

Project Hail Mary Homeschool: Companion Unit Study

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B E L I E V E

I N T H E

H A I L

M A R Y

PROJECT

HAIL
MARY

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ADITYA SOOD, p.g.a. RACHEL O'CONNOR, p.g.a. ANDY WEIR, BASED ON THE NOVEL BY ANDY WEIR
SCREENPLAY BY DREW GODDARD, DIRECTED BY PHIL LORD & CHRISTOPHER MILLER

ONLY IN THEATERS
03.20.26
FILMED FOR IMAX

#ProjectHailMary

ProjectHailMary.com

Introduction

PROJECT HAIL MARY is the story of science teacher Ryland Grace (Ryan Gosling), who wakes up on a spaceship light years from home with no recollection of who he is or how he got there. As his memory returns, he begins to uncover his mission: solve the riddle of the mysterious substance causing the sun to die out. He must call on his scientific knowledge and inventive ideas to save everything on Earth from extinction... but an unexpected friendship means he may not have to do it alone.

Ryland Grace comes face to face with Rocky, a being from another solar system. Like Grace, Rocky is also sent to solve the riddle of his dying sun in hopes of saving his planet. These two radically different explorers must work together, using their clever and unique abilities in a race against time to discover how to save their homes. In the process, they learn important lessons about themselves and each other, developing an unlikely friendship and connection.

How to Use This Guide

This unit study is divided into five fun and educational exploration lessons, each covering an academic subject using the movie as the spine of the unit. Middle and high school students will enjoy learning more about the themes from the movie as they prepare for the final activity: a field trip to a matinee screening on Friday, March 20, 2026, to see *Project Hail Mary*. These are great lessons to do with other families in your local homeschool community, too! Answer keys for all the lessons are located in the back of this unit study book.

Now it's time to dive into this Companion Unit Study and get ready for a fun, educational, out-of-this world experience!

(All these experiments should be done in the presence of an adult).

● Day 01: Science

● Day 02: Social Studies

● Day 03: History & Art

● Day 04: Language Arts

● Day 05: Field Trip

About the Author: Project Hail Mary curriculum was written by Apologia author Sherri Seligson, M.Ed. Sherri Seligson is a marine biologist, homeschool veteran, speaker, and author of several science courses and educational videos. You can find her at www.sherriseligson.com

Layout Design: by Justin & Kathy King

PROJECT
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Experiment with Propulsion

To launch a rocket, it needs enough energy to push it forward (or in this case, upward). That's called **propulsion**. You can explore how propulsion works in this experiment. This experiment must be done with adult supervision!

You will need:

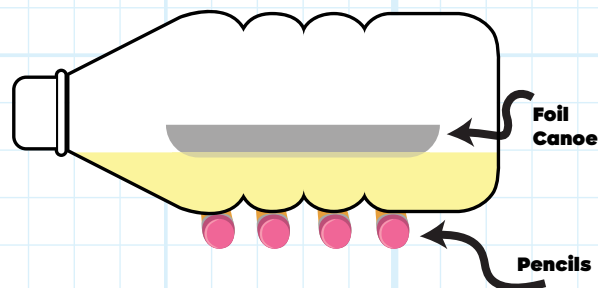
- 🔥 An empty 2-liter soda bottle
- 🔥 A cork that will fit within the bottle opening to seal it
- 🔥 Aluminum foil
- 🔥 Baking soda
- 🔥 Vinegar
- 🔥 5 or 6 Round pencils or pens
- 🔥 Small spoon
- 🔥 1 cup measuring cup
- 🔥 Funnel

This experiment should be done outside in an open area. Make sure the bottle is washed and dried. Using a funnel, pour 2 cups of vinegar into the bottle. Line up the pencils parallel to each other so they are side-by-side about an inch apart. Carefully lay the bottle on its side on top of the pencils. The bottle should be oriented perpendicular to them.

Now take a sheet of aluminum foil, fold it in half, and fold it in half again. Now pinch up the ends, forming it into a long, thin canoe shape. The canoe needs to be able to fit inside the mouth of the soda bottle.

Spoon several spoonfuls of baking soda into the foil canoe and gently place it inside the bottle so the canoe floats on the vinegar. It's fine if a little baking soda falls into the vinegar.

Your setup should now look like this:



Experiment with Propulsion Continued

Now, place yourself on one side of the bottle and gently insert the cork firmly into the bottle's mouth. **Be sure you are on the bottle's side and make sure no one is standing around you, particularly near the bottle's mouth or bottom!**

With a quick motion, pick up the bottle and gently shake it up and down so the canoe dumps the baking soda into the vinegar. Immediately set the bottle back down on the pencils and **stand back.**

Within a minute or two, you should see the effects of propulsion.

