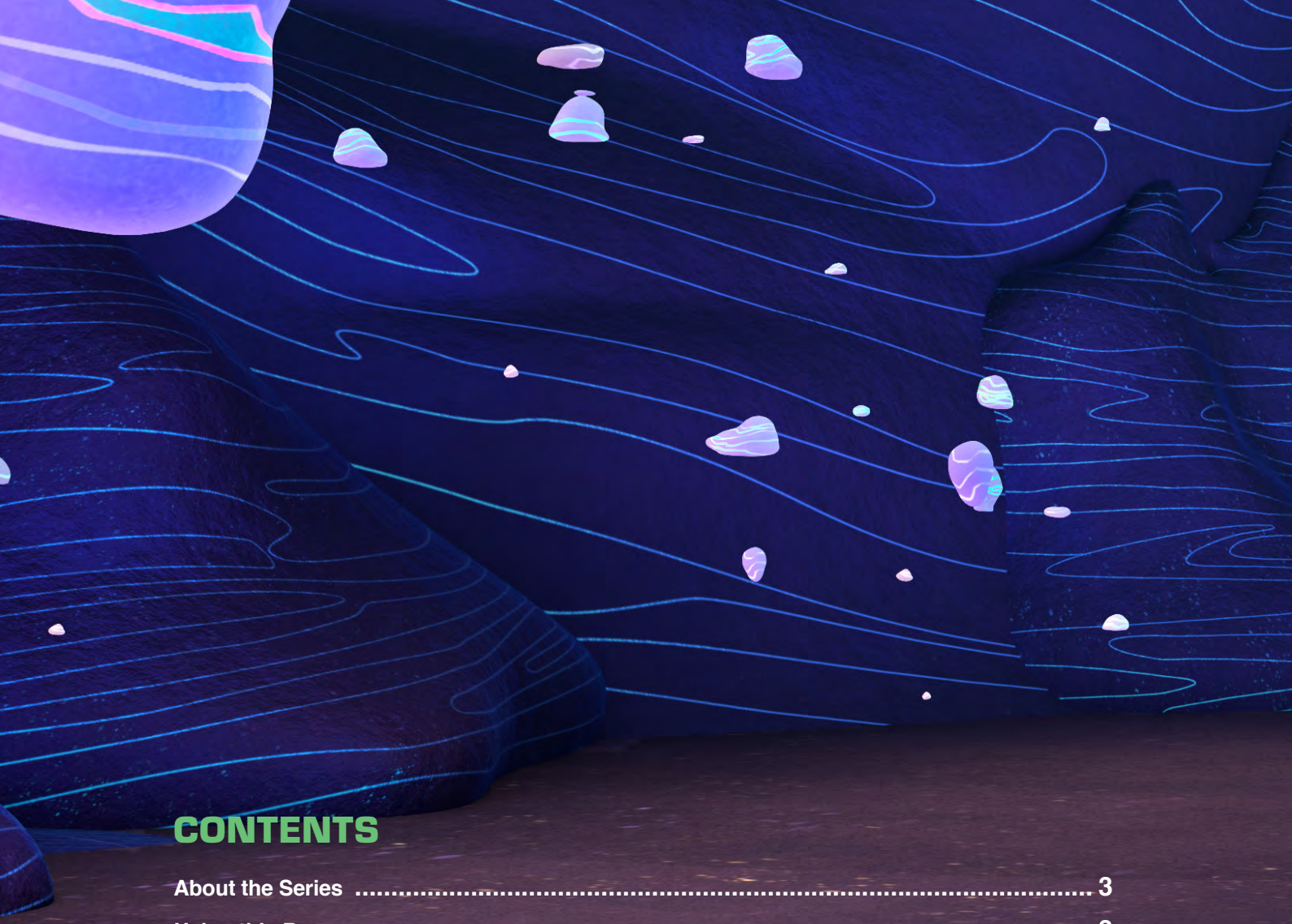
Australian Children's Television Foundation



CONTENTS

ABOUT THE SERIES

t's the year 2162 and life is a blast for space adventuring siblings, Jet and Adelaide Nova. Along with their parents, Josie and Hugo, these intrepid Aussies spend their days chasing rogue planets, surfing solar flares and avoiding being eaten by every kind of plantimal – all in the name of science! But what the Nova family really want to do is to meet intelligent extra-terrestrial life – something humanity has yet to do. Then everything changes... During a routine mission, the Novas stumble across an abandoned alien craft, powered by a rainbow substance that's so powerful it sends the craft zipping away at speeds humanity never dreamed possible. Although the Novas are unable to capture the craft, they now know there's a super advanced, intelligent species out there – and they're going to follow the clues to find them!

USING THIS RESOURCE

This *Space Nova* Teaching Toolkit is a science education resource for Year 4 students, with clips from the animated children's series used as provocations for a rich science learning sequence on Forces. The sequence addresses Science content descriptions in version 9 of the Australian Curriculum.

Through curated *Space Nova* clips, tangible experiences and thought-provoking discussion starters, this learning sequence will give students opportunities to critically analyse their observations and challenge their pe-conceptions. This approach lends itself to differentiation, as all students bring varying prior knowledge and experiences to the classroom.

Additional *Space Nova* Teaching Toolkits address key science understandings in other primary year levels. These resources focus on Living Things (Year 3), Science and Human Lives (Year 5), and Energy (Year 6). Find all teaching toolkits on the ACTF website.

To view the clips suggested in this resource, click on the timecodes provided in the PDF. Alternatively, the complete series (including the clips featured in this resource) is available to purchase in the ACTF Shop.

