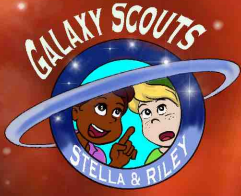


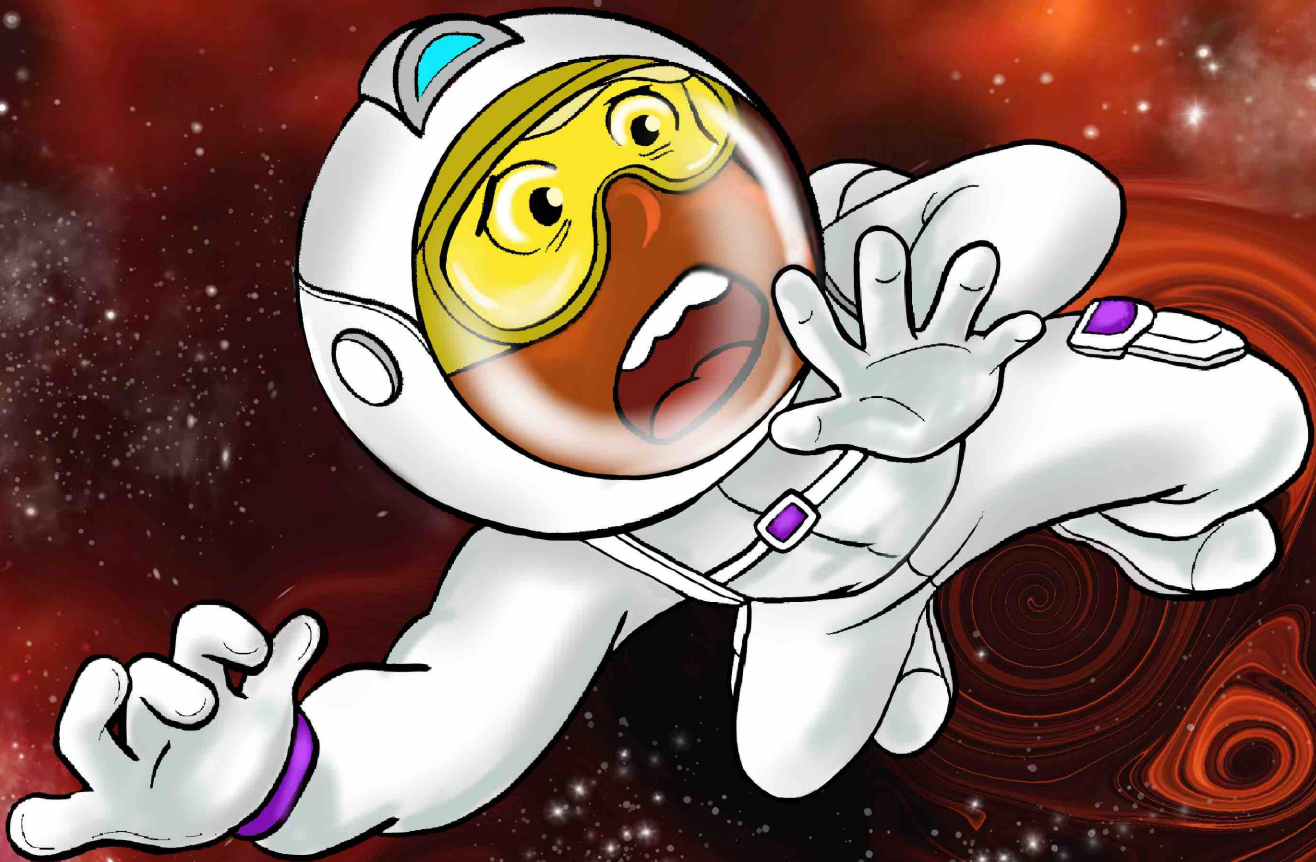
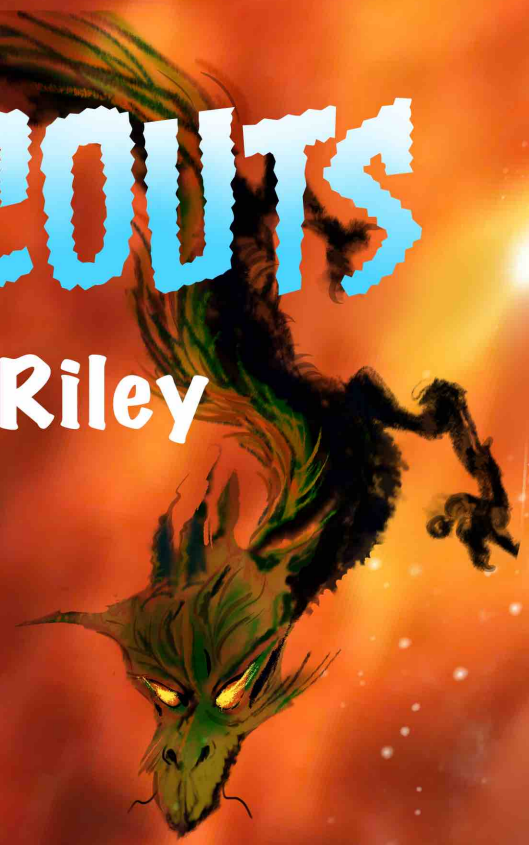
GALAXY SCOUTS



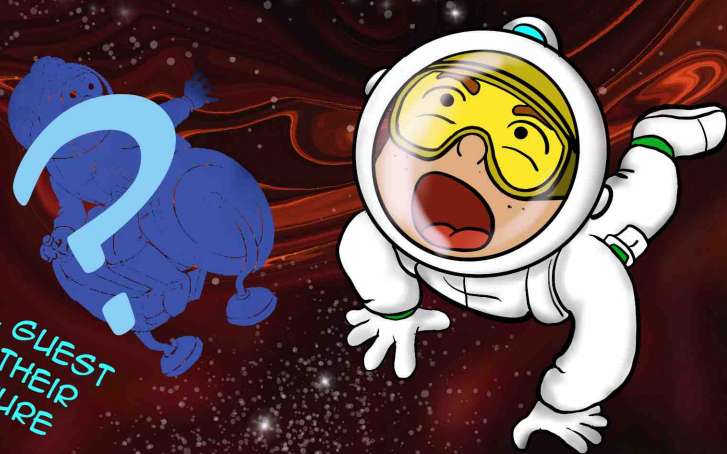
with Stella and Riley

BOOK 2

WHAT IS DARK MATTER?