[If nothing happens, **wait at least 5 more minutes.** Then – again making sure you are on the bottle's side, carefully remove the cork and try the experiment again with a larger canoe and more baking soda.]

What happened in the experiment? _____

The cork should have popped out of the bottle's mouth while the bottle moved along the pencils in the opposite direction. Propulsion follows a principle in physics, called Newton's third law of motion. This law states that every action has an equal and opposite reaction. In your experiment, carbon dioxide gas formed when the baking soda mixed with the vinegar. As more gas built up inside the bottle, it created more pressure due to the gas pushing against the bottle's sides.

The cork provided a way for the gas to escape, so when the gas pushed the cork out in one direction, an equal and opposite force resulted causing the bottle to move in the opposite direction.



Growing Crystals

In the movie, Grace mentions how life as we know it needs to exist within what he called a **habitable** zone, or the Goldilocks Zone. That refers to areas around a star where it's not too hot or cold, just the right amount of sunlight, perfect atmospheric conditions and more. But when he met Rocky, he realized that Rocky's planet was made up of different conditions. Rocky's body was rock-like, and crystals played an important part in his world.

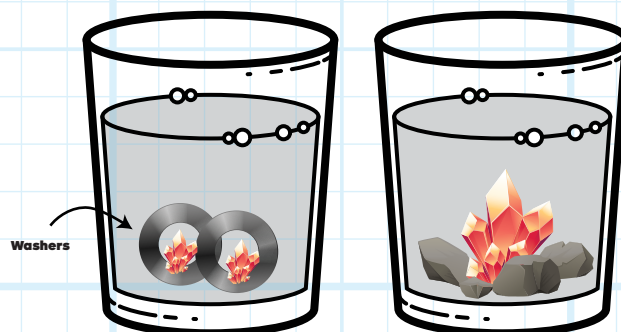
Explore crystals and crystal formation in the following experiment.

You will need:

- 1 cup measuring cup
- Water
- Epsom salts
- Saucepan
- Stove
- Stirring spoon
- 2 glass containers with lids
- A couple small rocks or pebbles
- 2 metal washers

Mix 2 cups of water with 3 cups of Epsom salts in the saucepan. Place the saucepan on the stove and heat it until the mixture boils while stirring constantly. When the crystals stop dissolving, remove the saucepan from the stove and allow it to cool. Place the rocks in one of the glass containers and the metal washers in the other one. Carefully pour the salt mixture into both containers, dividing the liquid evenly. Seal the containers and allow them to rest overnight or up to a few days. Depending on the mineral content of your water, you will see crystals forming on the rocks, washers, and even along the sides of the containers. With a spoon or fork, gently lift some of the crystals out of the solution and observe them.

Can you see how their structure is very different in design than living things on Earth?



The Airlock Challenge

Escape rooms are a great way to work together with other people in order to reach a common goal. In *Project Hail Mary* we see many examples of that. The countries of Earth must **collaborate** to create a ship that could send Grace and his team to solve the mystery of their dying sun. Grace and Rocky also must work together to figure out how to save their home planets.

One of the best things about working as a team is that each person uses unique strengths to help. Rocky had to be bold, and Grace had to be courageous. Rocky had advanced math skills that could create useful devices while Grace was able to think in a creative way when approaching each problem they faced.

Get the help of a parent to set up this **Airlock** Challenge escape room that you can solve with the help of a sibling or friend. Notice that when you use your unique skills, each team member is valuable as you work together to solve the problems you will encounter. Plus, compared to working by yourself, working alongside someone else can be much more fun!

You will need:

- 6 large envelopes
- 1 small envelope
(The small envelope should fit inside a large envelope.)
- Scissors
- 6 balloons
- Plain paper
- Tape or glue
- Marker
- Notepad or sheets of paper for explorers to use
- Pencils or pens for explorers to use



Parents, follow these instructions to set up the Escape Room:
Label the 6 large envelopes numbers 1-6 on the envelopes' corners.

Envelope #1 Prep:

Cut out INSTRUCTION #1. Cut out CLUE #1 and place it inside SMALL ENVELOPE #1. Label that small envelope CLUE #1. Cut out the CODE BOX with the blank spaces. Put INSTRUCTION BOX #1, the small envelope, and the CODE BOX in large envelope #1. You will be handing this envelope to your explorers along with a notepad or paper and pencils.

#1

Envelope #2 Prep:

Cut out and add INSTRUCTION #2. Cut out each boxed word in PUZZLE #1 plus LOCATION CLUE #2. Fold up each word and slide each inside a separate balloon. Fold up LOCATION CLUE #2 and place it in the 6th balloon. Blow up and tie the 6 balloons and place them in the bedroom closet where your explorers keep jackets and coats.

#2

Envelope #3 Prep:

Cut out PUZZLE #2 pieces along the solid lines and place them inside the large envelope. Place envelope #3 where you keep your salt.

