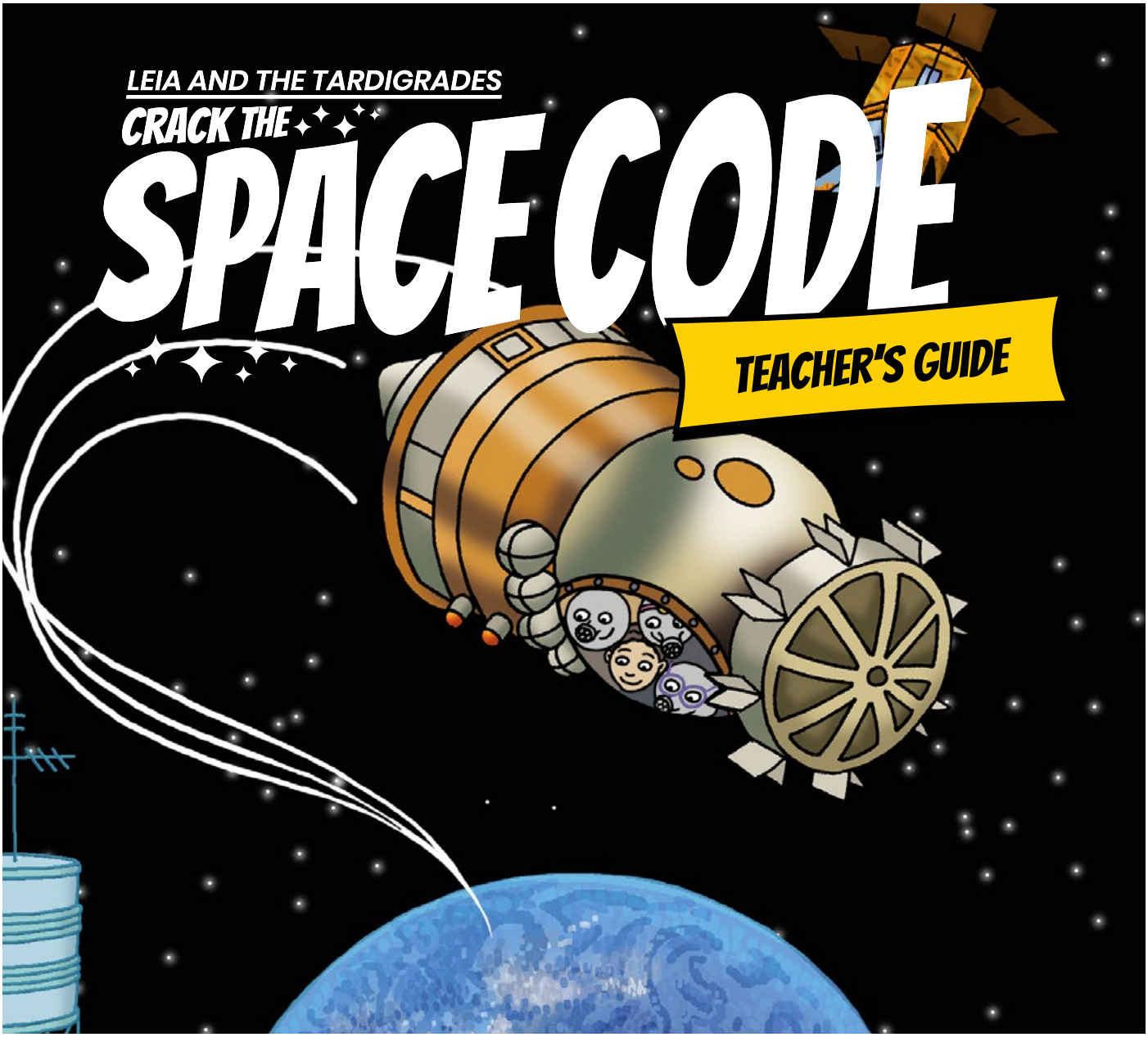

This is a package of interdisciplinary teaching material for Primary school Years 4–6. It covers space, mathematics and programming , and is produced by Kodcentrum, Mattecentrum and the Swedish National Space Agency. Leia and the Tardigrades Crack the Space Code is a fictional story that includes contemporary Swedish space research.

If you would like to access more teaching materials and inspiration about programming , mathematics and space, please visit our websites.

Kodcentrum.se
Mattecentrum.se
Rymdstyrelsen.se

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HELLO TEACHER!

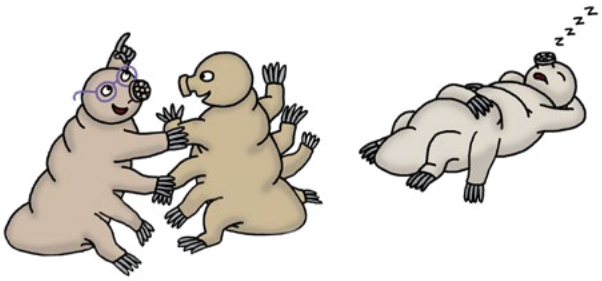
What you are now holding in your hand is teaching material in the form of a space adventure, with exciting missions and tasks for pupils in Primary school Years 4–6 that focus on space, mathematics and programming. This is a continuation of **Leia and the Tardigrades – a journey of discovery in space** which was published by the Swedish National Space Agency, with material that targets Years F–3 and is about the planets in our solar system.