WHICH SPECIAL GUEST
WILL JOIN ON THEIR
LATEST ADVENTURE



PUBLISHED BY UW-MADISON
ASTRONOMY DEPARTMENT
SNEŽANA STANIMIROVIĆ



STORY BY
ROBERT TETZNER

ART BY
JAN LIN

Our Mission

Galaxy Scouts Space-Ventures with Stella and Riley is a comic book series designed to get kids excited about astronomy and the sciences in general.

The comic book series strives to improve societal literacy of STEM (Science, Technology, Engineering, Math) subjects, and to share the excitement and importance of STEM discoveries with younger generations. The comic books feature space adventures of Stella and Riley, and involve cutting-edge STEM topics to engage youth in science learning and discovery.

Who is the Galaxy Scouts Comic Book Series for?

The comic book series is mainly for youth with a 4th to 8th grade reading level, or who are about 9 to 13 years old. Still, we welcome readers of all ages to explore these pages!

Youth educators, including science teachers, librarians, and science museum program managers, may find the material useful for working with individuals or groups.

Acknowledgements

This comic book is funded by the National Science Foundation award AST-2108370, and the University of Wisconsin Ira and Ineva Reilly Baldwin Wisconsin Idea Endowment fund.

The story for this volume was developed by Robert Tetzner, Jan Lin and Snežana Stanimirović, in close collaboration with the rest of the Galaxy Scouts team: Rebecca Cors, Amy Gaeta, and Kay Kriewald.

The Galaxy Scouts team greatly appreciates editing and proofreading help from Julie Persico, grant management support from Steve Anderson, fashion advice from Natasha Auman, and advice from Darth Vader expert Stefan Wyndham. Special thanks to youth educators John Buchmelter, Elsa Caetano, Quishanta Cary, Karen Dreyfuss, Doris Dubielzig, Evan Heintz, Melissa Kessling, Daniel Rybarczyk, Bernardo Traversari, and Sarah Wright for their feedback. We are also grateful for feedback from youth readers Jill Blair and Orrin Bulloss.

To access electronic versions of Galaxy Scouts comic books and activity books, please go to: <https://galaxyscouts.wisc.edu>

If you have any comments or questions, please contact UW Madison, Astronomy Professor Snežana Stanimirović, sstanimi@astro.wisc.edu



NEXT DAY...



WOW! THAT WAS AMAZING!



RILEY! WAKE UP!

HUH? COOL IT, MOM, GIVE ME ONE MORE MINUTE.



RILEY, WAKE UP! WE JUST WENT TO MARS! CAN YOU BELIEVE IT! THAT WAS AMAZING! MARS WAS SO RED, AND THE ROBOT TALKED TO US.

YAWN. SKIP IT, STELLA. IT WAS JUST A WEIRD DREAM.

OOOOOH, CHECK IT OUT. RILEY HAS A NEW GIRLFRIEND.

PFFT. SHE WISHES.

RILEY, ARE YOU LISTENING?



YEAH, CUTE COUPLE, I'D SAY. HA HA HA.



RILEY, IT WASN'T A DREAM.



RILEY, DID YOU HEAR WHAT I SAID?

JUST LEAVE ME ALONE! FORGET IT.



BUT RILEY... WE... REALLY... OH MY!