LEARNING SEQUENCE: FORCES

Key Content Description: Identify how forces can be exerted by one object on another and investigate the effect of frictional, gravitational and magnetic forces on the motion of objects (AC9S4U03)

SEQUENCE OUTLINE

	Learning Tasks	Additional Australian Curriculum Links
1	Introduction to forces	
2	Push contact force	
3	Pull contact force	
4	Friction	AC9S4H01, AC9S4I01, AC9S4I02, AC9S4I04, AC9S4I05
5	Introduction to non-contact forces	
6	Gravity	AC9S4H01, AC9S4I01, AC9S4I02, AC9S4I05
7	Gravity in space	
8	Magnetism	AC9S4H01, AC9S4I01, AC9S4I05
9	Rules that apply to all forces	
10	Forces in everyday lives	
11	Summarising forces	

LEARNING SEQUENCE: FORCES

LEARNING TASK 1: INTRODUCTION TO FORCES

In a class discussion, ask students to share ways to make something move and ways to stop something moving. Explain that these all involve forces. In front of the class, demonstrate the following actions and then discuss why the objects started and stopped moving:

- Pull a box
- Roll a ball
- Drop a pen.

Individually or as a class, construct a TWLH chart about forces (see Additional Resources), filling in the T (Think I know) and W (Want to learn) sections. Keep note of what students want to learn and make links to these topics whenever applicable throughout the sequence.

Explain that all forces are either a push or a pull. A push moves things away from each other or squishes them, while a pull brings things closer together or stretches them. Some forces require touching (or contact), while other forces don't need to be touching. Both non-living and living things can apply a force and have force applied to them.

While learning about forces, encourage students to use scientifically appropriate language. For example, guide them to say, '…the force of a magnet on a paperclip'. This will be aided by teacher modelling and explicitly stating that the word force has other meanings in everyday life.

Let's explore some different types of contact forces.

LEARNING TASK 2: PUSH CONTACT FORCE

Clip: Episode 1, 14:00 - 14:35

In the above clip, we see Adelaide and Jet jump up and out. They use their feet to push against the walls in order to jump. Have students jump on the spot. Ask them how they jump up, why they come back down again, and which forces are involved. After this exercise, view the following clip and discuss.

Clip: Episode 15, 12:30 - 14:35

In this clip, we see the bugs moving their planet towards the comet while the Novas try to push it away from the comet. After viewing, ask students how the bugs moved the planet.

Explain that when you jump, you bend your knees then push off the ground, and your body moves into the air for a short time. You have pushed the ground further away from your body. When you come back down and land, you push the ground again. This push isn't strong enough to move the Earth, but with ALL the bugs pushing at the same time they were able to apply a push force large enough to nudge their planet.

Clip: Episode 22, 15:35 - 16:15

In this clip, Sol has to push very hard make the heavy gyroscope turn. Choose a heavy classroom object (such as a table) and ask a student to apply a push force strong enough to move it. Then ask two students to work together. Then ask three, four, five or more students to work together to push the object. Ask them what they noticed. Explain that heavy objects require larger forces to make them move. More people pushing creates a larger force – one that is eventually large enough to move the heavy object.

Clip: Episode 7, 18:00 - 20:30

In this clip, we see the Novas throw the stardust gem between them to get it to safety. In a similar way, have students work together to push a ball or a balloon around the classroom. They can imagine the floor is lava, just like in the clip. Challenge students to extend how long they can keep the object from touching the ground and how far across the classroom they can get before dropping it. Afterwards, ask students how they throw objects. Which forces are involved? Why did the ball / balloon come back down again? Explain that throwing is a push force that makes the ball move away from you.

You can also push with air. Demonstrate this by constructing a straw rocket (see Additional Resources). Before testing the straw rockets, ask students what they think will happen when they blow into the straws. Then test the straw rockets and ask students to explain what they observe. Explain that when you breathe out fast, or blow, it pushes on the air which can then push on other things. Have students to measure how far they can make their straw rocket fly by blowing through the straw.

Key learning: When you push, you direct an object away from you.

LEARNING TASK 3: PULL CONTACT FORCE

Clip: Episode 3, 10:10 - 11:40

In this clip, we see the black hole that Pickles the hamster creates pull all the pickles into it. In order to prevent themselves from being pulled in too, Jet and Adelaide have to hold onto the side of the ship. They pull themselves back away from the black hole. Build on this scene by taking students outside and asking them to hold themselves up off the ground on a tree branch or monkey bars. Ask them to count or time how long they can pull their body up so that their feet don't touch the ground.

Clip: Episode 1, 16:25 - 18:00

In this clip, the Novas attempt to pull an object out of a celestial butterfly. (Note: celestial butterflies are not real – this is just some fun imagination.) Have students try pulling a heavy object, like a box of paper, towards them. Ask them whether it is easier to push or pull a heavy box? Does the surface the box rests on make a difference?

Provide students with an opportunity to use push and pull forces to manipulate clay, balloons, springs, balls or any other malleable material you have available. Encourage students to describe what they observe as they use forces to change the shape of these objects.

Key learning: A pull force brings things closer together.

LEARNING TASK 4: FRICTION

Clip: Episode 4, 4:30 - 5:30

In this clip, the Novas crash land their spaceship, the Eureka. After viewing, ask students which force stops the ship from moving.

In small groups, have students roll a ball across a table and then try to stop it. Encourage them to find lots of different ways to achieve this. Then come together as a class and have groups share their actions. Explain that many of their ideas created a force that made the ball move in the opposite direction so that it would slow down and eventually stop moving.

Have students return to their groups and construct a ramp using flat materials that do not bend. Students should then place a toy car or other rolling object at the top of the ramp and let go. After some time to play with this set up, ask students to measure how far the car rolls before it stops. Then ask students to come together and ask:

- What makes the car start moving?
- What makes the car stop moving?
- How fast does the car move?
- Is it moving in a straight line, fast or slow, speeding up or slowing down?