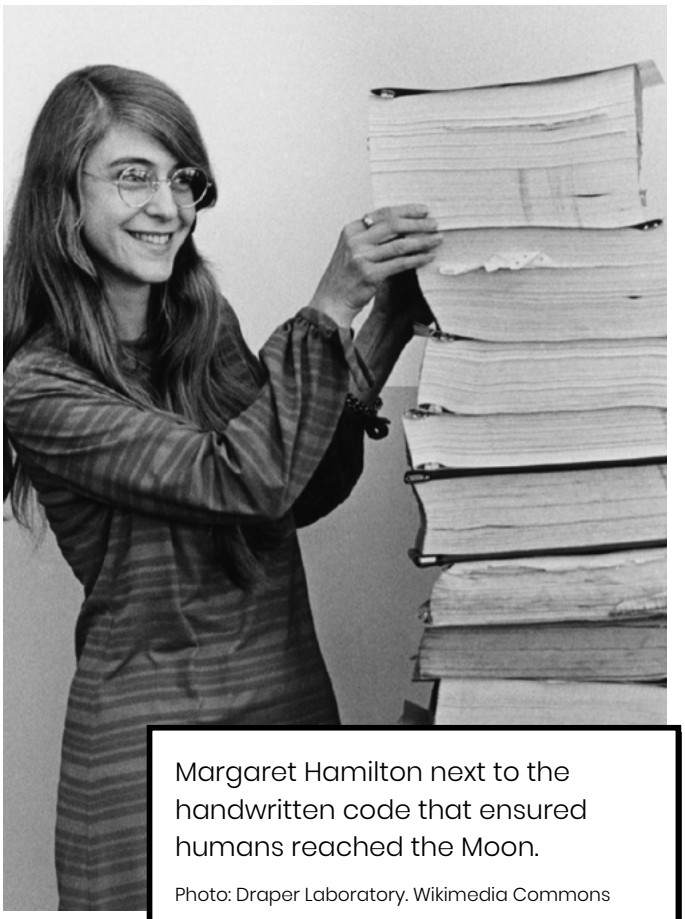
On this adventure, the pupils accompany the tardigrades on a new space adventure, where Mars is their final destination. To reach their objective, the pupils must help the tardigrades overcome a range of challenges, such as collecting space junk, plotting the right coordinates to get to the Moon, and visiting satellites that help us understand and explore our own planet.

The material is aligned with Lgr 11 (revised 2018) and links to the Swedish curriculum for Primary school Years 4–6 in mathematics, technology, natural science and civics. It is excellent for use with integrated subjects.

Thanks to the combination of adventure in the story and the enjoyable challenge of counting and programming to complete the tasks, we hope that this material will inspire pupils to learn more about space, programming and mathematics.

Enjoy your journey!
Kodcentrum, Mattecentrum and the Swedish National Space Agency



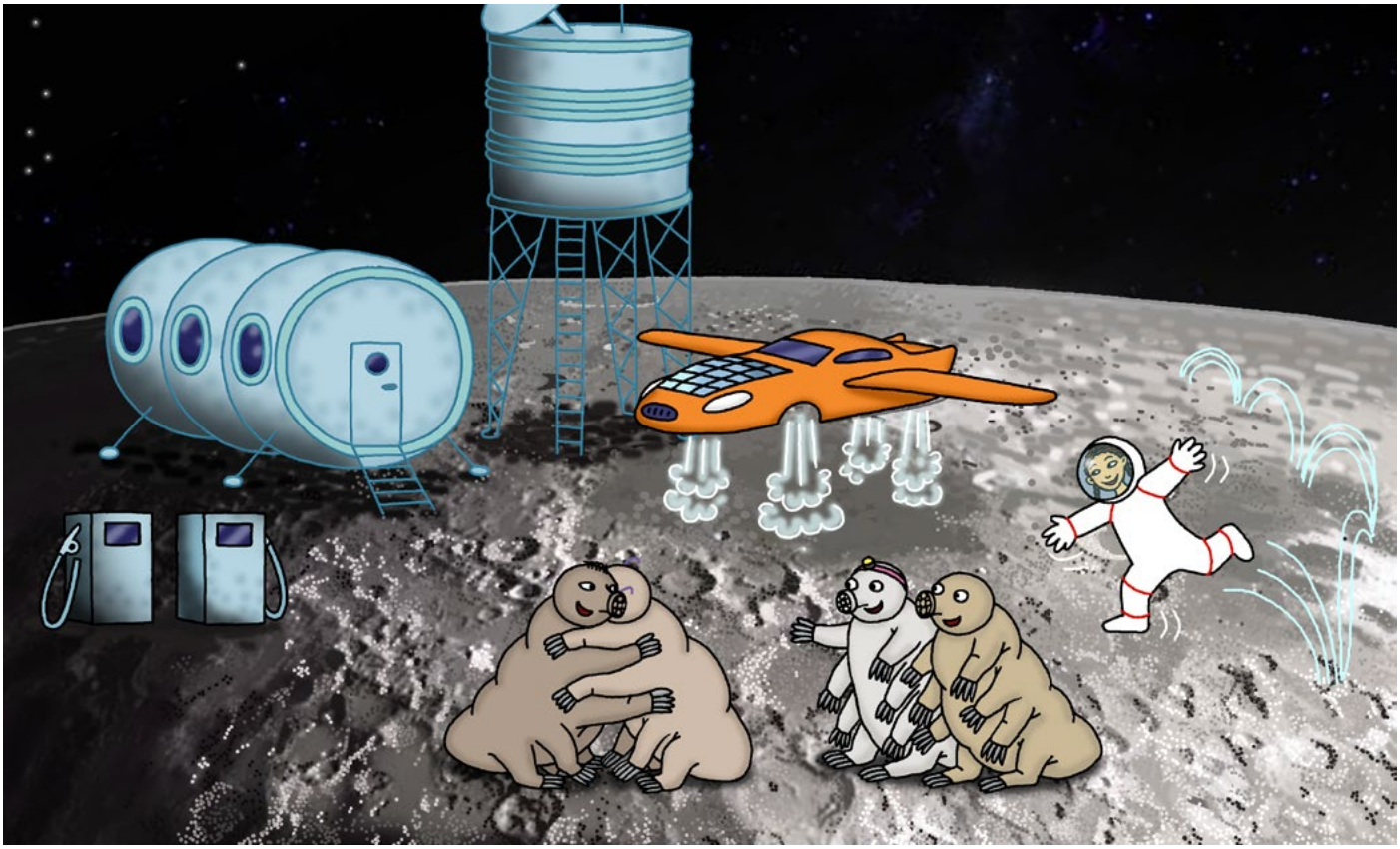


Margaret Hamilton next to the handwritten code that ensured humans reached the Moon.

Photo: Draper Laboratory. Wikimedia Commons

Margaret Hamilton is an American mathematician and software engineer who has inspired us in our work with producing material that highlights how mathematics and programming skills can be used to solve problems in space.

Margaret Hamilton was responsible for programming the software for the US' Apollo space programme, and Skylab, the first US space station. Her team developed the code that was needed to land Apollo 11 in 1969, the first manned space rocket on the Moon. This landing was dramatic, as the rocket's computer transmitted error messages and became overloaded. Thanks to a prescient piece of code from the team, the computer returned to its primary task – landing the spaceship on the Moon. History had been written.