#3

Envelope #4 Prep:

Cut out INSTRUCTION #4, the PIGPEN CIPHER, and PUZZLE #3 and add to envelope. Place envelope #4 near the family computer.

#4

Envelope #5 Prep:

Insert the two PUZZLE #4 sheets. Place envelope #5 on the couch, hidden under a pillow or blanket

#5

Envelope #6 Prep:

Cut out the WINNER'S BADGE and add it to envelope. Seal envelope and tape or glue the AIRLOCK IMAGE on the outside. Tape the envelope to the front door.

#6

INSTRUCTION #1

Time is short! you and your teammate are in a spaceship orbiting a foreign star. You have just completed a spacewalk and in returning to the airlock chamber, you find that the door to the inside of the ship is stuck! The only way to open it is to figure out the four-digit override code.

You will be searching for clues to reveal this code, but you have only 30 minutes before all the oxygen in the airlock chamber is gone. Bring the Code Box sheet with you as you solve each puzzle. Your challenge begins when you open the small envelope with Clue #1.

Good Luck!

CLUE #1

When he was outside his spaceship, Grace needed to wear a special suit to provide both air to breathe and to warmth for his body. To find your next clue and your first puzzle, look in the place in your room where you hang up your jackets and coats which keep you warm.

CODE BOX

The code to unlock the airlock door is:

Once you get these four numbers put them on the combination of the airlock door to escape. Check with a parent to see if your lock is open.

INSTRUCTION #2

Pop the 6 balloons and solve your first puzzle. Add your code number to the corresponding Code Box space.

PUZZLE #1

The

third

number

is

8.

LOCATION CLUE #2

Even though this is different from Grace, Rocky played an important role in helping them both save their planets. Rocky is made of crystalline material. Once you've solved your number clue, look for your next puzzle and clue where crystalline salt is stored.

PUZZLE #2

The		second	
number		is	
	0.		

Technology is something created to make practical jobs easier. Scientists use their knowledge of the world to improve technology. Both Rocky & Grace have several examples of technology on their ships. Your next clue will be where you have a technological device that helps you send emails easily, find information, and create electronic documents.

INSTRUCTION #4

A Pigpen Cipher is a code replacing letters with symbols that are found on a grid (which looks like pens that hold pigs). To accommodate all the letters of the alphabet, there are two tic-tac-toe grids and two x-shaped grids, one grid with dots and one without. The letters are placed in the grids, and the **geometric shape around each letter** becomes the code for that letter. For example, the word:

 translates to "HELLO".

While trying to communicate, Rocky and Grace must work to understand each other's method of symbols and sentence structure. Imagine that Grace uses the alphabet while Rocky uses something completely different, such as the shapes in the cipher.

Solve your next clue by translating the cipher included in this envelope.

PIGPEN CIPHER

A	B	C	J	K	L
D	E	F	M	N	O
G	H	I	P	Q	R

	S		W	
T		U	X	Y
	V		Z	

PUZZLE #3



Once you solve your last clue, you will be able to rest easy.
Look for your final clue on the