Use the ramps again, only this time turn it into an experiment. Place different materials along the ground at the end of the ramp to influence the distance the car will roll. Before they test, students should predict how far the car will roll before stopping. They should consider whether the material will make a difference, and whether this will make the car roll further or not as far. Students can experiment with materials such as paper, fabric, sandpaper, bubble wrap and more. They should test each one separately, always measuring how far the car rolled before stopping. Students should then be encouraged to compare their results to their predictions. Did the car behave as they expected? Why or why not? A possible extension is to discuss with students the benefit of repeated tests and encourage them to test each material with multiple runs.

Explain to students that friction is the force of things rubbing together. Ask them to rub the palms of their hands together quickly. Do they feel their palms heat up? That heat is generated by the force of friction between their hands. Friction happens on the road between car tyres and the asphalt. It also happens between swimmers and the water, and aeroplanes and the air. Friction slows down moving things by applying a force in the opposite direction. Friction is stronger on rougher surfaces than on smooth ones, so bumpy materials would have stopped the students' cars faster than smooth materials.

LEARNING TASK 5: INTRODUCTION TO NON-CONTACT FORCES

Challenge students to make a piece of paper, paperclip and/or ball move without touching the objects. Ask students to share methods they found that were successful.

Explain that some forces can act without touching and these are called non-contact forces. These include gravity and magnetism. If students used gravity or magnetism to move their object, they were using non-contact forces. However, blowing on an object to make it move (i.e., creating wind) is a contact force. This is because wind, or air, is made of physical particles that comes into contact with objects.

Let's explore some different types of non-contact forces in more detail.

LEARNING TASK 6: GRAVITY

Clip: Episode 1, 12:40 - 13:30

In the above clip, we see a place where unusual gravity seems to pull G9 to the ceiling, and Jet and Adelaide against the walls. In a class discussion, ask students what gravity is. Which way does gravity pull on Earth? Why do things fall down when you drop them? Which way is down?

Draw a circle and explain that it represents the Earth: a sphere. Draw something to represent a person at the North Pole. Ask the class: if this person in the north drops something, which way does it go? Repeat with a person in the south, and on opposite points on the equator. Explain that objects always fall towards the centre of the Earth. This is due to the pull force of gravity which always brings things towards the Earth.

Place students into small groups to conduct experiments. Tell them they will be dropping objects and timing how long they take to hit the ground. Ask students to try different objects (though nothing fragile or messy) and different heights. Ensure students predict how changing the height and the material will affect these times, as well as recording the height, material and time to hit the ground for each test.

Guide a class discussion by asking students the following questions:

- How do you stop something from falling?
- Is gravity pulling down on things that aren't falling?
- Is gravity pulling you down when you are sitting on the ground?
- Is gravity pulling you down when you are sitting in a chair?
- Is gravity pulling the chair down?
- What would happen if there was suddenly no gravity?

Explain that gravity is always pulling everything towards the centre of the Earth.

Clip: Episode 21, 17:50 - 18:50

In this clip, Adelaide predicts where Jet will fall and catches him. By understanding physics, we can predict the way things will move. As a class, compare the motion of two sheets of paper – one flat and the other crumpled into a small ball – when they are dropped at the same time from the same height. Discuss what students observe and how they can explain it.

Explain that the gravitational forces acting on each piece of paper are the same, but their motion is very different due to the action of air resistance. Ask students for examples of when air resistance plays a part in the motion of an object. They may suggest parachutes, aeroplanes, kites and other familiar objects.

The gravitational force on an object from the Earth is the same regardless of whether the object is moving or stationary, and whether it is surrounded by air or water or anything else. However, the force of wind resistance can counteract the pull of Earth's gravitational force. Wind resistance is a type of friction. It can also reduce push forces. As an example, aeroplanes are designed to be streamlined as this reduces the backwards push of air resistance, enabling them to fly faster.

As a group challenge, ask students to design and construct structures that will slow down a falling object. Ensure groups predict the effect of their design before testing, evaluating and redesigning their structures. Provide them with assorted craft materials, such as paper, icy pole sticks, fabric, string, paper cups and plates, and other available materials. Testing must involve comparing the time it takes to fall with and without the structure that students have designed. This task may be particularly entertaining if you ask students to slow down a falling egg. (To reduce waste, if the whole class is trying to slow down falling eggs, the 'control' test in which you time how long an egg takes to fall without any structure slowing it may be completed just once and that data used by every group.) Filming the fall will help students to evaluate the effects of their design, especially if the footage can be replayed in slow motion.

Clip: Episode 14, 11:10 - 12:15

This clip shows a planet where gravity is weaker than the Novas are used to, enabling them to jump around easily.

The strength of the pull force of gravity depends on how massive the thing is. Earth is not the most massive planet, but it is bigger than some others. For example, Mars is one-third the mass of Earth, so it also has one-third the gravitational pull.

Having provided this example, ask students if a person would float away from Mars. Would it be easier or harder to jump high on Mars? Explain that the greater the mass of the objects, the greater the size of the gravitational force. This means that people would not weigh as much on Mars and would be able to jump more easily.

LEARNING TASK 7: GRAVITY IN SPACE

Clip: Episode 14, 8:10 - 8:50

In this clip, the Novas find a planet that orbits a star but does not rotate. (Note: These are not actually called pillow planets by scientists.) The most massive thing in our solar system is the sun (a star), so it has the most gravity. It pulls all the planets so that they don't float away into space. The planets move along round paths around the sun. This movement is called orbiting.

Clip: Episode 1, 3:00-3:20

In this clip we learn that the Yolngu people (Aboriginal Australians who live in north-eastern Arnhem Land in the Northern Territory) have known for a very long time that the Moon and the tides were linked.

Explain that the Earth's gravity holds the Moon in orbit around the Earth. The Moon also has its own gravity, because it's quite massive even though it's smaller than Earth. The Moon's gravity pulls the water in Earth's seas and oceans: this is the reason we have tides.