How to use the material

Leia and the Tardigrades Crack the Space Code is a story with five chapters and associated missions, in which the pupils solve math and programming problems and answer questions about space.

The material consists of this Teacher's Guide with suggested lesson plans and links, as well as separate material for pupils with the entire adventure and comic-style illustrations that encourage reading. The material for pupils includes knowledge quizzes, factual information, mathematics and programming tasks.

The pupils accompany three tardigrades, Obi, Wan and Zen, on a journey into space. They are sent on a Swedish satellite called Mats and have to stop the satellite from colliding with space junk before they can continue their journey to Mars, with the help of their friend, Leia. They are going to build an environmentally friendly filling station.

Using this material, pupils find out about current space research. They become acquainted with tardigrades, which have actually – in real life – survived space travel without spacesuits. They learn about the planets and about how satellites help us on Earth, about environmental degradation, weightlessness and much, much more.

TIP!

You can either print out the material for the pupils or display the pages on the smartboard and give the pupils an exercise book where they can answer the questions and do the exercises.

The main characters in our story are the first beings to walk on the planet Mars, which gives pupils the chance to reason and reflect on how we build societies, what law and justice are, and who should make decisions.

Links to the curriculum

The material is constructed so that it can be used as a whole or in separate parts. It is suitable for integration across subjects, as it covers mathematics, programming, natural science and civics. For example, the story and the questions about space can be covered in natural science and civics, and mathematics and programming tasks in mathematics and technology classes.

Read more about how you can link the material to the curriculum in each chapter.

> Tardigrades continue to intrigue children and adults alike, twelve years after they were sent into space. This story about space provides inspiration for discussions about the conditions necessary for life and where life can survive. And children love them.
>
> Ingemar Jönsson, professor of theoretical and evolutionary biology at Kristianstad University, who conducts research into tardigrades.

Mathematics tasks for everyone

There are links to the math tasks that are part of each mission. They have also been collected at **Matteboken.se/thespacecode.**

The math tasks for each mission have three different levels. The calculations and the route to the solution are different for each level, and are increasingly difficult at higher levels. It is important to note that the solution, or the end result, is identical for every level. For example, mission 1, The Space Rocket, has three levels. If the level increases by a step, so does the mathematical challenge. However, the space rocket that is constructed, the end result, will be exactly the same for all pupils, regardless of the level they worked with. The levels for all the math tasks allow the material to remain flexible in a class where the pupils' knowledge levels vary, as the solutions are always identical. All pupils then begin the next task from the same starting point. The material is also flexible between different school years, as it can be adapted depending on what a pupil knows in Year 4 compared to a pupil in Year 6.

We recommend that teachers look through the various levels in advance and decide which level(s) your class should work on.

Programming in Scratch

Every mission has links to programming tasks. These are also available at **Kodboken.se/thespacecode**.

Tasks are done using the Scratch programming tool, designed by an American university, MIT. Scratch teaches the basics of programming through pre-programmed visual blocks that fit together like a jigsaw. Scratch is free to use and is available in English, Swedish and many other languages. It is available as a web version and an offline download. You can use it without logging in.

The programming tasks for Space Code have different levels of difficulty, where mission 1 is an introduction for people who have never used Scratch before and missions 2–4 become increasingly difficult. Choose the missions that you think are suitable for your pupils.

If you have never covered programming with your pupils, there are suggestions for getting started at **Kodboken.se/thespacecode**.

What are tardigrades?

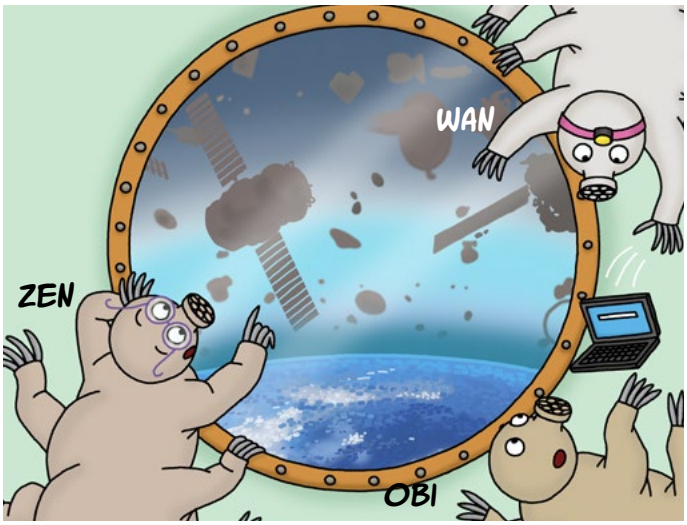
The tardigrades – also called water bears – come from the moss on the limestone plain of the Swedish island, Öland. They were sent into space in a Photon capsule and lived in a container on the outside of the space probe, almost without protection. When they returned to Earth, many of them were unaffected by space's cosmic radiation, the complete vacuum and the resulting dehydration.

Tardigrades are tiny creatures that live in moss, as well as in seas and lakes, which is why they are also called water bears or moss piglets. If you look at them in a microscope, it looks like they are wearing a spacesuit. They have a tube-shaped mouth that looks like a nose. The name tardigrade means "slow stepper" – they move very slowly.

Tardigrades are one of the few organisms that can withstand extreme cold and heat, and they also survive being frozen and being dehydrated. They can survive for years without water or oxygen. They have probably developed an effective way of protecting and repairing their DNA. This means you can find them in mosses and lichens in tough conditions, such as the summits of very high mountains in Antarctica.

The tardigrade's ability to survive such extremes makes it very interesting for researchers to study, and to use what they learn in future spaceflights for humans. This knowledge is also useful for the food and pharmaceutical industries, for example, for learning how to store medicine and food.

Foto: dotted hippo, iStockphoto



CHAPTER 1

THE SPACE ROCKET

About the chapter and the mission

In "The Space Rocket", the pupils accompany tardigrades called Obi, Wan and Zen when they – by mistake – are launched into space with Mats the satellite. Based on this story, the pupils work to answer questions about the tardigrades, Mats the satellite and how a space rocket is constructed. All the questions can be answered using the text in chapter 1.

The math tasks are mainly about geometry and are divided into three levels of difficulty. The space rocket that the pupils build is the same for all levels, but the instructions get progressively more difficult and require greater conceptual understanding, placing higher demands on the pupils' problem-solving skills.