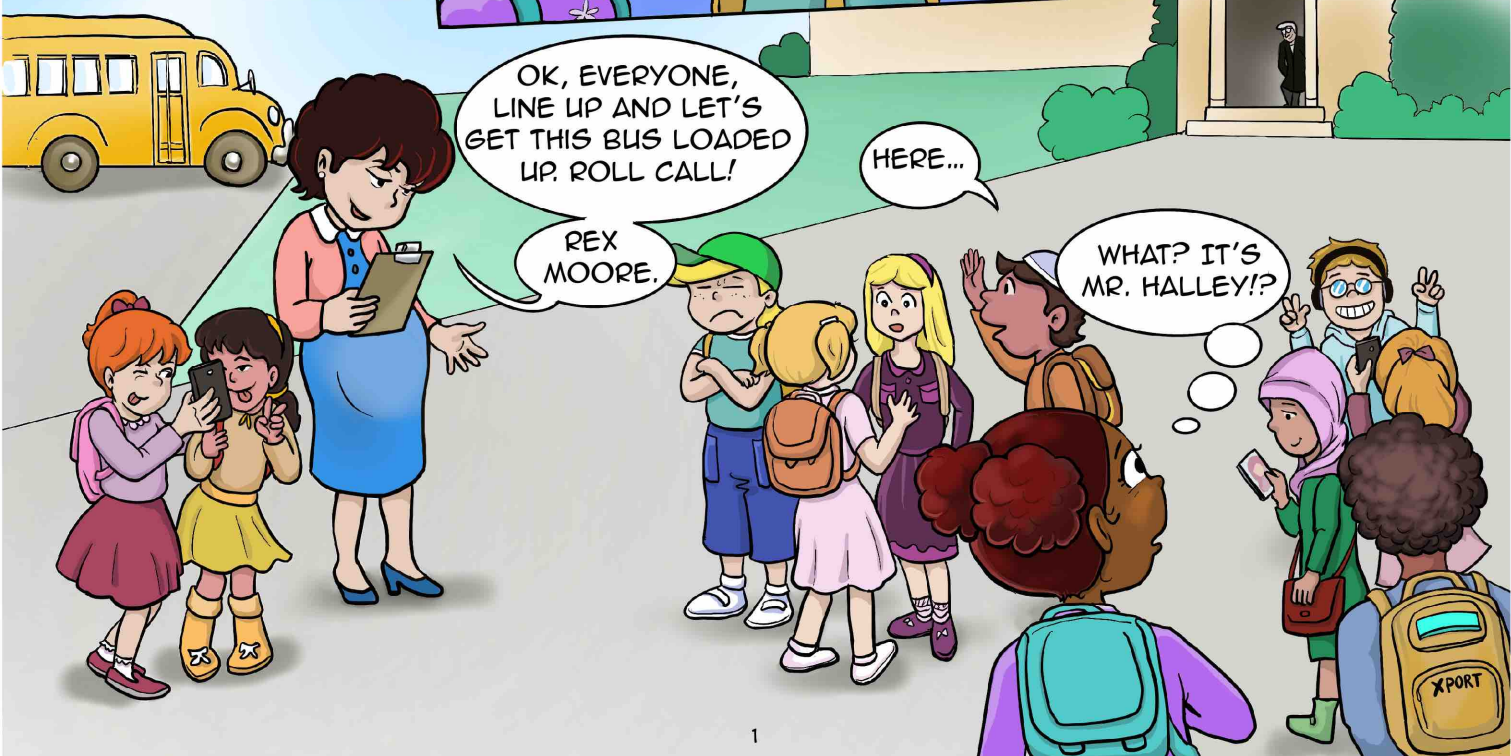


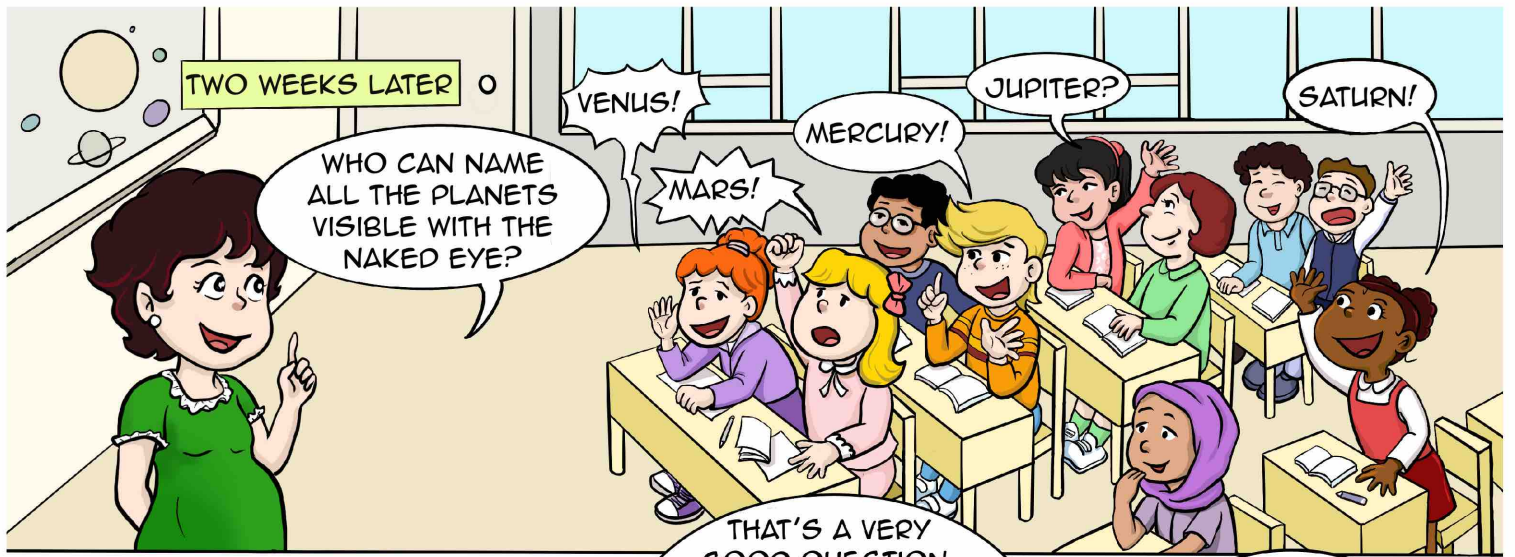
OK, EVERYONE, LINE UP AND LET'S GET THIS BUS LOADED UP. ROLL CALL!

HERE...

REX MOORE.

WHAT? IT'S MR. HALLEY!?





RINNGGGG!



OKAY, CLASS. PICK UP YOUR PHONES BEFORE YOU LEAVE!



WHERE DID HE GO? I SAW HIM.



COMING THROUGH.

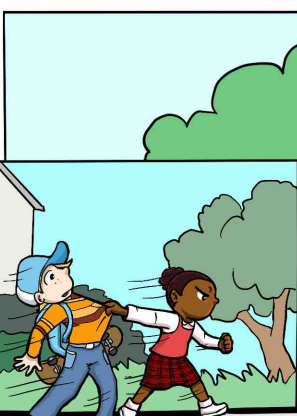


HEY!

WHAT THE HECK? HUH?



IT WASN'T A DREAM. HE'S REAL. IT WASN'T A DREAM. I CAN PROVE IT.



SEE? IT'S MR. HALLEY!

WHAT?

HI, KIDS!



WHERE HAVE YOU BEEN? IT'S BEEN FOREVER!



IT WAS JUST TWO WEEKS. I'VE BEEN BUSY PLANNING YOUR NEXT TRIP...THE LAST ONE WAS JUST A TEST. YOU PASSED!



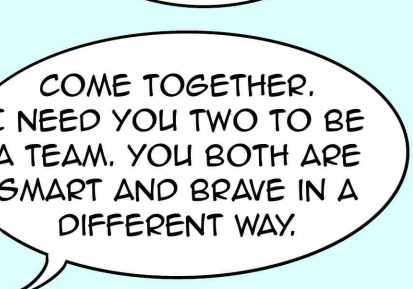
YOU TWO ARE THE TEAM I'VE BEEN LOOKING FOR. TOGETHER WE CAN DISCOVER THE SECRETS OF THE COSMOS.



YOU MEAN WE CAN GO ON ANOTHER ADVENTURE?



EXACTLY. COME BACK TO THE ZEISS TELESCOPE ON SATURDAY 1:00 P.M. SHARP.



COME TOGETHER. I NEED YOU TWO TO BE A TEAM. YOU BOTH ARE SMART AND BRAVE IN A DIFFERENT WAY.



WE WILL BE THERE!



A TEAM?