To simulate ocean tides with patty pans, draw the Earth in the bottom of a paper muffin patty pan. Secure a short piece of string to one side of the patty pan. Place a little water inside the patty pan until it is about half full. Ask students what shape the body of water is. Is it evenly spread? Is it the same distance from the Earth's surface all the way around? Pull gently on the string to simulate gravity of the moon. Release and pull again a few times to notice the difference, then consider the previous questions again.

LEARNING TASK 8: MAGNETISM

As a class, discuss what students already know about magnets. What do they do? Where can you find them?

Give students some time to play with magnets. Ensure that each student / group has at least two magnets to explore. (Fridge magnets will not be strong enough for this exploration. Fish tank cleaning magnets are a good option if you don't have an educational kit.) Ask students what they notice about the magnets. Are there different parts to a magnet? What happens when you put them together one way? What happens when you turn one around and put them together that way?

Clip: Episode 2, 5:10 - 6:15

In this clip, Hugo expresses how excited he is about rocks, especially rocks that are magnets. Explain that magnets are able to push and pull without touching. It depends on which pole of the magnet is facing the other. Magnets have two poles. We can call them north and south or positive and negative.

Ask students to make labels for the ends of the magnets they are using. Explain that, just like Hugo says, when you bring two of the same poles together, they repel or push apart. Then ask: what happens when you bring two different poles together? (They attract or pull together.)

Clip: Episode 2, 18:45-20:40

In this clip, Adelaide and Jet cleverly use the push force of repelling magnets to avoid crashing into the magnetic rocks. Challenge students to use the magnets to make something move. Suggest to them that they use tape to attach one magnet to a toy car (or something else that can roll) and use the other magnet to push the car away or pull it towards them.

Explain that magnets can also attract (pull) materials that aren't magnets, but they cannot repel (push) them. If an object interacts with a magnet, but isn't itself a magnet, it is described as magnetic.

Have students test some materials that they find around the school to see if they are magnetic. Ask them to predict whether each material will be magnetic before testing. Objects could include pipe cleaners, safety pins, paper clips, paper, furniture, rocks, nails, coins, foil and more.

Bring the class together to jointly compile a list of all the materials students tested. Sort the tested objects into two groups – magnetic and not magnetic – based on whether they were attracted to the magnet. Ask students what objects in each group have in common, which properties make an object magnetic and if they can find a pattern to explain this. Explain that magnetic materials are always metals, but not all metals are magnetic. In our everyday lives, most metals appear to be magnetic. This is because the most widely used metal is steel, which contains magnetic iron.

Clip: Episode 16, 19:10 - 21:00

(Please note: The following task will only work if you have magnets that are strong enough to attract through a table.)

In the above clip, the Novas follow the magnet's force along a path. This force repels or pushes away the aliens. Ask students to draw a map on a piece of paper and mark out a path. They will then use masking tape to stick their map onto a tabletop. Ask them to place a magnet at the start and also place a magnet under the table at the same point so the two magnets are attracting or pulling together through the table. Moving the magnet that is under the table will carry the magnet on top with it. Can you carry the magnet to the end of the path while only touching the bottom magnet?

LEARNING TASK 9: RULES THAT APPLY TO ALL FORCES

Rule 1: Objects keep doing what they are doing until an unbalanced force is applied.

Clip: Episode 14, 3:10 - 4:05

In this clip, G9 and Sol pull equally on the jar, and it doesn't really move. Then, Sol gets stuck to the bench and pulls away but doesn't move because it is pulling him back equally. While Sol is still pulling, Jet turns off the adhesive so that it is no longer pulling back, Sol is then pulling himself backwards and falls.

Explain that objects won't move until they are forced, and they won't stop moving unless something stops them. Sometimes, objects still don't move even when forces are applied. For example, ask student whether they could make a box move downwards if it was on top of a table? Could they force a ball through a wall?

As a class or in small groups, conduct a tug of war with a skipping rope. Ask students why the rope does not move much despite many people applying a force. If half the people on one side stopped pulling, what would happen?

Explain that the rope doesn't move much because it is being pulled (roughly) equally in opposite directions. Objects only move if the forces are unequal or unbalanced. If more people are pulling on one side than the other, then they will be pulling

with more force and the rope will move towards them (because pull forces bring things closer together).

Rule 2: For every action, there is an equal and opposite reaction.

Explain that when you sit in your chair, your body exerts a downward force on the chair and the chair exerts an upward force on your body. Because it is balanced, you don't move. When you push against a wall, you can feel the wall pushing back against you. That is because every force has an equal force pushing back against it. There is an action force (you pushing the wall), and a reaction force (the wall pushing back).

Clip: Episode 1, 7:35 - 8:20

In this clip, G9 uses his thrusters to move around in space. After viewing this clip, ask students how thrusters work. Explain that there are different types of thrusters, but most work by applying a force backwards. This will push the craft forwards because forces always have an equal and opposite force. Birds use the same physics rule to fly. The wings of a bird push air downwards. The reaction force results in the air pushing the bird upwards.

If time permits, students could create balloon rockets to explore backwards force.

Ask students to time how long they can hold a pen out with a straight arm. After this exercise, ask students why it is difficult to hold up a pen despite not even moving it. Explain that when you hold a pen out, it doesn't fall because you are pushing your arm and the pen up just as strongly as gravity is pulling them down. It's actually hard work!

Suspend a somewhat heavy object from a rubber band so that it stretches. Ensure students note that it stretches because the object is pulling down. Ask a student to place a finger at the point where the object is attached. Tell them you are going to remove the hanging object and that they should use their finger to prevent the elastic band from recoiling back. They will feel the rubber band pulling their finger upwards. This upwards force was also applying to the hanging object. The object pulled down just as hard as it was pulled up.

Rule 3: The effect of forces depends on the mass of the objects.

Clip: Episode 2, 18:15 - 18:45

In this clip, Adelaide says that extra weight is making it harder for her to go faster. Ask students why this is the case.