The programming task functions as an introduction to block programming in Scratch for pupils who have not worked with it previously. The students learn how to use the Scratch interface, with sprites, stages and scripts. They test the drawing tool to create their own rocket. After this, they create their first algorithm, which is the same thing as a script – the instructions that tell the programme what to do. In this task, the algorithm makes the rocket take off and travel into space.

More facts about tardigrades are available here:

- Tardigrade, Britannica, **britannica.com/animal/tardigrade**
- Tardigrade facts for kids. Kids Encyclopedia Facts, **kids.kiddle.co/tardigrade**

More facts about Mats the satellite are available here:

- Investigating atmospheric waves, SNSA **rymdstyrelsen.se/en/swedish-satellites/mats**

Links to the curriculum

Physics

Physics and world views:

- The planets of the solar system and their motion in relation to each other. Man in space and the use of satellites.

Technology

- Controlling pupils' own constructions or other objects by means of programming.
- Documentation in the form of sketches with explanatory words and terms, symbols and measurements, as well as physical and digital models.

Mathematics

Algebra:

- How algorithms can be created and used in programming. Programming in visual programming environments.

Geometry:

- Basic geometrical objects such as polygons, circles, spheres, cones, cylinders, pyramids, cuboids and their relationships. Basic geometrical properties of these objects.
- Construction of geometrical objects, both with and without digital tools.
- Methods for determining and estimating circumference and areas of different two-dimensional geometrical figures (levels 2 and 3)

SUGGESTED LESSON PLAN

Previous knowledge

No previous knowledge is necessary for the space task. The answers to the questions are in chapter 1 of the story.

The math task requires previous knowledge of:

- Geometric shapes and solids, and the difference between them.
- Geometric terms such as corner, line, diagonal, circumference (level 2) and area (level 3).

No previous knowledge is required for the programming task, as it is an introduction to Scratch and creating a first algorithm.

Suggested lesson plan

Lesson 1: Work based on the chapter "The Space Rocket"

Use the material for pupils with the story. There are fact boxes next to the story with more in-depth information. Questions and material for the pupils to work with are at the end of the chapter.

1. Start the lesson by talking briefly about tardigrades. Perhaps the pupils could draw their own version of them or ask them to discuss what they think a real tardigrade does in space.
2. Ask the pupils to read chapter 1 as quiet reading or read it aloud to them so that everyone starts at the same time.
3. Present the mission and which tasks are included.

As teacher, you choose whether to start with the information or go straight to the math and programming tasks.

4. Finish the lesson by having the pupils present their answers in the group, and then go through what is correct and why.

Lesson 2: Build your space rocket

Use the material on Mattecentrum's website, **Matteboken.se/the-space-rocket**. There is also a link to a printable pdf.

Required materials: ruler, pen, scissors, paper and tape.

1. Describe the mission again and remind the pupils that they are going to build their own space rocket.
2. Present instructions for the math task and how it should be done.
3. The students can do the calculations individually or in groups. Each pupil gets the level for the task that suits them.
4. Get the pupils to follow the instructions for building their space rockets.
5. When all the pupils have built a space rocket, the rockets can be hung up inside or outside the classroom to display what the pupils have achieved. This is also a reminder of the space journey we are about to take together with Kodcentrum, Mattecentrum and the Swedish National Space Agency.

Lesson 3: Code your space rocket

Use the material on Kodcentrum's website, **Kodboken.se/thespacerocket**

1. Describe the mission again and tell the pupils that they are going to build their own space rocket in Scratch, which they will launch into space – using their first algorithm!
2. Present Scratch as a programming tool, and its interface with sprites, stages and scripts. You can explain Scratch using the analogy that it is like directing a film, where the sprites are actors and the script blocks are parts of a script. The pupils are directors, who control the stage!
3. Start the task by doing it together with the entire class, where you control the programming using the display computer and ask the pupils questions about how to build your rocket and then program it.
4. When you are programming as a class, take the opportunity to show them the script blocks and how they are colour coded in different categories. In this task, you use Events and Motion.

The pupils then create their own projects. They need to open an empty start project in Scratch and have the task on **Kodboken.se/thespacerocket.**

5. All the pupils can demonstrate their space rockets at the end of the lesson!

CHAPTER 2

SPACE JUNK

About the chapter and the mission

In the "Space Junk" chapter, the tardigrades must rescue Mats the satellite from space junk. Based on the story, the pupils study and answer questions about space junk and what could happen to Mats the satellite in space. All the questions can be answered using the text in chapter 2.

In the math and programming tasks, pupils create a space game where the tardigrades travel through space and tidy up space junk to protect Mats the satellite. Every piece of space junk that is collected generates points for the number of tons the junk weighs.

The math section is a problem-solving task where the pupils have to calculate the weight of different types of space junk, represented by different geometric shapes. The results of the calculations are used in the programming task, where the weight in tons is used as variables for points.

The results in all three levels of the math tasks are identical for all the pupils. Regardless of the level they do, they obtain the same values for the programming task.

More facts about space junk can be found here:

- Space junk, ESA, **esa.int/kids/en/learn/Technology/Mission_control/Space_junk**
- Space junk is a huge problem — and it's only getting bigger, National Geographic, **nationalgeographic.com/science/space/reference/space-junk**
- What is space junk and why is it a problem? The Natural History Museum, **nhm.ac.uk/discover/what-is-space-junk-and-why-is-it-a-problem**

Links to the curriculum

Physics

Physics and world views:

- The planets of the solar system and their motion in relation to each other.
- Man in space and the use of satellites.

Mathematics

Algebra:

- How algorithms can be created and used in programming. Programming in visual programming environments.

Geometry:

- Construction of geometrical objects, both with and without digital tools. Scale and its use in everyday situations.

Problem solving:

- Strategies for mathematical problem-solving in everyday situations.

Technology

- Controlling pupils' own constructions or other objects by means of programming.
- Documentation in the form of sketches with explanatory words and terms, symbols and measurements, as well as physical and digital models.

Previous knowledge

No previous knowledge is necessary for the space task. The answers to the questions are in chapter 2 of the story.

The following previous knowledge is necessary for the math task:

- Arithmetic.
- Basic understanding of unit conversion.
- Choosing the right method for the task.
- Levels 2 and 3 require a basic understanding of percentages.

