aliens they have made.
- Further ideas for activities around space can be found here

Creativity and critical thinking rubric

	CREATIVITY Coming up with new ideas and solutions	Steps	CRITICAL THINKING Questioning and evaluating ideas and solutions	Steps
INQUIRING	Make connections to other concepts and knowledge from the same or from other disciplines	1,3	Identify and question assumptions and generally accepted ideas or practices	3
IMAGINING	Generate and play with unusual and radical ideas	2,3,4	Consider several perspectives on a problem based on different assumptions	3
DOING	Produce, perform or envision a meaningful output that is personally novel	3,4	Explain both strengths and limitations of a product, a solution or a theory justified on logical, ethical or aesthetic criteria	2,3,4
REFLECTING	Reflect on the novelty of solution and of its possible consequences	2,3,4	Reflect on the chosen solution/position relative to possible alternatives	4