Name________________________ Class________

Mousetronaut Predictions

Astronaut **Mark Kelly** piloted the Space Shuttle *Endeavor* in 2001. He went on to pilot or command three additional space shuttle missions, as well. He has a twin brother, Scott Kelly, who spent an entire year on the *International Space Station* (*ISS*) with Russian Cosmonaut Mikhail Korniyenko.You can watch Scott Kelly read his brother's picture book, *Mousetronaut*, from the *ISS* at https://storytimefromspace.com . Kelly writes that *Mousetronaut* is "based on a (partially) true story."

Before Reading: Write your prediction (best guess) about what part you think will be true:

I predict that...

During Reading: As you listen to the story, try to decide what part is actually true-to-life.

After Reading: What part of *Mousetronaut* was based on actual events?

I think that...

EXIT TICKET:
After Discussion: What part of *Mousetronaut* was based on actual events?

I know that...

Extra Time on your hands?
Think about how animals might be useful in science: Research? Space travel?
What ideas do you have? Draw a picture of how you think mice might really be kept on a spaceship.

Name_________________________ Class________

Freefall!

The Space Shuttle transports astronauts to the International Space Station, (*ISS)* about 400 kilometers (240 miles) away. At this distance, the pull of Earth's gravity is still exerting most of its force. At this position in space, the bodies of astronauts (or mice) still retain 90% of their weight. That means that due to Earth's gravity, the spacecraft is falling towards Earth (freefalling). What keeps the spacecraft from falling back to Earth? It is the thrust of the engines. The ISS is travelling at 17,000 mph (that's about 5 miles per second).

When you let go of the cup, the cup and the water (just like the astronaut and the spacecraft in orbit around earth) are in freefall. The cup & water move together with only gravity acting upon them. Draw a model of Earth/ISS freefall. (10 pts)

Mission Accomplished? Go to the following website and see how basketball can be played on the ISS:
https://www.nasa.gov/audience/foreducators/microgravity/home/free_fall_ball.html

ARIZONA GEOGRAPHIC ALLIANCE

Name_________________________ Class_________

Micrогravity Math & the Moon

The International Space Station, *ISS,* is in near-Earth orbit, about 400 kilometers (240 miles) away. At this distance, the pull of Earth's gravity is still exerting most of its force. In this position, the bodies of the astronauts still retain 90% of their weight.

A full-size mouse weighing 30 grams on Earth would weigh 27 grams on the *ISS*.
30 x .9 = 27.0

Upon arriving at the moon, however, almost 400,000 km (240,000 miles) away from Earth, the pull of Earth's gravity is reduced by 83%. That means that the astronaut weighs only ⅙ of her weight on Earth's surface.

The same 30 gram mouse would weigh only 5 grams on the moon! **30 x 1/6 = 5**

Read carefully and make the calculations.

	Weight on Earth	Weight on ISS	Weight on Moon
Man or Mouse?	**mass**	**m x .9**	**m x 1/6**
Full grown Mouse	**30 g**	**30 x .9 = 27.0 g**	**30 x 1/6 = 5g**
Little Mousetronaut	**20 g**		
Average Astronaut	**80 kg**		
YOU!*			
Your Imaginary Friendstronaut**			

*** Weigh yourself to the nearest unit**
****Make up weight on Earth, calculate weight elsewhere**

Mission Accomplished? Turn over & take on the challenge question.

If gravity is only reduced by 10% at the ISS, why do astronauts still experience weightlessness there?

Use all of your mission know-how to explain with models, drawings, labels, pictures, numbers...

ARIZONA GEOGRAPHIC ALLIANCE

Microgravity Math & the Moon Answer KEY

The International Space Station, *ISS,* is in near-Earth orbit, about 400 kilometers (240 miles) away. At this distance, the pull of Earth's gravity is still exerting most of its force. In this position, the bodies of the astronauts still retain 90% of their weight.