For the programming task, pupils need to have had a basic introduction to Scratch and understand the concept of repetition (loops), conditions (if-then) and variables. The pupils may need to think for themselves for a while to solve some elements.

Suggested lesson plan

Lesson 1: Work based on the "Space Junk" chapter

Use the material for pupils with the story. There are fact boxes next to the story with more in-depth information. Questions and material for the pupils to work with are at the end of the chapter.

1. Ask the pupils to read chapter 2 of the story.
2. Present the mission and which tasks are included.
3. Before the pupils begin the factual questions, show the film/picture about space junk that you can find at ESA´s website: **esa.int/kids/en/news/ESA_gives_go-ahead_for_the_world_s_first_space_junk_removal_mission** and this film showing how NASA protects the International Space Station from space junk, **youtube.com/watch?v=Ok_QkTW4a28**
4. Pupils work on the factual questions. The answers are in the story.
5. Finish the lesson by asking the pupils to present their answers to the group. Then go through what is correct and why.

Lesson 2: How heavy is the space junk?

Use the material on Mattecentrum's website, **Matteboken.se/space-scrap.** There is also a link to a printable pdf.

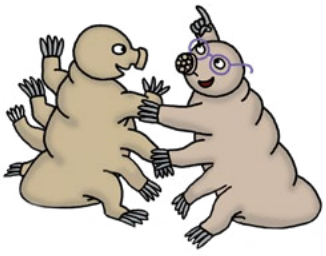
1. Start by describing the mission again.
2. Present instructions for the math task and how it should be done.
3. The students can do the calculations individually, in pairs, or in groups. Allocate the levels in the math task to suit the groups or individuals. Each pupil should get the level that suits them. Remember that the answers will be the variables used in the programming in the next lesson, so don't forget to save the answers!
4. Have a teacher-led review of how the pupils chose to do the task and the weights they calculated for the pieces of space junk.

Lessons 3-4: Coding a space junk game

Use the material available on Kodcentrum's website, **Kodboken.se/spacejunk.**

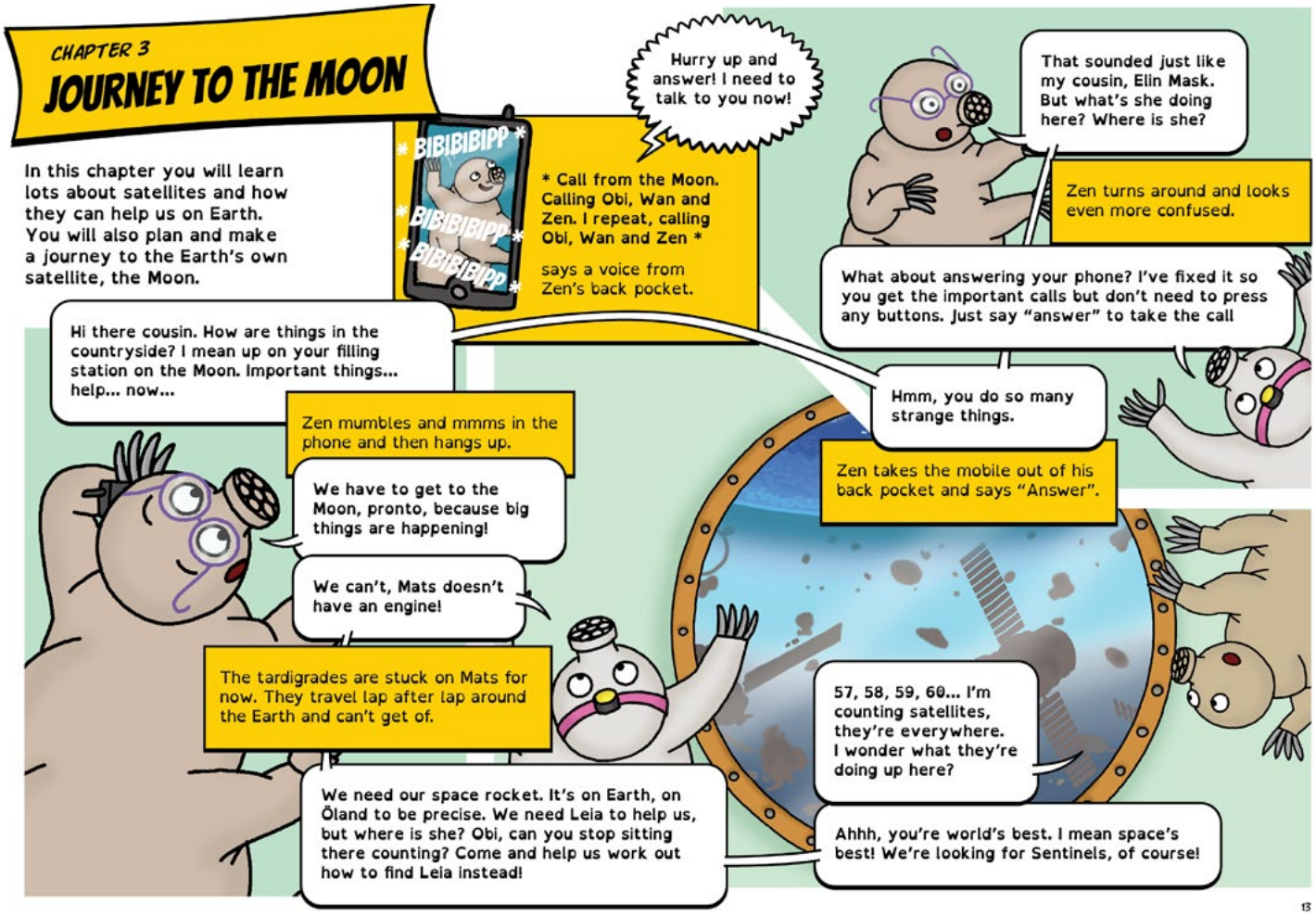
Describe the mission again, and tell the pupils that they are going to create a space game where the tardigrades need to collect space junk to protect the satellite Mats. You choose whether the pupils will work on their own, in pairs, or in small groups.