GREAT!



WE NEED A TEAM NAME. THE DYNAMIC DUO?

THAT'S ALREADY TAKEN.

HOW ABOUT GALAXY SCOUTS?

JEEZ

SATURDAY, ON THE WAY TO THE OBSERVATORY...

YOU AND YOUR BIG IDEAS. I COULD HAVE BEEN PLAYING BASEBALL WITH THE GANG.

BUT YOU HEARD WHAT MR. HALLEY SAID.

YOU CAN PLAY BASKETBALL ANY TIME.

BASEBALL!! UGH, GIRLS!!

WHATEVER! YOU KNOW WHAT I MEAN!!

WE'RE HERE! ISN'T THIS EXCITING? I WILL PICK YOU UP AFTER THE TOUR!

YEAH, I'M GONNA FAINT FROM THE THRILL! OOF!

BYE, MOM!

AT THE OBSERVATORY...

OKAY, EVERYONE, FOLLOW ME. WELCOME TO THE GRIFFITH OBSERVATORY.

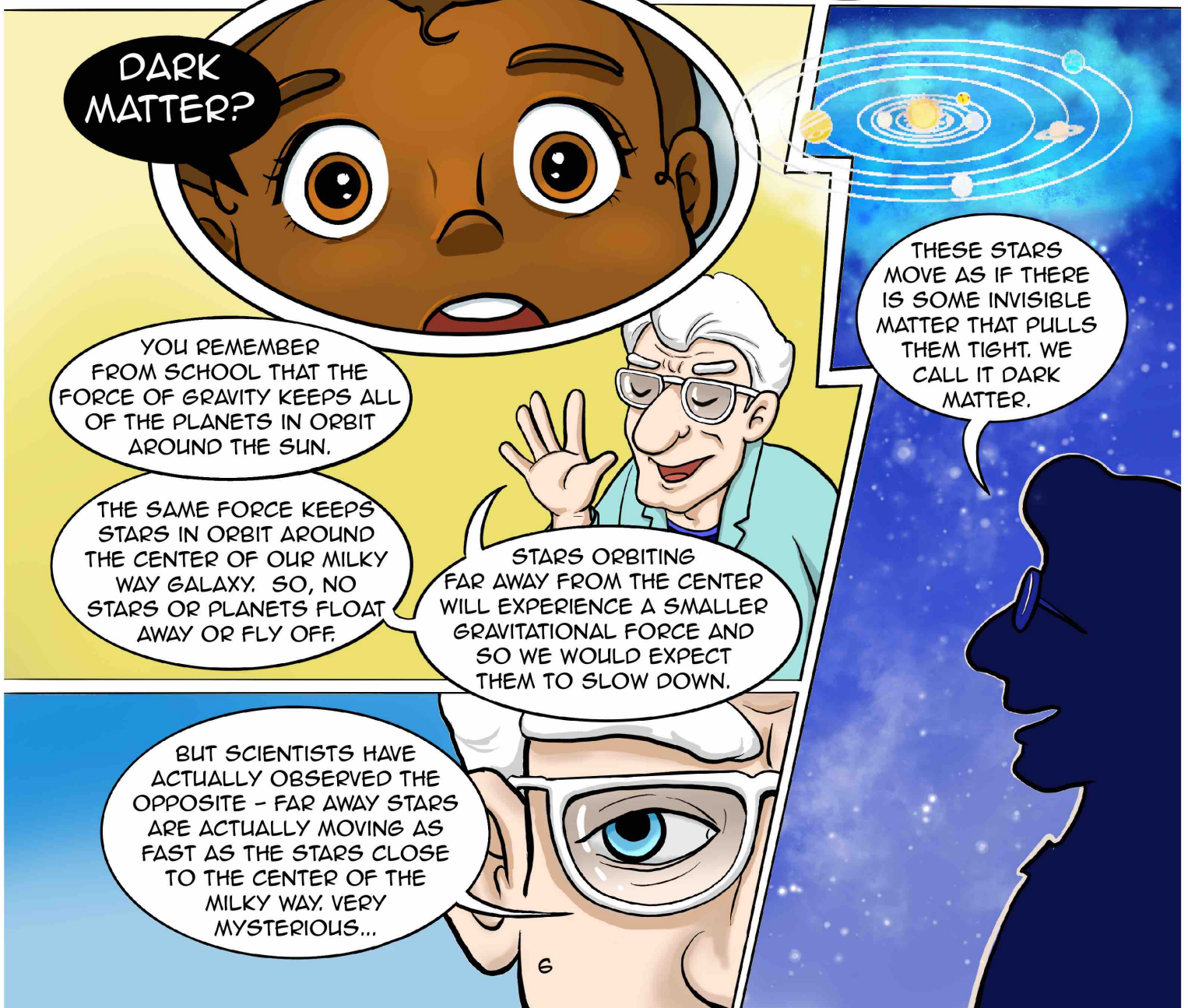
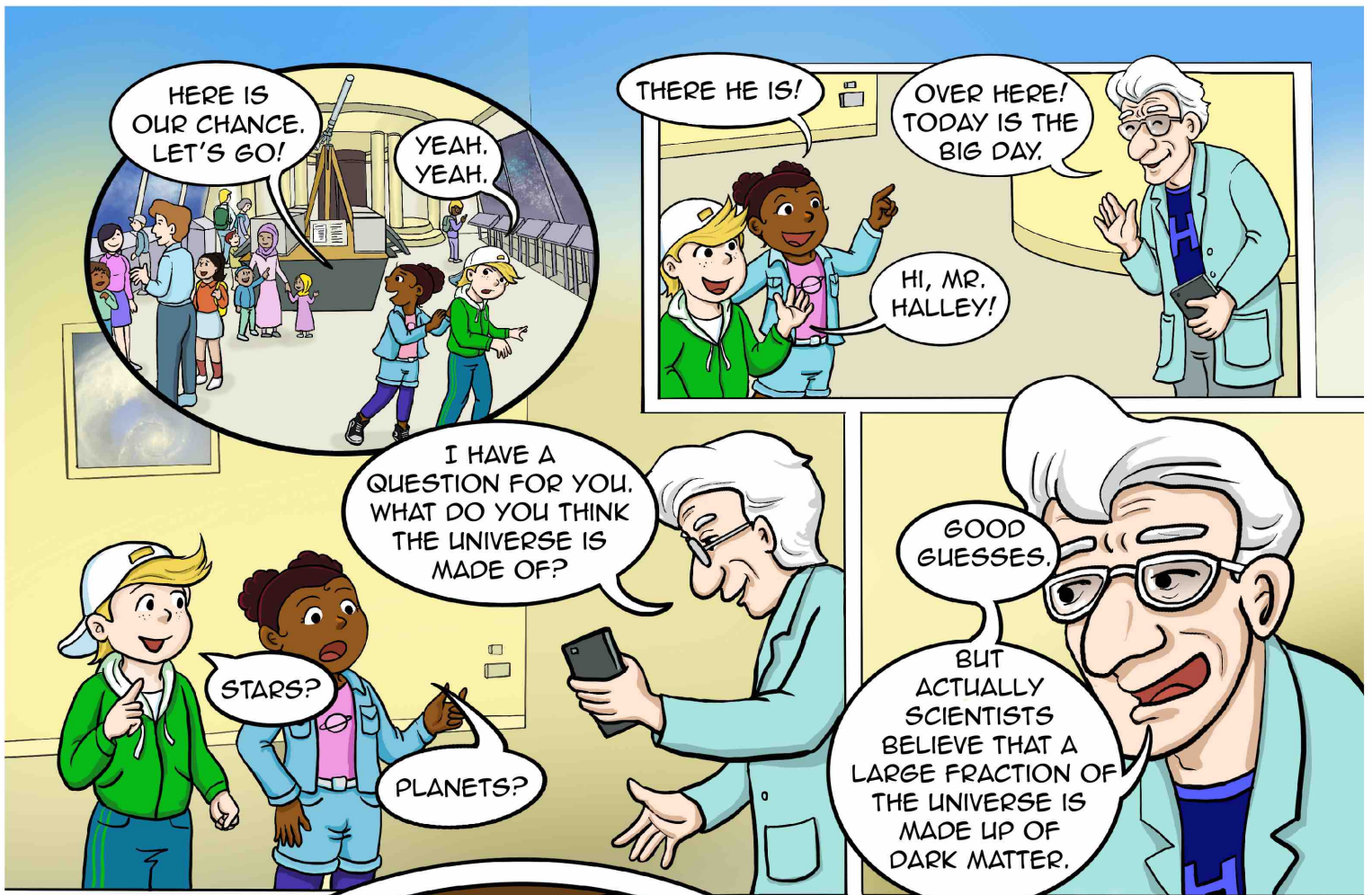
DR. DAVE, CAN WE SEE THE CHRISTMAS STAR?