Place students in small groups and give each group a range of balls with various weights. Have students push the balls so that they roll into other stationary balls and observe how the moving ball applies a force that makes the stationary ball move after they collide. Draw students' attention to how fast the two balls move. Help them to notice that a large ball makes a smaller ball roll faster than it did when they collide, and a small ball makes a larger ball roll more slowly (if at all). Explain that this is because heavier objects require more force to make them move the same speed as lighter objects. This means the same force on a light ball makes it go faster than that force on a heavy ball.

LEARNING TASK 10: FORCES IN EVERYDAY LIVES

Clip: Episode 2, 7:15 - 7:35

In this clip, Hugo uses a printer to make breakfast for his family. He says that it is 'synthesised to perfection' due to the way he pushes the buttons.

Ask students to identify times in their daily lives when they use a push or a pull force and create a list of these examples together. Students could think about toys they play with, games they play, chores they do at home, how they travel between places, and more.

If your school has a playground, have students explore and observe the forces involved when interacting with playground equipment. Discuss how the motion of students is different on each part of the playground. Do they push or pull, get pushed or pulled, speed up, slow down, or stop? Compare and contrast each part of the playground in terms of the forces and type of movement involved.

Watch the following clips (perhaps more than once) to identify forces in the Novas everyday lives. While viewing, students could take notes to answer the questions:

What forces can you identify in the clip?

Are they pull or push forces?

Are they contact or non-contact forces?

Episode 13, 7:15 - 9:40

- Push to throw Grav Ball
- Vacuum from the hole in the Grav Ball court pulls Sol out
- G9 pulls Sol and Adelaide back into the court

Episode 15, 7:45 - 9:00

- Comet pulls Novas' ship into its slip stream
- Gravity from sun pulls comet in
- Suggestion to push off asteroid

Episode 18, 1:10 - 2:45

- Drone pushes to throw balls
- Thrusters on Sol's boots push him as he flies
- Synthetic gravity pulls Jet and Adelaide to the floor

LEARNING TASK 11: SUMMARISING FORCES

Clip: Episode 1, 0:45-2:05

In this clip, we see the kids on Lunar Port enjoying a game of Grav Ball. They utilise the low gravity, push off platforms, push the ball through rings, push against moving balls to stop and catch them as well as pull the ball off opponents and pull fellow players along.

Place students in groups to design a game that utilises at least three different forces. Ask them to identify what the forces are and whether they are contact or non-contact. Students then teach their game to another group.

As a class or individually, complete the K (now I Know) and H (How I know) sections of the TWKH chart you started in Learning Task 1.

EPISODE SYNOPSES

EPISODE 1
STAR DUST

The Novas, a family of maverick space explorers, make an interstellar discovery that could change the course of history. Armed with knowledge that they have come across an alien space craft powered by a rainbow substance they have never seen before, they set out to find where the space craft and its ethereal substance – Star Dust – has come from.

EPISODE 2
OVER BEING A NOVA

Bored with searching rocks for evidence of their recent findings, Adelaide accepts Sol's challenge to a 'space-off' in the asteroid belt. But when Sol gets into trouble, Adelaide and Jet perform a heroic rescue and rediscover what being a Nova is all about.

EPISODE 3
BLACK HAMSTER

When Jet creates a nutrient-dense super pickle, it attracts a space hamster that Jet calls 'Pickles'. Pickles' survival instinct allows it to turn into a small black hole, throwing Luna Port into chaos. Will Jet be able to keep his new friend – or will he have to free him for the good of Luna Port?

EPISODE 4
ESCAPE FROM TR-227

While travelling to complete a supply drop off at a research facility, the Novas crash land on the planet. They are confronted by a deadly gravity storm that threatens not only their lives – and the lives of the researchers they find there – but also their life-saving work!

EPISODE 5

SEAWEED SAMBA

When the Nova's mission to what they believe is a Star Dust Planet goes horribly awry, they find themselves held underwater by a sentient seaweed plant. Meanwhile Aubrina, determined to learn what the Novas are up to, sends son Sol to find out – undercover.

EPISODE 6

STEEL COMET

When a large comet appears on a collision course with Luna Port, the Novas take a huge risk to divert it. They realise it's no comet at all, but a frozen-over spaceship presumed lost for over 100 years!

EPISODE 7

FRIENDS IN DARK PLACES

When the Novas investigate a system based on data they obtained from the 'Eagle' (the frozen spaceship from 'Steel Comet'), they find a planet that appears uninhabited – until they fall through quicksand to the caverns beneath! Meanwhile, Aubrina continues to keep a close eye on the Novas – often popping up on comms at the most inconvenient times!

EPISODE 8

INVISIBLE SIBLINGS

When G9 malfunctions at the Luna Port centennial celebrations, Aubrina takes him into custody and seeks to reprogram G9. Jet and Adelaide go on a mission to save their favourite robot, stumbling across a library of hidden alien artefacts inside a locked room owned by Aubrina – including a mysterious alien tech cube!

EPISODE 9

STEAM SHIP

When the Novas are forced to land on a junk planet for repairs, they come face to face with Old Phil and his dog Calisto. Phil claims to enjoy solitude and quiet, but he may know more than he is letting on – especially after he takes the Novas' cube!

EPISODE 10

GRAFTER

Sol's attempt to win at the science fair by sabotaging all of the other projects goes drastically wrong when the Nova's project – a giant half plant half animal – kidnaps him. Even stranger, on analysis it seems Sol was responsible for the creature's sudden transformation – and this transformation was caused by alien DNA!

EPISODE 11

GHOST STATION

It's Josie's favourite holiday, Halloween, and to celebrate she surprises her sceptical family by booking a 'ghost tour' of a spooky space station. When they receive a distress call from the station and land there, even the most sceptical Novas start to believe!

EPISODE 12

THE JUMP

After the Novas help expose Aubrina for her wrongdoing and have the Star Dust Crystal returned, they're ready to make their first Star Dust 'jump' and explore parts of space that humanity has never seen before. Aubrina, meanwhile, isn't going down without a fight, and enlists a shadowy figure to stop the Novas at all costs!