5. The pupils need to use their results from the math task. They function as variables in the game's points counter, where each ton of junk is converted to 1 point.
6. You can show some example projects for the task from **Kodboken.se/spacejunk.**
7. Then let the pupils go to Scratch and the task on Kodboken.se. If the pupils want to use Rymdkoden's illustrations, they begin by remixing a start project. The link is in the task.
8. Pupils can have the task in Kodboken open in a separate browser window/tab while they are programming in Scratch. They solve the task in different steps. There are pictures that show a possible solution before they click to move to the next step.
9. Let the pupils demonstrate their space game at the end of the lesson!



CHAPTER 3

JOURNEY TO THE MOON



About the chapter and the mission

In the "Journey to the Moon" chapter, pupils learn about satellites and how they can help people on Earth. To gain more understanding, they will work on the factual questions in the material for pupils.

In the math and programming tasks, pupils plan their own journey to the Moon and create a space game where they send a space rocket from Earth to the Moon by providing the correct coordinates.

Before the space game can be created, pupils must solve a math task where they work with coordinate systems and then use the result in their programming. The math task is divided into three levels, where the more difficult levels require a greater understanding of the coordinate system and its construction.

The task involves plotting the Earth and the Moon (sprites in Scratch) in a coordinate system, thus creating a game board as a foundation for the programming task. It is important that the pupils keep a log of the coordinates they have chosen for each picture, as they are going to use these coordinates when they create their game in Scratch. Pupils will also scale the coordinate system in the more difficult levels of the math section.

More facts about the Moon can be found here:

- Moon exploration, ESA, **esa.int/kids/en/learn/Our_Universe/Planets_and_moons/Moon_exploration**
- Moon phases, ESA, **esa.int/kids/en/learn/Our_Universe/Planets_and_moons/Moon_phases**
- Interesting facts about the Moon, Royal Museums Greenwich, **rmg.co.uk/explore/interesting-facts-about-moon**

More facts about satellites are available here:

- Satellites, ESA, **esa.int/kids/en/learn/Technology/Useful_space/Satellites**
- What is a Satellite? NASA, **nasa.gov/audience/forstudents/5-8/features/nasa-knows/what-is-a-satellite-58.html**

SUGGESTED LESSON PLAN

Links to the curriculum

Physics

Physics and world views:

- The planets of the solar system and their motion in relation to each other.
- Man in space and the use of satellites.

Mathematics

Algebra:

- How algorithms can be created and used in programming. Programming in visual programming environments.

Relationships and change

- The coordinate system and strategies for scaling coordinate axes.

Technology

- Controlling pupils' own constructions or other objects by means of programming.
- Documentation in the form of sketches with explanatory words and terms, symbols and measurements, as well as physical and digital models.

Biology

Nature and society

- People's dependence on and the impact on nature and what this means for sustainable development. Ecosystem services, such as decomposition, pollination, and purification of water and air.

Chemistry

Chemistry in everyday life and society

- Fossil and renewable fuels. Their importance in energy use and impact on climate.

Previous knowledge

No previous knowledge is necessary for the space task. The answers to the questions are in chapter 3 of the story.

Pupils will work with a coordinate system where the x and y axes are in positive and negative directions. The negative direction cannot be removed because the programming requires the use of the coordinate system presented on the worksheet, which is linked to the lesson planning.

The previous knowledge necessary for the math task is:

- The ability to read and position points in a coordinate system, and to write them down individually.
- Knowledge that the x and y axes in a coordinate system have a negative and positive direction.

The programming task requires that pupils have a good understanding of Scratch and the concepts of repetition (loops), conditions (if-then-else) and working with variables. The pupils use the coordinate system in Scratch and need to think independently in order to solve some problems.

Suggested lesson plan

Lesson 1: Space task

Use the material for pupils with the story. There are fact boxes next to the story with more in-depth information. Questions and material for the pupils to work with are at the end of the chapter.

1. Ask the pupils to read chapter 3 of the story aloud to each other.
2. Present the mission and which tasks are included.
3. Before pupils start the factual questions, show a short film from NASA's website about when man first walked on the Moon **(nasa.gov/mission_pages/apollo/apollo11.html)**.
4. Pupils work on the fact questions. The answers are in the story.
5. If there is time:
   a. Discuss the Moon's effect on the Earth, ebb and flow.
   b. Show pictures of different sorts of satellites and get the pupils to construct their own based on what they want it to study on Earth (draw, build, describe).
6. Finish the lesson by having the pupils present their answers in the group, and then go through what is correct and why.

Lesson 2: Math task

Use the material on Mattecentrum's website, **Matteboken.se/the-moon-journey**. There is also a link to a printable pdf.

1. Present the mission again and provide instructions for the math task and how it should be done.
2. The pupils can work alone or in groups to do the task, depending on what level is most suitable. Remember that all the answers the pupils arrive at are different for each individual or group.
3. Pupils use the worksheet and list the coordinates they decide for the pictures used in the programming. So that the game programming will work well, pupils must be given the chance to create a game board where they use the entire area of the coordinate system and the coordinates are written down as numbers.
4. Finish the lesson by asking the pupils to show how they planned their journey to the Moon!

Another way of planning the lesson is for you to decide coordinates for the sprites in advance, so the pupils' task is to plot them at the correct coordinates.

Lessons 3-4: Code your journey to the Moon

Use the material on Kodcentrum's website, **Kodboken.se/journeytomoon.**

1. Describe the mission again, and tell the pupils that they are going to create a game where they send a space rocket from Earth to the Moon by plotting the correct coordinates. You choose whether the pupils will work on their own, in pairs, or in small groups.
2. You can show them the example project in the task at **Kodboken.se/journeytomoon.** Explain that the pupils will use the coordinates from the math task to position the sprites for Earth, Moon and space rocket in the coordinate system.
3. Also use the example project to show that the user of the program can state which x-coordinate and y-coordinate the space rocket will travel to, to reach the Moon. The pupils will program this using the script block. Ask and wait from the Sensing category. The answers are saved as two variables in the program.
4. Let the pupils go to Scratch and the task at Kodboken.se. It is important that the pupils start by remixing a start project where the coordinate system has already been set out. The link is in the task. The coordinate system is a sprite and, if you look below Costumes, there are several to choose from. It is important that the pupils keep the pre-programmed script for the sprite, which plots the centre at 0,0.
5. Pupils can have the task in Kodboken open in a separate browser window/tab while they are programming in Scratch. They solve the task in different steps. There are usually pictures that show a possible solution before they click to move to the next step.
6. All the pupils can demonstrate their space game at the end of the lesson.