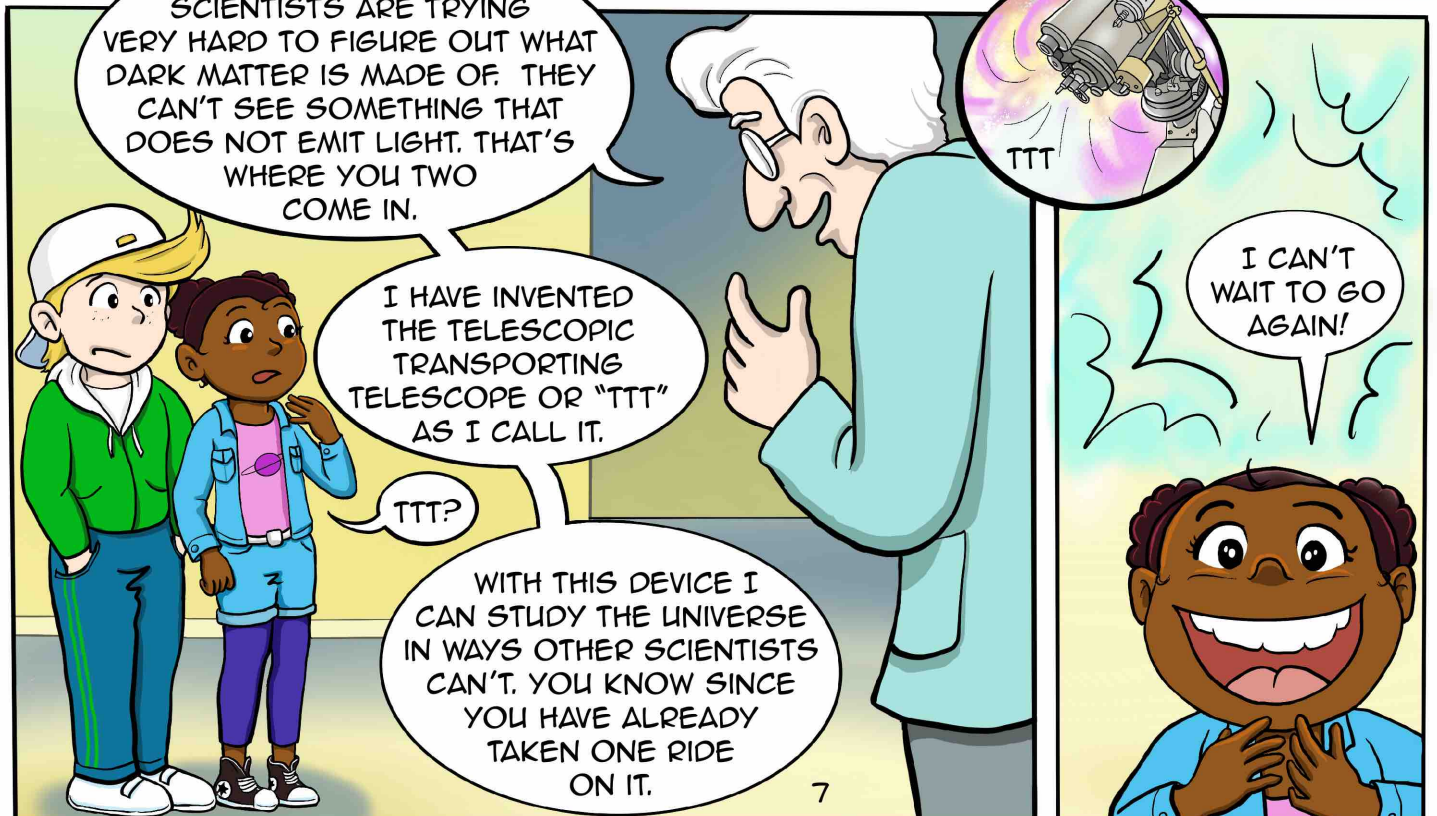
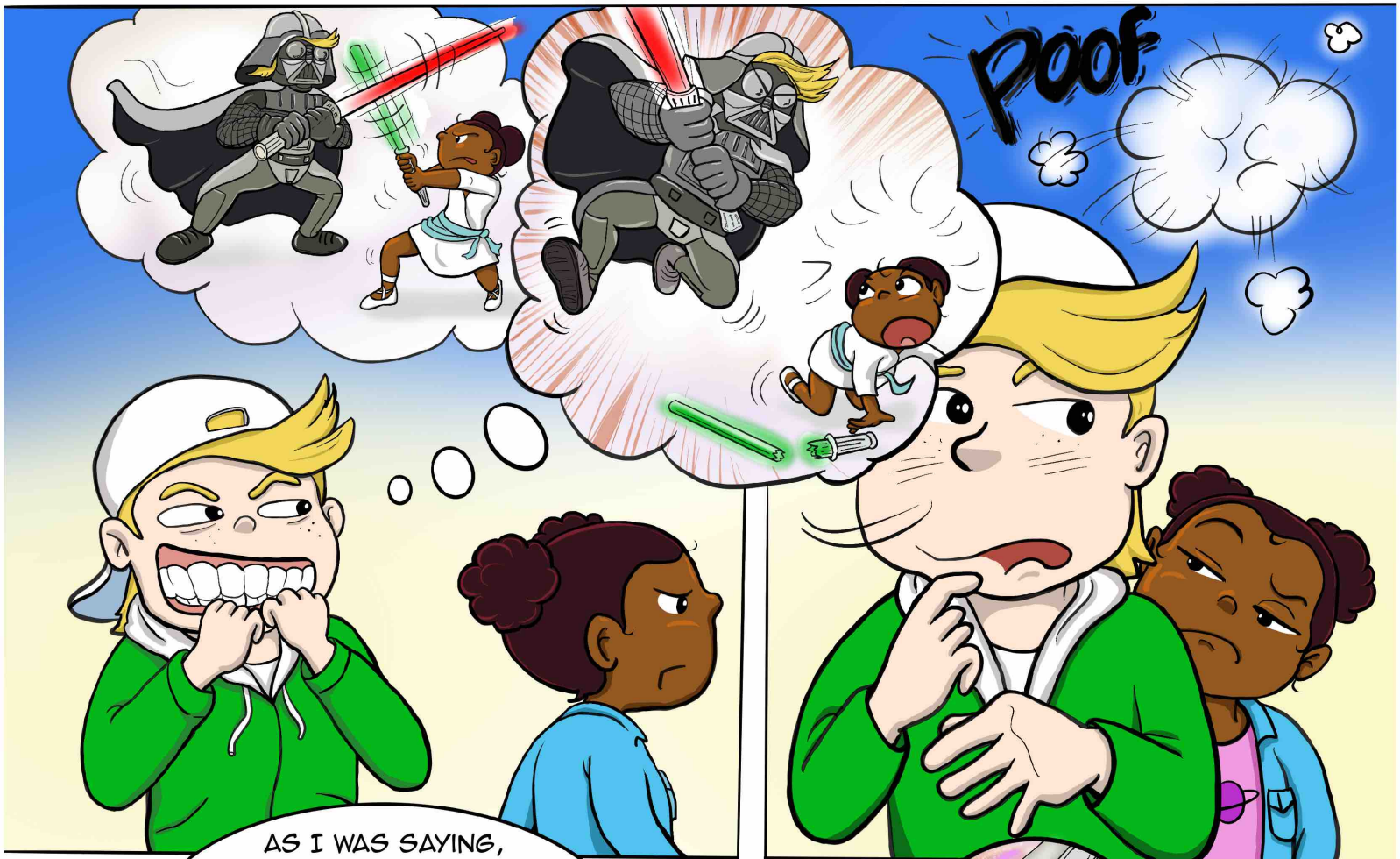
THE OBSERVATORY WAS BUILT IN 1935 BY GRIFFITH J. GRIFFITH, WHO WANTED EVERYONE TO BE ABLE TO SEE SPACE THROUGH A TELESCOPE. SO, HE CAME UP WITH THE IDEA OF A "PUBLIC OBSERVATORY".