PUZZLE #4 Sheet 1

I H E

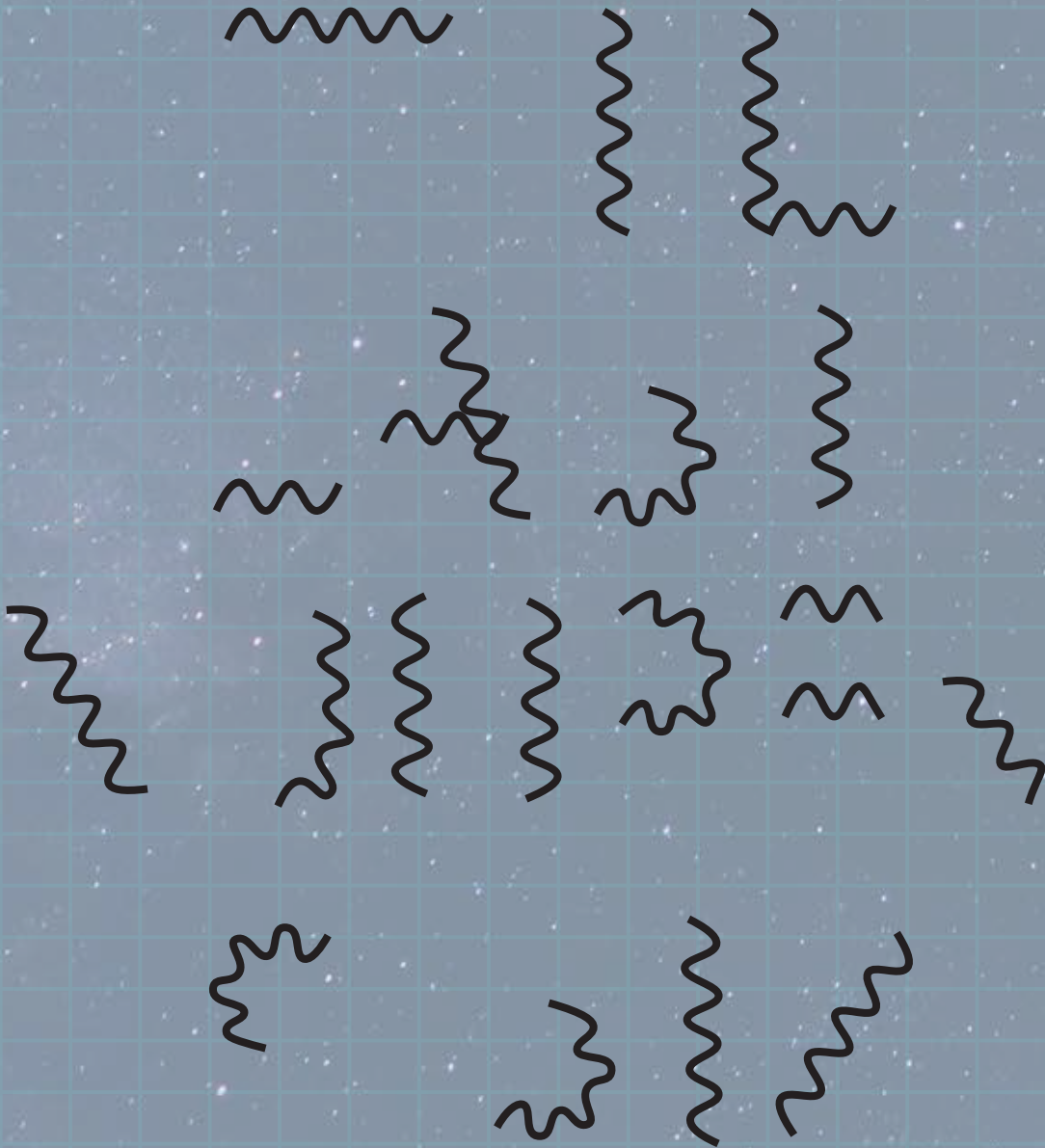
I / C -

I I L V L L P

I C \

The airlock door is located

PUZZLE #4 Sheet 2



on the front door.

Winner's Badge



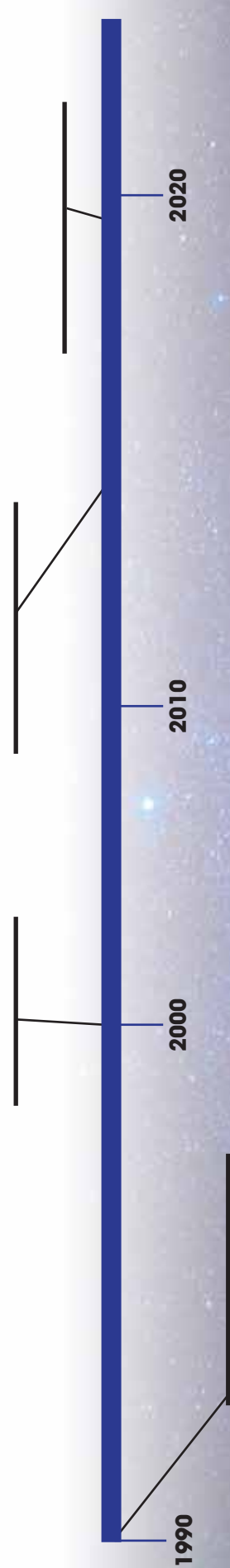
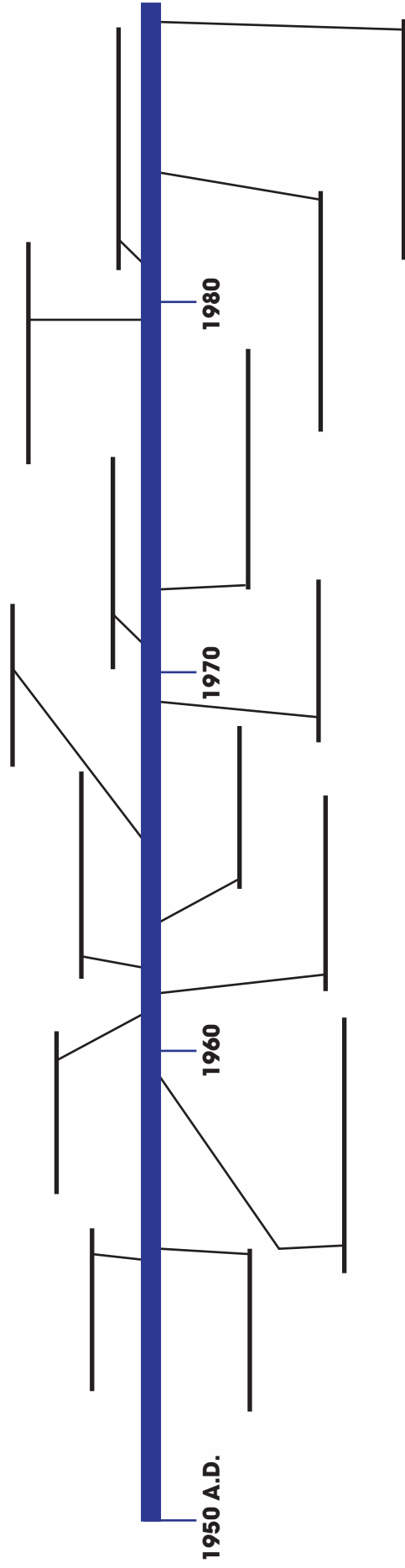
“Enter the Airlock Code”