CHAPTER 4

LANDING ON MARS

About the chapter and the mission

In the chapter on "Landing on Mars", pupils become more familiar with the Moon and Mars, as well as the other planets in our solar system.

Once the pupils have finished working on the chapter, they create a simulator in Scratch and then analyse the results using probability theory in mathematics. The pupils first code a program that tests landing on Mars at different times, where each time has a different probability of a successful landing. The results of the simulation will be whether they land successfully or not at different times, which must be recorded in tables that are the basis of the analysis.

More facts about Mars can be found here:

- Mars - the red planet, ESA, **esa.int/kids/en/learn/Our_Universe/Planets_and_moons/Mars_-_the_red_planet**
- Films about Mars, ESA, **esa.int/spaceinvideos/ Missions/Mars_Express**

Links to the curriculum

Physics

Physics and world views:

- The planets of the solar system and their motion in relation to each other. Man in space and the use of satellites.

Mathematics

Algebra:

- How algorithms can be created and used in programming. Programming in visual programming environments.

Probability and statistics:

- Standard probability and methods for calculating probability in everyday situations. How combinatorial principles can be used in simple daily and mathematical problems.
- Tables, diagrams and graphs, and how they can be interpreted and used to describe the results of the pupils' own and others' investigations, both with and without digital tools.

Technology

- Controlling pupils' own constructions or other objects by means of programming.
- Documentation in the form of sketches with explanatory words and terms, symbols and measurements, as well as physical and digital models.

Previous knowledge

No previous knowledge is necessary for the space task. The answers to the questions are in chapter 4 of the story.

The programming task requires that pupils have a good understanding of Scratch and the concepts repetition (loops), conditions (if-then) and working with variables. The pupils use the coordinate system in Scratch and need to think for themselves in order to solve some problems.

For the math task, they must have a basic understanding of probability and how it can be used to argue for and arrive at a final result. They must also understand what a simulation is and how it can be used.

Suggested lesson plan

Lesson 1: What do you know about Mars?

Use the material for pupils with the story. There are fact boxes next to the story with more in-depth information. Questions and material for the pupils to work with are at the end of the chapter.

1. The pupils read chapter 4.
2. Present the mission and which tasks are included.
3. The pupils work on the factual questions in small groups. Ask them to discuss the answers and then think about which three things each of them would take if they could travel to Mars.
4. Draw or describe a planet in the solar system.
5. Finish the lesson by having the pupils present their answers in the group, and then go through what is correct and why.

Lessons 2-3: Code a simulator for your landing on Mars

Use the material available on Kodcentrum's website, **Kodboken.se/landingonmars.** You can also print out the page for the task.

1. Give the pupils the mission and tell them they are going to make a simulator, a computer program that can test things. The pupils are going to test landing a space rocket on Mars at different times of the day, so they discover the best time to avoid asteroids. Using a simulator, they will collect data for the math task.
2. Show the example projects for the task at **Kodboken.se/landingonmars.** They show how the simulator will be used when it is finished. Tell the pupils that they are going to remix a project that includes a simulator with some already added code that they need to finish.
3. The pupils go to Scratch and the task at **Kodboken.se/landingonmars.** It is important that the pupils begin by remixing a start project where the slightly pre-coded simulator. The link is in the task.
4. Pupils can have the task in Kodboken open in a separate browser window/tab while they are programming in Scratch.
5. Each pupil demonstrates their simulation when they have finished.

Lesson 4: Analyse the simulation and decide which time to land on Mars!

Use the material available on Mattecentrum's website, **Matteboken.se/landing-on-mars**. There is also a link to a printable pdf.

1. Present the mission again and provide instructions for the math task and how it should be done.
2. The pupils can work alone or in groups to do the task, depending on what level is most suitable. Remember that all the data the pupils produce will be different for each individual or group.
3. The pupils gather data by conducting simulations in Scratch. The material for pupils includes tables where pupils can document their observations and use these in the following steps. This part is done in the same way regardless of the level of difficulty.
4. Using the data collected in the previous task, pupils present their results as a bar chart. The material for pupils is designed so it offers different support structures for completing the task depending on the level of difficulty.
5. The pupils answer questions about probability that are linked to the bar charts they made (see material for pupils).

CHAPTER 5 AND EPILOGUE

LIFE ON MARS

About the chapter and the mission

In the "Life on Mars" chapter, the pupils work with and reason around what living on Mars would be like. They will work on the differences between Earth and Mars, what is necessary for life on a new planet and what is necessary for building and designing a society.

This task does not have an associated math or programming task. It is linked to the subject of civics. In addition to the questions that relate to civics, there is also space for discussing life in space and research on Mars.

More facts about Curiosity are available here:

- Welcome to Mars, Curiosity!, ESA, **esa.int/Science_Exploration/Space_Science/Welcome_to_Mars_Curiosity**
- NASA's website about Curiosity, videos etc, **mars.nasa.gov/msl**
- NASA's website about Curiosity, films, images, etc. **nasa.gov/mission_pages/ msl/index.html**

More facts about Insight can be found here:

- NASA's website about Insight, films, images, etc. **mars.nasa.gov/insight**
  nasa.gov/mission_pages/insight/main/index.html

Links to the curriculum

Physics

Physics and world views:

- The planets of the solar system and their motion in relation to each other.
- Man in space and the use of satellites.

Civics

Rights and the judicial system

- Society's need for legislation, some different laws and sanctions, crime and its consequences on the individual, family and society.
- Human rights, their meaning and importance, including the rights of the child under the Child Convention.

Decision-making and political ideas

- What democracy is and how democratic decisions are made. Local decision-making bodies, such as pupil councils and association. How individuals and groups can influence decisions.

Previous knowledge

This task requires basic knowledge of what a society is and the necessary foundations for a functioning society.