SADLY NOT. THE CHRISTMAS STAR ISN'T REALLY A STAR. IT IS WHEN JUPITER AND SATURN ARE SO CLOSE TO EACH OTHER, THEY APPEAR AS A SUPER BRIGHT POINT OF LIGHT.

THIS SPECTACULAR EVENT IS VERY RARE. IT HAPPENED ON DEC. 21, 2020 FOR THE FIRST TIME SINCE THE MIDDLE AGES.

BUT WE CAN SEE THE "EVENING STAR" - WE USE THIS NAME FOR VENUS WHEN IT IS VISIBLE RIGHT AFTER SUNSET.



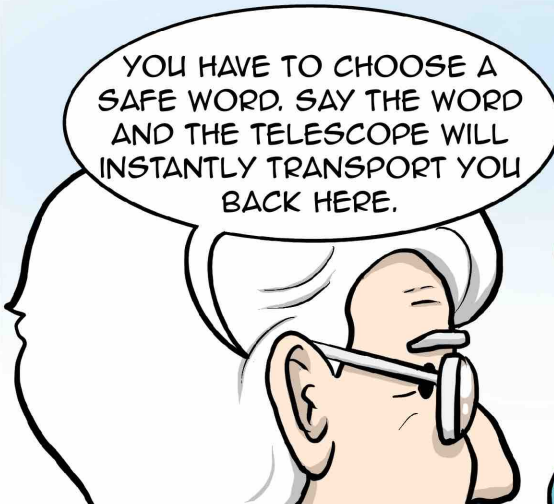




SAFETY RECALL?