EPISODE 13

FINALLY AN ALIEN

With the Novas now able to jump millions of lightyears in minutes, their quest to find Star Dust Aliens kicks into high gear. But after Sol demonstrates unexplained super strength in a Grav Ball game, Jet and Adelaide realise that their search for aliens might take them closer to home.

EPISODE 14

THE GOLDILOCKS ZONE

Having learned where the Tychon was being taken on the day Sol was discovered on as a baby, the Novas take Sol on a mission to a planet inhabited entirely by mega-flora – then Sol goes missing.

EPISODE 15

ROGUE PLANET

When the Novas research drones send them an image of what looks like a Star Dust Ship, the Novas and Sol go to investigate. In the process, however, they become trapped on a tiny rogue planet full of adorable insects – and the planet is heading directly towards the system's sun! Meanwhile, Aubrina has plans of her own – to get her own Star Dust Crystal and gain the power of 'jumping' for herself.

EPISODE 16

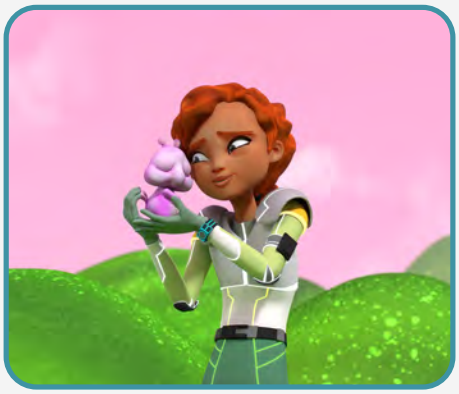
THE PUZZLE

The Novas investigate a planet millions of lightyears from known space that appears to have pyramid-like temples that may have been created by intelligent beings. Soon, however, they find the pyramids ARE the intelligent beings – and these aliens aren't the type looking for a friendly chat!

EPISODE 17

A BLACK HOLE ATE MY HOMEWORK

When Jet and Adelaide realize they have too much work and reading to get through in one night, they devise a plan to slow time by taking Adelaide's flyer to the very edge of a black hole in order to slow down time.



EPISODE 18

WHITE HAMSTER

After detecting human technology in a far-flung region of the universe previously inaccessible to humans, the Novas excitedly head out to examine it – only to find that it is the escape pod that Jet used to evacuate his space hamster, Pickles. When they finally catch up with Pickles, however, he – and his family - need their help more than ever.

EPISODE 19

PAMELA BARNACLE

With Luna Port's security system malfunctioning (and no longer responding to orders), the Novas journey to visit the ex-president of Luna Port, Pamela Barnacle, the system's creator. When they arrive, however, they find Pamela is even more under the same system's control – and soon, so are the Novas!

EPISODE 20

SHORE LEAVE

After a series of dead ends in their search for Star Dust, the Novas spot a planet that looks like paradise itself and decide to visit it for some much-needed R&R. Soon, however, their dream getaway turns out to be just that – and one that they're unable to wake up from!

EPISODE 21

ALIENOSAURS

The Novas head to an Earth-like planet, hoping to find the Star Dust aliens. Instead, they find highly evolved and aggressive alien dinosaurs, and they find out what it's like when humans are at the bottom of the food chain!

EPISODE 22

COLLISION COURSE

Jet, Adelaide, Sol (and a visiting Marcie Yang) are thrown together to represent Luna Port in a Grav Ball game for visiting delegates – they just aren't the best team. Then, in the middle of the game, Luna Port faces a catastrophic shut-down and blackout. Now this not-so-awesome foursome really must learn to work together – and the stakes couldn't be higher. Meanwhile, Aubrina goes in search of plans for the Star Dust cube to create her own!

EPISODE 23

YOWIE!

While on the lookout for intelligent life on the other side of the universe, one of the Novas' drones delivers footage that will make them question everything they know about Aliens – blurry video of what appears to be a real live bigfoot!

EPISODE 24

SWEET DREAMS

After Sol starts to have vivid dreams about his home world, the Novas enlist the help of the 'energy creature' from Shore Leave to help uncover the details of this planet. Things take a turn, however, when Sol's brain refuses to release him from the dream state – and not even the powerful energy creature can stop him!

EPISODE 25

DARK ICE

Following Sol's vision, the Novas journey to a what they believe is Sol's home planet – only to discover that it is completely frozen over. On closer inspection, they realise the planet may hold the answers to all of their questions - and they must journey below the ice...

EPISODE 26

STAR DUST ALIENS

The Novas finally locate another Star Dust alien rock ship and set off to finally make first contact. When they arrive, however, the ship's engines explode. They uncover Sol as a stowaway and find out that Andy, who accompanied them, is a robot in disguise – all part of Aubrina's plan to stop the Novas in their tracks and make first contact with the aliens herself. Will the Novas lose their chance to make real contact with the Star Dust aliens forever?

THE MAKING OF *SPACE NOVA* BY SLR PRODUCTIONS

The science fiction genre presents a great opportunity to wonder 'What if?' in an imagined futuristic world with human dynamics we can all relate to. At the core, the Novas are like most families: full of love and support, with the occasional sibling rivalry, shenanigans and plenty of dad jokes. But what if this is an intrepid family of intergalactic explorers in search of alien life in the year 2162? Now we're talking! We jumped at the opportunity of creating a unique, exciting show.

Animation lends itself to boundless imagination and creativity since every frame has to be created from scratch – literally. The stories were crafted around classic science fiction tropes in a world full of exciting possibilities. *Space Nova* allowed us to push the limits of imagination in every aspect of life in space: family and home, friendship and play, school and work. And when work involves discovering Star Dust, a powerful rainbow substance powering a rock ship, launching an epic alien quest across the universe, more than just a job, this becomes the adventure of a lifetime.