Create a “History of Space Travel Milestones” Timeline

Read the information below about **milestones** in the history of space travel. Create a timeline using the outlined page that follows. Use the bold terms to add to the timeline spaces.

- The U.S.S.R. sent the **first** artificial Earth **satellite**, named **Sputnik 1**, into orbit on October 4, 1957.
- That same year, the U.S.S.R. sent a dog named **Laika**, aboard *Sputnik 2* into orbit on November 3. This was the **first animal** launched into space.
- On September 14, 1959, the U.S.S.R. sent **Luna 2** to the moon. It was the **first hard-landing** of a spacecraft on another galactic object.
- The **first chimpanzee was launched into space** on January 31, 1961, by the U.S.
- The **first human** to orbit Earth is **Yuri Gagarin** on April 12, 1961. He was on board the U.S.S.R. ship, the *Vostok 1*.
- On Dec. 14, 1962, the **first data** was returned **from another planet**. The U.S. *Mariner 2* sent data about the planet Venus.
- The U.S.S.R. sent the **first woman**, Valentina Tereshkova, **in space** on June 16, 1963.
- The **first spacewalk** was on March 18, 1965, by Aleksey Leonov of the U.S.S.R.
- On July 20, 1969, **Neil Armstrong** of the U.S. was the **first human** to walk **on the moon**.
- April 19, 1971, was the **first space station** to be **launched**. The *Salyut 1* was sent into space by the U.S.S.R.
- The **first spacecraft to fly by Jupiter** was the *Pioneer 10*, sent out by the U.S. on December 3, 1973.
- On September 1, 1979, *Pioneer 11* from the U.S. was the **first spacecraft to fly by Saturn**.
- From April 12-14, 1981, the space shuttle *Columbia* was the **first reusable crewed spacecraft** launched and returned from space.
- The **first spacecraft to fly by Uranus** was the *Voyager 2*, sent out by the U.S. on January 24, 1986.
- On August 25, 1989, *Voyager 2* from the U.S. became the **first spacecraft to fly by Neptune**.
- The **first large optical space telescope** was **launched** by the U.S. and the European Space Agency on April 24, 1990. The **Hubble** Space Telescope is still in flight and working today.
- On November 2, 2000, the **first resident crew** from the U.S. and Russia occupied the International Space Station.
- The **first spacecraft to fly by Pluto** was the *New Horizons*, sent out by the U.S. on July 14, 2015.
- The **farthest celestial object was explored** by the *New Horizons* spacecraft on January 1, 2019. 486958 Arrokoth is a small object in the Kuiper belt that orbits the Sun beyond Neptune and Pluto.

The History of Space Travel Milestones



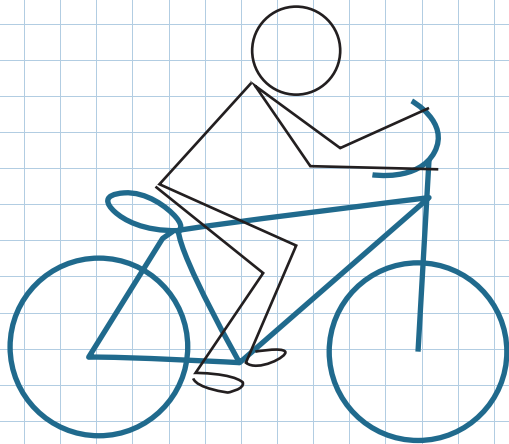
● Day 03: History & Art

Designers create useful objects to **enhance** how we live. Think of a chair. We can rest by sitting on one. But what if our body design was different? In *Project Hail Mary*, Rocky has a very different body structure. He has several legs and a very different physical shape compared to humans. Below, we've given you a simple stick figure suggestion of his body.