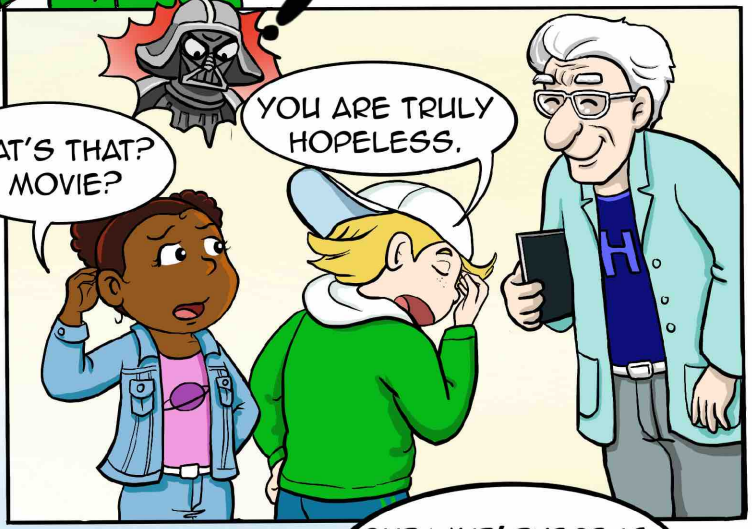
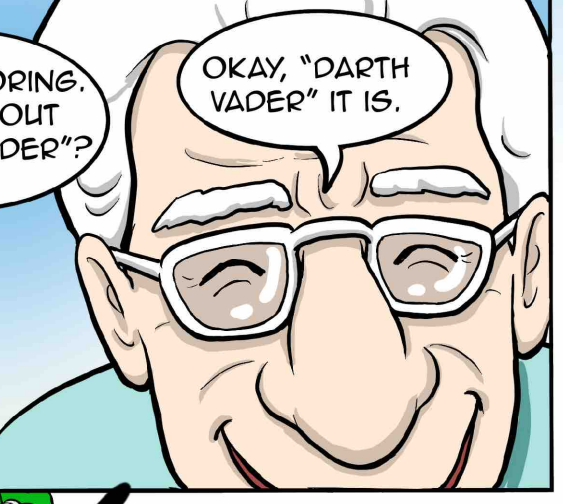


HOW DOES IT WORK?

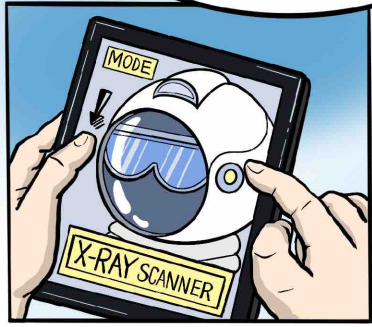


HOW ABOUT "DARK MATTER"?

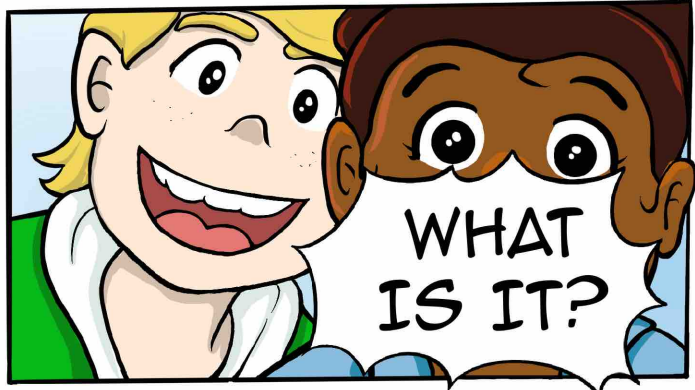
THAT'S BORING. HOW ABOUT "DARTH VADER"?



I'VE ALSO ADDED X-RAY SCANNERS. WHEN YOU PRESS THE BUTTON ON THE SIDE OF YOUR HELMET, YOU WILL HAVE X-RAY VISION. TRY IT OUT AND SEE WHAT HAPPENS.



IT'S SHOWTIME!