Suggested lesson plan

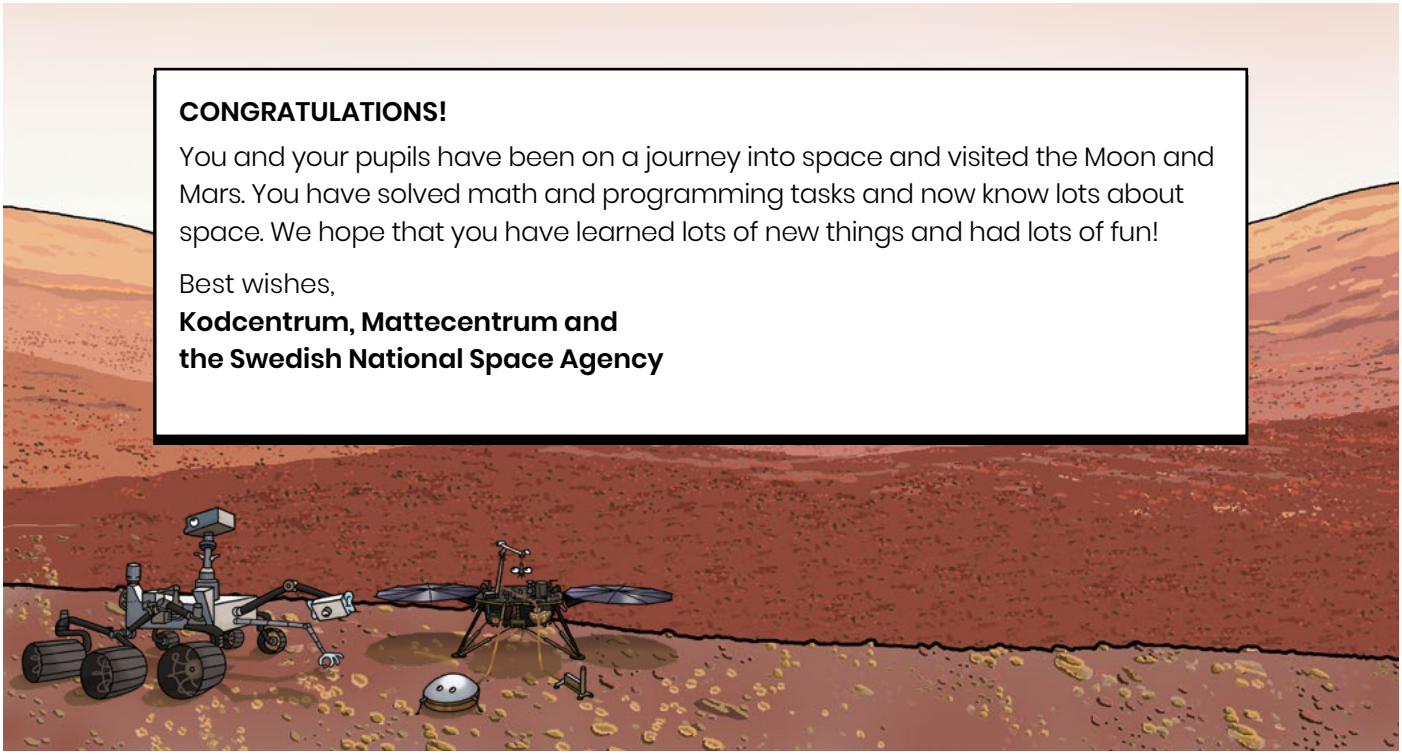
Lesson 1: Work on the "Life on Mars" chapter

Use the material for pupils with the story. There are fact boxes next to the story with more in-depth information. Questions and material for the pupils to work with are at the end of the chapter.

1. The pupils read chapter 5.
2. Present the mission and which tasks are included.
3. The pupils work on the factual questions on their own.
4. Pupils can discuss in groups, so that they can jointly arrive at the five most important things for surviving on Mars. Present the answers in groups made up of one pupil from each of the previous groups.

Lesson 2: Space task, "Building a successful society"

1. Revise what a society is and the necessary foundations for a functioning society.
2. Divide the class into groups. Give each group a big piece of paper and coloured pens.
3. The pupils work on the question: How do we build a successful society? They draw it and describe it on the paper.
4. Write the three questions from the material for pupils in the smartboard or the board.
5. The pupils put up their pieces of paper around the classroom and then the groups present them to each other. Leave space for discussion.
6. End the lesson by reading the epilogue to conclude the story.



CONGRATULATIONS!

You and your pupils have been on a journey into space and visited the Moon and Mars. You have solved math and programming tasks and now know lots about space. We hope that you have learned lots of new things and had lots of fun!

Best wishes,
Kodcentrum, Mattecentrum and the Swedish National Space Agency

LEIA AND THE TARDIGRADES

CRACK THE SPACE CODE

Leia and the Tardigrades Crack the Space Code provides interdisciplinary teaching materials for Primary school Years 4–6. It consists of a story with five chapters and associated tasks, in which pupils solve math and programming problems and answer questions about space.

It consists of a Teacher's Guide with suggested lesson plans and links, as well as separate material for pupils with the entire adventure and comic-style illustrations that encourage reading. It includes knowledge quizzes, facts, mathematics and programming tasks.

The pupils accompany three tardigrades, Obi, Wan and Zen, on a journey into space. They are sent on a Swedish satellite called Mats and have to stop the satellite from colliding with space junk before they can continue their journey to Mars, with their friend, Leia. They are going to build an environmentally friendly filling station.

Using this material, pupils find out about current space research. They become acquainted with tardigrades, which have actually – in real life – survived space travel without spacesuits. They learn about the planets and about how satellites help us on Earth, about environmental degradation, weightlessness and much, much more. To successfully complete their space adventure, pupils have to solve a range of enjoyable and interesting tasks in mathematics and programming.

Kodcentrum
Kodcentrum is an NGO that introduces children to programming and digital creation for free. With the help of volunteers, they strengthen digital democracy, broaden the view of who codes and what can be created with code. Read more at **Kodcentrum.se** and explore their educational material at **Kodboken.se.**

Mattecentrum
Mattecentrum is a non-profit organisation that offers free mathematics support to children. The organisation works to promote equal opportunities for learning and to increase knowledge of and interest in mathematics. Read more about us at Mattecentrum.se and explore our tutoring tools **mathplanet.com, Matteboken.se, Pluggakuten.se, Formelsamlingen.se,** as well as the math labs we hold around the country.

Swedish National Space Agency
The Swedish National Space Agency is responsible for publicly funded national and international space research and development in Sweden. The Agency is also tasked with increasing young people's interest in technology and natural science. Read more at **rymdstyrelsen.se**

<Kod centrum> Matte centrum Rymdstyrelsen Swedish National Space Agency