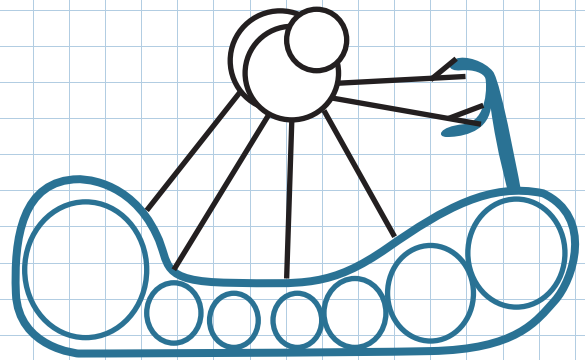
Imagine you are a designer on Rocky's planet. How would you construct a chair, a bed, or a flight of stairs to fit that different structure?

Make illustrations of an object you would create for Rocky. To get your imagination flowing, below are illustrations of a human bicycle design and a possible design for a bicycle Rocky could use. Would you improve the bike design?

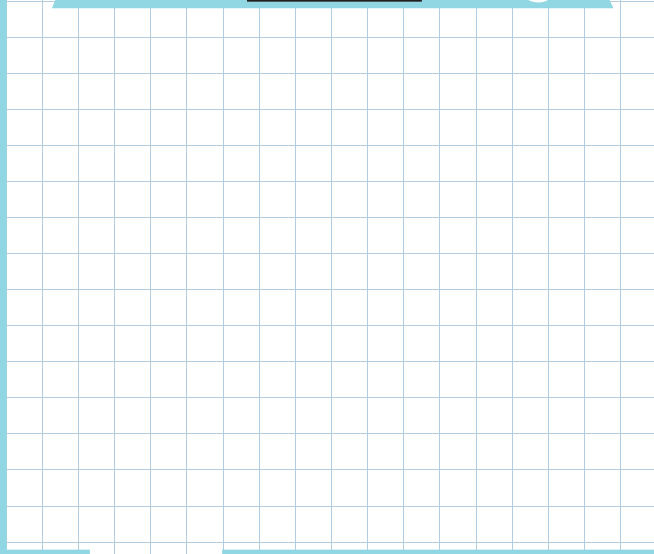
Human Bicycle Design



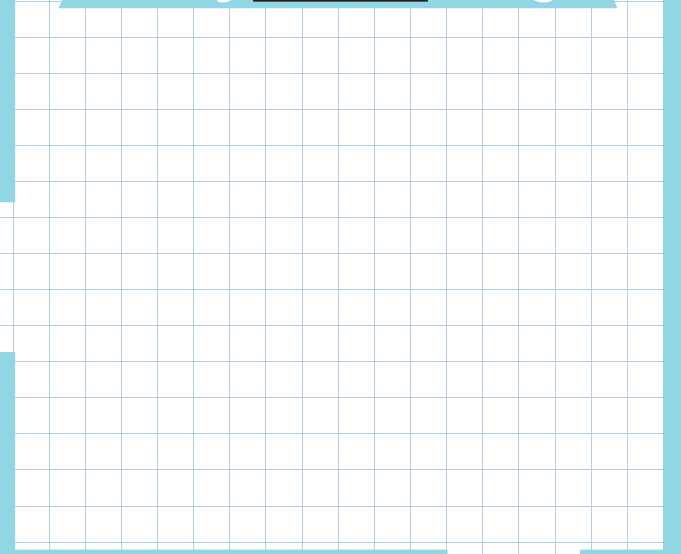
Rocky Bicycle Design



Human _____ Design



Rocky _____ Design



■ Grammar ■

In the movie, Rocky and Grace are learning how to talk with each other. They both realize communication can be difficult. For example, the computer cannot identify whether Rocky's sentences are asking a question or making a statement. So, it must tell Grace the sentence *type* after Rocky communicates with him. The translator will make Rocky say something like, "What do we do now – question" or "We can go home – statement".

In the English language, there are actually four **fundamental** sentence types that help us to communicate well. Each sentence we speak or write serves a purpose to help us clearly exchange information.

■ Here's a quick guide to the sentence types: ■

Declarative Sentence

States a fact, opinion, or observation. It ends with a period.

Example:

"Rocky and Grace must work together to solve a problem."

Interrogative Sentence

Comes from the word, "**interrogate**," asks a question, and ends with a question mark. Often starts with question words, like "what," "who," "how," and "why."

Example:

"How did Rocky and Grace start to communicate with each other?"

Imperative Sentence

Gives a command or instruction. Often starts with a verb and ends with a period or exclamation mark depending on the statement's urgency.

Example:

"Give me that tool from the toolbox."

Exclamatory Sentence

Makes a statement with strong emotion and ends with an exclamation mark.

Example:

"The sun's light is so beautiful!"

Determine the sentence type of the following sentences. Place the sentence number in the appropriate category below.

1.