The *Space Nova* world was created with a base in science and a healthy dose of imagination. Extensive research was carried out on space exploration and the latest technological advancements. Their home, the Luna Port international space station, is based on structures that are capable of generating artificial gravity with and added touch of wow factor which makes it inviting and special. The characters wear high-tech, insulating suits with glowing LED lights and self-propulsion based on future trends of comfort and functionality. We took the possibilities of 3D printing into creating nutritious, delicious food. The Grav Ball game was born out of the combination of zero gravity and team sports such as basketball.

Space Nova presents a hopeful, aspirational take on the future which informed the look of the show in every aspect. Their world is bright, colourful and friendly. Organic shapes like curves and swirls dominate the design as opposed to straight lines and harsh angles. Surfaces are smooth and warm instead of sleek and cold. And since the Novas are a family of Australian astronauts, an Aussie flavour is interspersed in their palette with greens and golds. Their spaceships also have echoes of Australian fauna (the cicada and sugar glider) which was also carried through to the sound design. G9, the lovable family bot, resembles an adorable marsupial.

Space phenomena in itself is spectacular proving that nature is indeed the best inspiration. Planets, celestial butterflies, comets, black holes, supernovas, nebulas and galaxies, all presented incredible story and visual opportunities where we had to look no further than the latest findings on space exploration. Serendipity came knocking when NASA released the first ever image of a black hole just as we were in the middle of production. Needless to say, we gladly took visual cues in our design from this historic moment.

From the outset, the Novas discover the first ever proof that humanity is not alone in the universe setting in motion a thrilling saga across the cosmos. Along the way, we visit planets with different alien life forms where we let our imagination run wild along with interesting scientific ideas. To name a few: hamster-like aliens capable of creating black holes; a cross between a plant and an animal resulting in plantimals; sentient, bioluminescent seaweed with their own unique visual language; bismuth formations come to life, while dinosaurs evolve on another planet! Once again, nature provided the source material and we just had to add inventiveness and have fun with it.

Space Nova was produced with the latest CGI technology, a medium which perfectly suited the epic scale of the show as well as the subtle emotional needs of character animation. A very successful blend of artistic and technical skills; every design and storyboard was initially crafted by hand and then fully realized through computer animation to reach our screens (something that was considered science fiction not that long ago!). The result is a rich, vibrant world that draws us in, we can feel it and almost touch it.

We had the ride of our lives making *Space Nova* and hope the show will be enjoyed by all for years to come. The universe keeps surprising us in this new frontier for exploration and we can't wait to find out what's in store in the future. Reach for the stars!

CHARACTER BIOGRAPHIES

ADELAIDE NOVA

13-year-old Adelaide Nova is a keen adventurer and scientist with a special passion for technology, robotics, and flying spacecraft. In fact, as excited as she is at the prospect of encountering intelligent extra-terrestrial life, an equal priority on her list is finally earning her large ship pilot's license!

When she's not taking lessons, Adelaide can usually be found in her lab or the cargo bay tinkering with her latest invention. Whether it's creating camouflaging meta-fabric to turn into 'invisibility suits', creating nano-technology that can repair an entire eco-system, or simply upgrading her VR gear, Adelaide always has a technological hack up her sleeve.

Due to her affinity with tech, it's also no wonder Adelaide is especially close to the family robot, G9, and always giving him special upgrades (with varying levels of success!).

JET NOVA

The youngest of the intrepid Nova family, 12-year-old Jet has a passion for space exploration, Grav Ball, astrobiology and – most importantly – aliens!

Whether at home or in his lab on the family's starship, Jet is surrounded by all manner of plants, both from Earth and beyond. He especially likes doing experiments with his specimens. Whether it's creating a super sticky plant-based glue, or a flower designed to explode on impact, the rest of the Nova family often find themselves test subjects for Jet's latest biological masterpiece!

Jet has even created a specially designed chart, which he uses to track the various 'levels' of lifeforms he and the Nova family encounter on their missions. He just hopes that, now the Novas are on the trail of the first confirmed alien spaceship sighting, he can finally fill the chart all the way to the top!

JOSIE NOVA

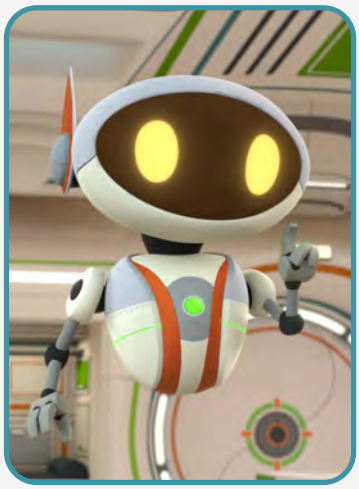
Josie Nova is both an intrepid astrobiologist and an ecologist. Mother of Adelaide and Jet Nova, she has a lot to teach her kids about seeking out adventure! Tempering her passion for adventure is her love of nature. Josie is an expert on all things in the natural world. In other words, she doesn't mind getting her hands dirty when it comes to the search for extra-terrestrial life!

A respected scientist on Luna Port – especially when it comes to space exploration – Josie is also well known for her 'can do' attitude. And this attitude certainly comes in handy when dealing with bureaucrats like the Luna Port President, Aubrina Eridani, who seems determined to restrict the Novas' 'frivolous' scientific missions. Between Josie and Hugo, Josie is the risk taker and has a 'devil-may-care' attitude when raising her children. As long as they are good and have fun – she doesn't mind too much what they do.

HUGO NOVA

Like the rest of his family, Dr. Hugo Nova has a passion for unlocking the secrets of the universe. One of the best astro-geologists (and pilots) on Luna Port, Hugo spends most of his time collecting, examining and thinking about rocks – after all, they're core building blocks of the universe. Just don't try to tell him geology is boring: in his own words, 'rocks rock!'