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	Weight on Earth	Weight on ISS	Weight on Moon
Man or Mouse?	mass	m x .9	m x 1/6
Full grown Mouse	30 g	30 x .9 = 27.0 g	30 x 1/6 = 5g
Meteor Mousetronaut	20 g	20 x .9 = 18 g	20 x ⅙ = 20/6=3 ⅓ g
Average Astronaut	80 kg	80 x .9 = 72 kg	80 x ⅙ = 80/6 =13 ⅓ kg
YOU!*	Answers vary	Check math	Check math
Your Imaginary Friendstronaut**	Answers vary	Check math	Check math

*** Weigh yourself to the nearest unit**
****Make up weight on Earth, calculate weight elsewhere.**

If gravity is only reduced by 10% at the ISS, why do astronauts still experience weightlessness there? They are in free fall because they are moving at the same speed as the ISS in orbit: 17,150 miles per hour (about 5 miles per second!).

How A 10-Year-Old Boy Helped Apollo 11 Return To Earth

A half-century ago, America's dreams were realized in space. The power of U.S. innovation and spirit took the Apollo 11 crew to the moon and back.

That mission was possible because of a diverse team of engineers, astronauts and mathematicians. It was also possible thanks to the help of one 10-year-old boy who was in the right place at the right time.

In 1969, Greg Force lived in Guam, where his father, Charles Force, worked as the director of a NASA tracking station that helped connect the capsule with NASA Mission Control for voice communication.

"I loved it," Force told his daughter, Abby Force, in a StoryCorps interview. "I looked up to him a huge amount. Not only was it a prestigious job, but he was very good at it."

After Apollo 11 began its departure from the moon, a problem arose — a bearing had broken in the dish antenna needed to track the ship. Without it, NASA risked losing the ability to communicate with the capsule as it approached Earth.

Scrambling to find a solution, Charles called home, hoping that Greg's child-size dimensions could be of assistance. He asked Greg to come to the tracking station and squeeze his arm through the antenna's access hole and pack grease around the bearing.

The 10-year-old rose to the challenge and scampered up the ladder.

"I would take a big handful of grease — you know, you squish it," Greg says. "It comes out between your fingers, and I stuck them down in there and packed them the best I could."

Greg succeeded, and on Day 8 of the Apollo mission, a NASA public affairs officer noted his contribution in an announcement from Apollo Control:

"The bearing was replaced with the assistance of a 10-year-old boy named Greg Force who had arms small enough that he could work through a 2½ inch diameter hole to pack [the bearing]."

The rest is history. This month, America celebrates the 50th anniversary of the Apollo 11 moon landing, an event firmly planted in the nation's collective memory.

Ten-year-old Greg Force in 1969, greasing the antenna bearing at the NASA tracking station in Guam
(*Courtesy of Greg Force)*

"Now that I look back on it, I'm very proud," Greg says. "Not especially anything amazing that I did, but that I happened to be in the right place at the right time. I'm also proud that my dad trusted me enough ... to do it."

Greg, now 60 and the owner of a gymnastics studio, says he wanted to follow in his father's footsteps and work for NASA, but his colorblindness prevented him from becoming an astronaut.

His father, Charles, died in 2007 after 29 years of service to NASA.

Following the Apollo 11 mission, Charles continued on to develop NASA's Tracking and Data Relay Satellite System.

According to Charles' NASA obituary, the technology he helped implement "replaced an aging ground-based communications network and was designed to increase the time spacecraft were in communication with the ground and improve the amount of data that could be transferred. It cut NASA's telecommunications costs in half and is still in use today."

Though he never went on to a career at NASA, Greg's role in history has been memorialized. He inspired a children's book titled *Marty's Mission: An Apollo 11 Story*, by Judy Young.

His 17-year-old daughter admires both her father and grandfather for the roles they played in history.

"I mean, I think it's pretty dang important," Abby says. "My dad helped with Apollo 11. I look up to you and Pop Pop for it."

NASA Mission Patch Match Pieces

"Several months before the mission, I mentioned to Pete that I'd never been in a military organization that didn't have its own patch. Pete hadn't either. We decided right then and there that we were at least going to have a patch for our flight.

"Pete's father-in-law had whittled a model of a Conestoga wagon, the preferred mode of transportation for pioneers of an earlier era. We thought a covered wagon might be a good way to symbolize the **pioneering** nature of our flight."