Rocky and Grace struggle to communicate.

2.

Push the button when I ask you to.

3.

Was Rocky's ship larger or smaller than Grace's?

4.

Who lost members of their crew during the trip to the star, Tau Ceti?

5.

Grace doesn't have enough fuel to make it back to Earth.

6.

Watch for the light to turn on.

7.

That was a brilliant idea, Rocky!

8.

This is an impossible problem to solve!

Declarative: _____ **Imperative:** _____

Interrogative: _____ **Exclamatory:** _____

Composition

In **Project Hail Mary's** story, Dr. Grace struggled with the idea of traveling through space without any possibility of a safe return to Earth. Throughout the film, you see his character grow and mature as he faces the concept of giving up himself for others. He faces loneliness as he discovers the loss of his companions. He gains courage and risks his life as he works with Rocky to solve the puzzle of the Petrova line.

Dr. Grace keeps records of what he is experiencing so he can send information back to Earth. Keeping a journal is a great way to track what is happening.

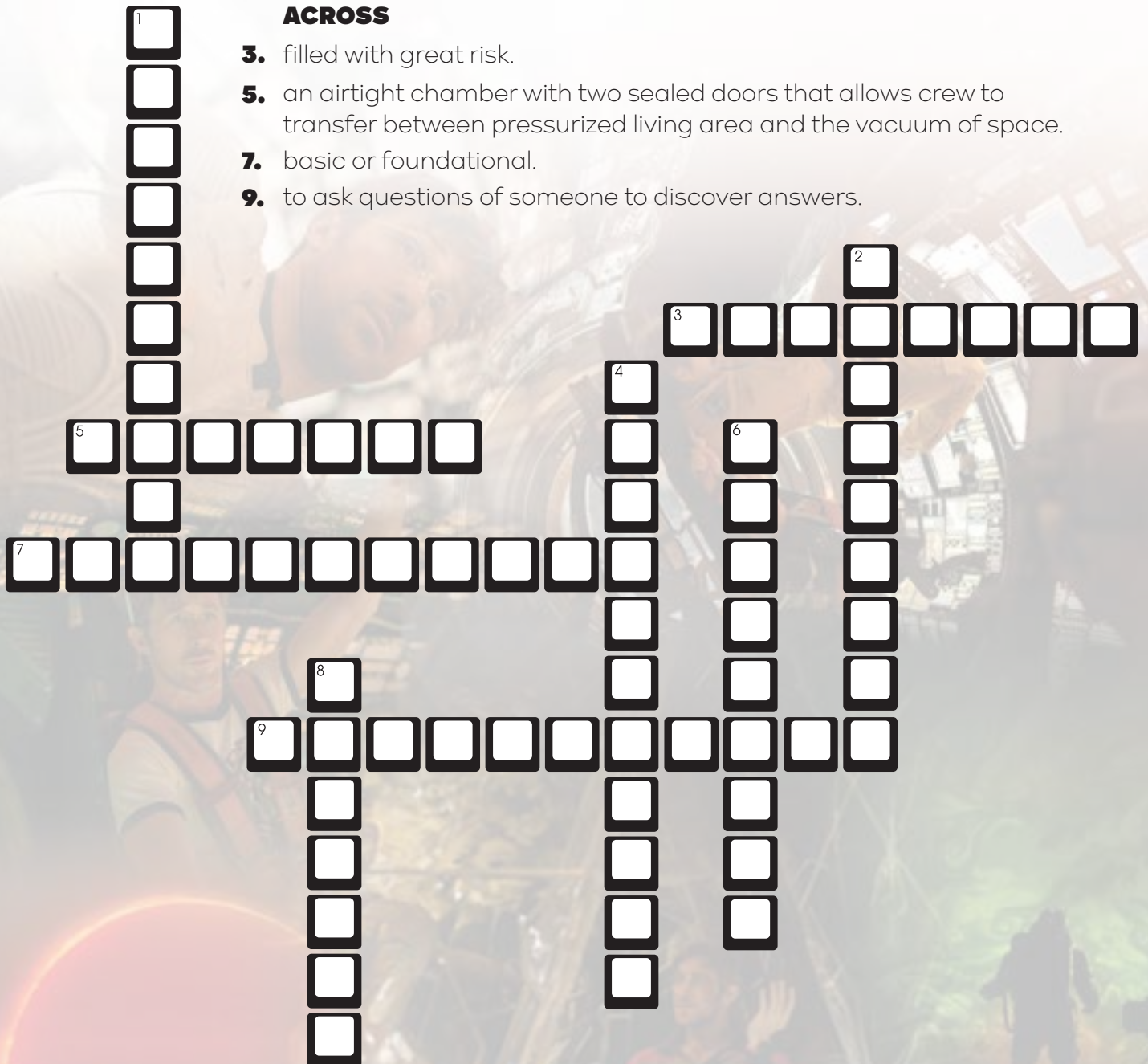
Pretend you are in the spaceship in Dr. Grace's place. Imagine you are facing one of the **perilous** situations he experienced. On the next page, write a journal entry about what you might be feeling and any emotions you may be having – loneliness, nervousness, excitement, or fear. What motivates you to keep going and why? What do you expect will happen?