Still, Hugo is more than just a scientist. Hugo is also a great chef (he even uses old-fashioned 20th century implements), a student of history and a great dad. Compared with wife, Josie, Hugo is also the more over-protective parent. If anyone is going to be a little conflicted when it comes to taking Jet and Josie on their away missions, it's Hugo. Still, space will always be an unpredictable place, and the kids wouldn't have it any other way!



G9

The family's 'pet' robot, G9 is the 5th member of the family. With databanks full of useful info, G9 is a real asset to the Novas' missions. He's also a favourite of Adelaide, who is constantly working on new 'upgrades' for the robot, improving his intelligence, pumping up his strength, or even teaching him to play the ukulele at parties!

If there's one thing Adelaide can't 'fix' about G9, it's that he can be a terrible worry wart, and will often be the first to hide when danger rears its head – and thanks to the Novas' missions, danger is never far. After all, he may be nuts and bolts, but G9 still fears the 'big reset'. Still, when his 'humans' are really threatened, G9 can find extreme courage deep within his circuits. He's quite attached to the Novas – they're not bad for a bunch of irrational humans!

SOL ERADANI

Found by Aubrina as a baby on an abandoned exploration ship, Sol has grown up the spoiled child of the most powerful person on Luna Port – it's really gone to his head! Aubrina is such a workaholic, he still often feels that he comes second behind her job and is always keen to earn her attention and love. From everyone else on the station he not only expects but demands respect – and most give it to him.

In fact, the only kids who don't seem to respect this 'power' are Jet and Adelaide Nova, who think he's a bully and a joke. Jet and Adelaide never have to fight for their parents' attention, and this annoys Sol. He takes every opportunity to take the Nova kids down a peg and show them who's the true 'top dog' on the port. As such, Sol easily latches onto the Nova family's eccentric reputation to ridicule them.

AUBRINA ERADANI

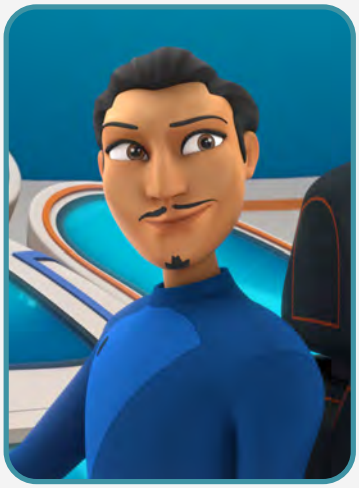
Aubrina Eradani was once a young explorer out to make a name for herself. Then, just over 13 years ago, she discovered a baby on an abandoned space cruiser – and an unidentified craft shooting out streams of a strange rainbow substance and disappearing at an incredible speed! Aubrina raised Sol as her own and waited for Star Dust to appear again.

She became Luna Port's president after clawing her way to the top. It's from this position that Aubrina wields the control and power she thinks she deserves. Still, the Novas refuse to toe the line. When she suspects this same family may have sighted HER discovery, she's determined to take the spoils for herself – at any cost! If she's going to take what's hers and discredit the Novas, she's going to have to do it quietly and carefully!

JANALI BANKS

Like the Novas, Janali works for the Australian Space Association and is Head of the E.M.U. telescope which sits above Luna Port. Janali is an Indigenous Australian astronomer from Gamilaraay. She was also a child prodigy who could have done anything, but, like the Novas, believes there are still great mysteries left to be uncovered out there.

As such, she is a great champion for the Novas and their more 'maverick' methods. So, when the Novas tell her about their discovery of Star Dust she is keen to help – and determined to keep a watchful eye out for anything that might help them on their quest. A former babysitter to Jet and Adelaide, Janali also has an important 'big sister' relationship to the siblings, and they often go to her for advice and guidance.



ANDY LING

A beloved figure on Luna Port, Andy is both the head of the Australian Space Association and one of four international members on the Luna Port Council. Most importantly, he is a big supporter of the Novas and their covert quest to find Star Dust and Star Dust aliens.

This means he is walking the fine line between allowing the Novas to bend the rules and actively bending the truth to the Council and Aubrina. Even though Aubrina and Andy are technically equals on the council, if he is found to have broken the rules, it might endanger his position – and therefore ASA's ability to continue doing any missions in deep space.

GLOSSARY

Contact force	Any force that requires physical contact to occur.
Force	A push or pull that acts upon an object. It can change the shape of or move the object.
Magnet	An object which has its atoms ordered so that it exhibits properties of magnetism, such as attracting other iron-containing objects or aligning itself in a magnetic field.
Magnetic	Capable of being magnetised or attracted by a magnet.
Non-contact force	A force applied to an object by another body that is not in direct contact with it.
Orbit	The curved path of a celestial object or spacecraft round a star, planet, or moon such as the moon around Earth, or Earth around the Sun.
Tides	The alternate rising and falling of the sea, usually twice in each lunar day at a particular place.

ADDITIONAL RESOURCES

LEARNING TASK 1: INTRODUCTION TO FORCES

Find instructions for creating a TWKH chart here:

https://www.primaryconnections.org.au/resources-and-pedagogies/strategies/using-twlh-chart-document-inquiry

LEARNING TASK 2: PUSH CONTACT FORCE

Follow these instructions to make a straw rocket. Students can draw a rocket on paper, cut it out and stick it to the rolled paper.

https://simpleplayideas.com/make-straw-rockets

LEARNING TASK 11: SUMMARISING FORCES

If your school has the budget for a paid subscription to CoSpaces Edu Pro, you could use the platform's physics function to experiment with forces by simulating physical experiments. Have students note down what question they are investigating, what they will be changing in each experiment (the variable) and their hypothesis, or prediction. Students may want to find out how the height of a ramp effects how far things roll off it, or if a heavier ball falls faster. In CoSpaces you can change the mass, amount of friction, height, bounciness, and shape. Make sure students record the results of each experiment.

https://edu.cospaces.io

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Curriculum Writer: Sophie Oakes