- Astronaut Gordon Cooper

"We wanted to keep our three names off it because we wanted the design to be representative of everyone who had worked toward a **lunar landing**…"

- Astronaut Michael Collins

Fellow astronaut Jim Lovell suggested the eagle, the national bird of the United States, as the focus of the patch. Running with that proposal, Michael Collins found a picture of an eagle in a National Geographic book about birds: *"Water, Prey, and Game Birds of North America,"* and traced it using a piece of tissue paper. He then sketched in a field of craters beneath the eagle's claws and the earth behind its wings.

The mission patch features the names of the "core crew" around the top, with a tab underneath showing the names of ISS crews.

-**Utilization Flight** mission to the International Space Station: The UF designation distinguished this from earlier Station flights which were considered assembly flights. The shuttle would deliver the Expedition-4 crew of Onufrienko, Bursch, and Walz to the station and return the Expedition-3 crew to earth.

-The Animal Enclosure Module is a commercial experiment using mice and seeking information that could lead to better treatment of osteoporosis in humans.

The mission insignia itself is the only patch of the shuttle program that is entirely shaped in the orbiter's outline.
-The central element of the patch is the **microgravity** symbol, *µg*, flowing into the rays of the astronaut symbol.
-The sunrise is representative of the numerous experiments that are the dawn of a new era for continued microgravity research on the International Space Station and beyond.
-The constellation Columba (the dove) was chosen to symbolize peace on Earth and the Space Shuttle *Columbia*.
"We will try to learn more about the human body and other biological organisms and how they function in space. We will look at dust storms and see how they affect the environment. We will look at the ozone layer."
-Astronaut Michael Anderson

	**Numeral One** Emblazoned with US and Russian Flags. Represents the duration of the mission and the countries of its crew. **Kelly - Корниенко** Commander Scott Kelly and flight engineer Mikhail Korniyenko, who both will be on board for the entire year. **Thirteen stars** Representing the astronauts and cosmonauts working together in harmony throughout the mission. **Orbital Planes** Depicting the orbit of the ISS around the Earth and Earth's orbit around the sun.
	-Three stars with the Moon superimposed forms the letter "L," the Latin symbol for 50. -The Moon is depicted as a waxing crescent, as it was on July 20, 1969. -The familiar silhouette of the International Space Station is visible, flying across the night sky. - Stars, numerous and bright as seen from the space station, form the shape of an eagle in the same pose as on the iconic patch of the Apollo 11 mission. -The **hexagonal shape** of the patch represents the space station's cupola, with the six points of the hexagon symbolizing the six crewmembers of Expedition 60. -Just like on the Apollo 11 mission patch, the names and nationalities are deliberately omitted as a way to highlight that space missions — then, now, and in the future — are for Earth and all humankind.

Designing a Mission Patch

Team Name: ___________________________________

Team Members:
___________________________, Team Commander
___________________________, Team Pilot
___________________________, Mission Specialist
___________________________, Mission Engineer

Team Mission: 3 Goals your team is working on together
1.____
2.____
3.____

10 Key Symbols & Meanings—5 of which must reflect geographic thinking. These can include

- landforms,
- bodies in the solar system
- modes of transportation
- natural resources of earth and space
- origins of language
- evidence of migration/movement
- direction (latitude/longitude, compass rose
- symbols of nations

First draft of mission patch

Team Checklist for Mission Patch:

- Does Team patch show a team identity with **team name**? (5 pts)
- Does Team patch show individual team **members names**? (5 pts)
- Does Team patch display common mission **goal**(s) with 10 **symbols** (pictures) that represent mission components? (20 pts)
- Do 5 of the symbols show **geographic thinking**? (10 pts)
- Does Team patch include **all** team members input? (10 pts)
- Is the patch visually attractive? (30 pts)
- Did you explain what your 10 symbols mean and circle the 5 that show geographic thinking? (20 pts)

Final Draft

What are your 10 symbols and explanation of these symbols? Circle the 5 that show geographic thinking.

1.
2.
3.
4.
5.
6.
7.
8.
9.
10.