Vocabulary

The words in the crossword puzzle are highlighted in **purple** throughout this unit study. By reading the sentences they are in, you can use that context to get clues to their definitions. Add each word to the appropriate spaces in the crossword puzzle.

Project Hail Mary Vocabulary words



ACROSS

3. filled with great risk.
5. an airtight chamber with two sealed doors that allows crew to transfer between pressurized living area and the vacuum of space.
7. basic or foundational.
9. to ask questions of someone to discover answers.

Down

1. a process that causes something to move forward or onward
2. an important event or stage of life
4. to work with one another as on a project
6. able to be lived in; allowing life to survive
8. to improve or raise to higher degree

Movie Day is Here!

You've learned much about space exploration in this **Companion Unit Study**, so now it's time to celebrate.

The grand finale of this week is attending a matinee screening of **Project Hail Mary** at a theater near you. So, join your family, gather your friends, and get your co-op together to be the first to see this exciting movie in theaters!

Let's send Hollywood a message that the **Homeschool community** will always support great – and educational – family entertainment!



Answer Key

Day 2: The Airlock Challenge

Puzzle #1: The third number is **8**.

Puzzle #2: The second number is **0**.

Puzzle #3: The first number is **four**.

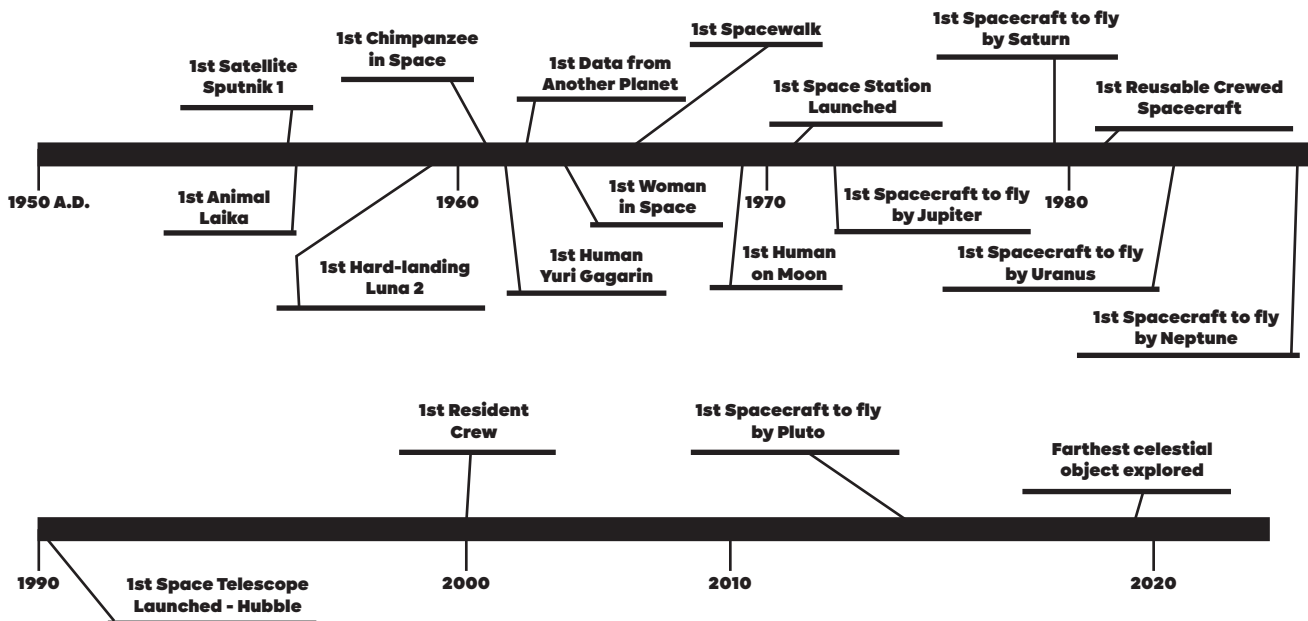
Look for your final clue on the **couch**.

Puzzle #4: The last number is **six**. The airlock door is located on the **front door**.

Code box: the combination for the airlock door is **4086**.

Day 3: Create a History of Space Travel Milestones Timeline

The History of Space Travel Milestones



Answer Key

Day 4: Grammar

Declarative: **1, 5**

Interrogative: **3, 4**

Imperative: **2, 6**

Exclamatory: **7, 8**

Day 5: Vocabulary