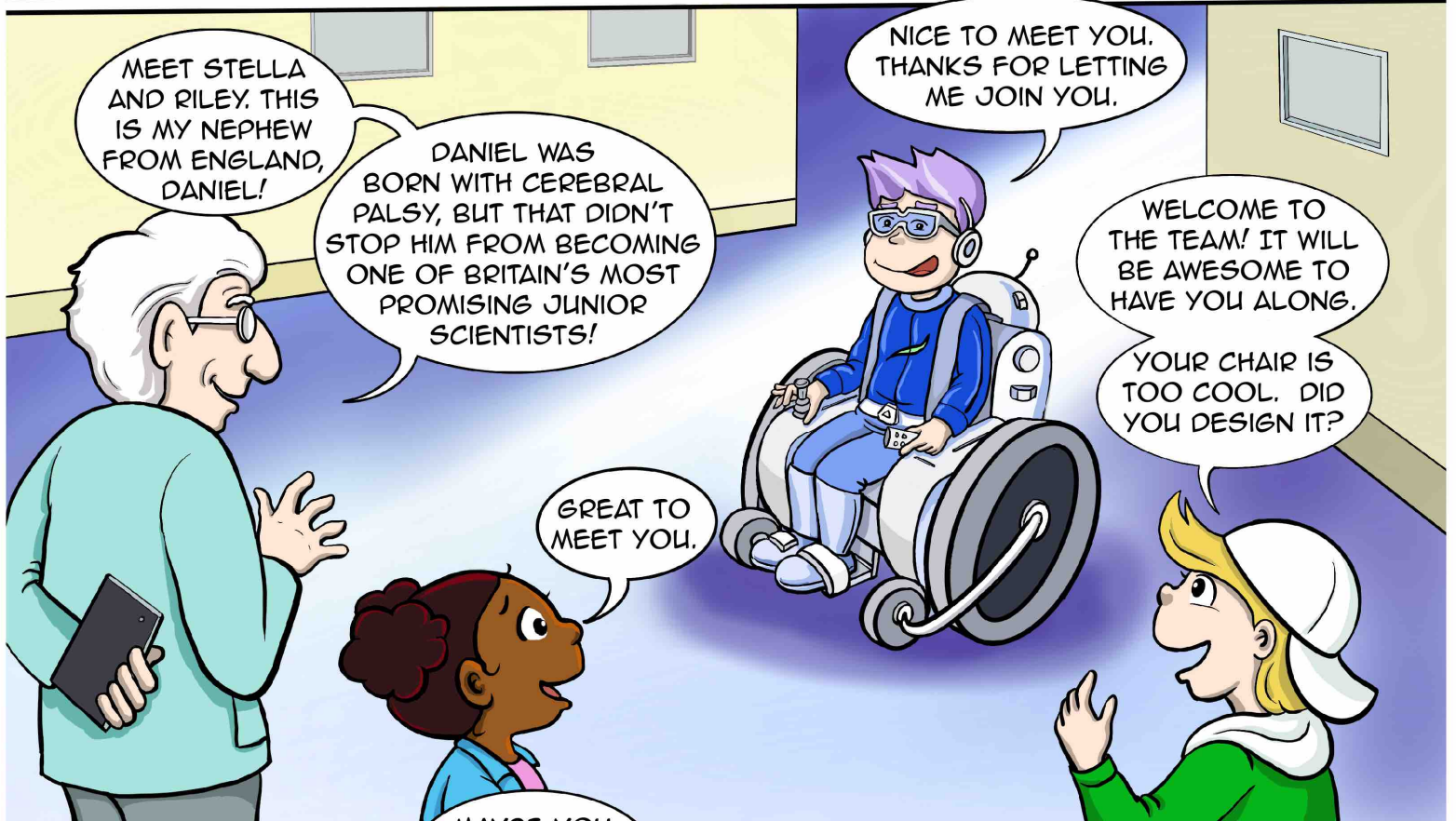


LET ME INTRODUCE YOU TO A GUEST MEMBER ON YOUR JOURNEY TODAY.

GUEST...

MEMBER?

COME ON IN, DANIEL.



MEET STELLA AND RILEY. THIS IS MY NEPHEW FROM ENGLAND, DANIEL!

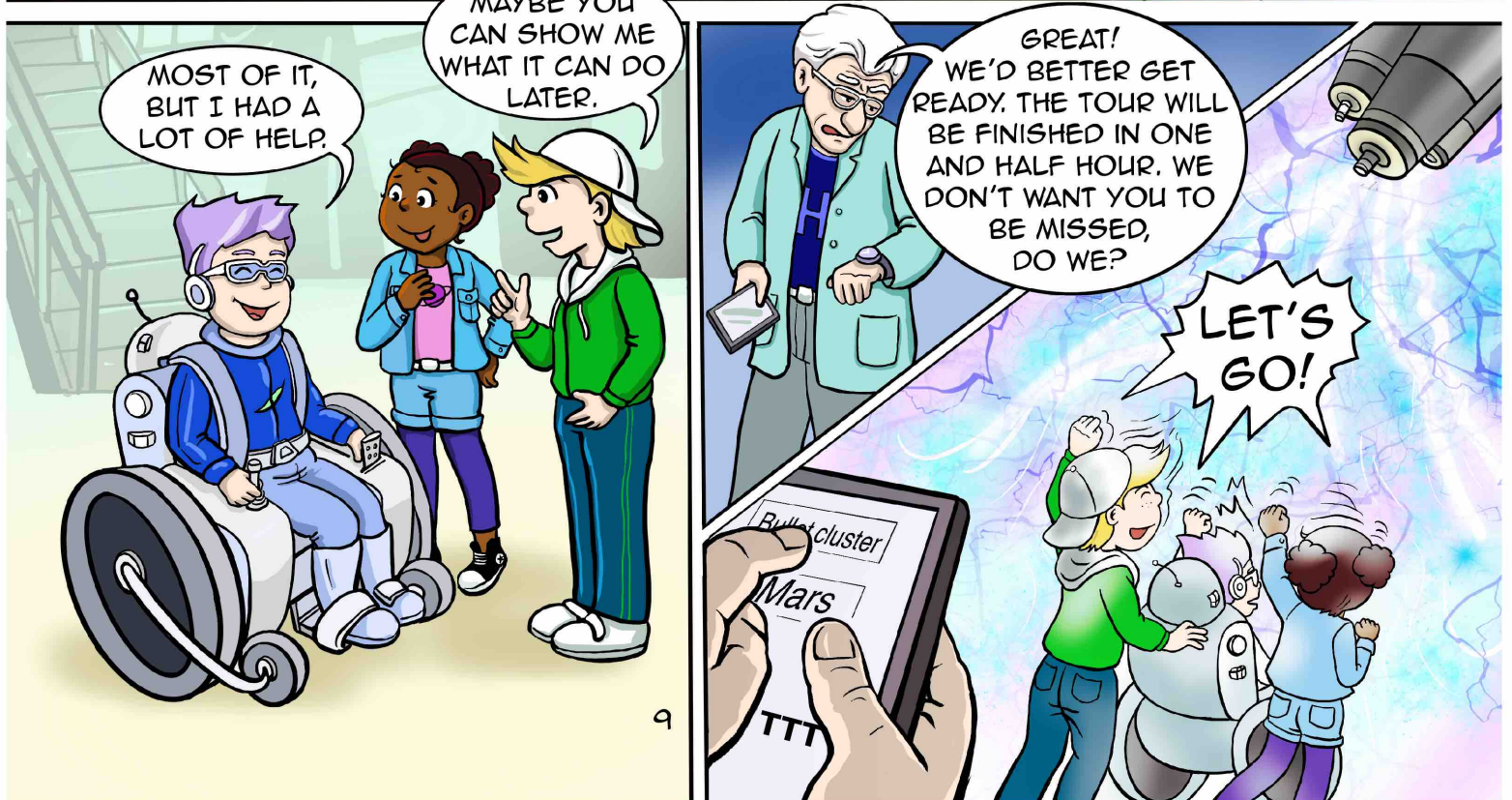
DANIEL WAS BORN WITH CEREBRAL PALSY, BUT THAT DIDN'T STOP HIM FROM BECOMING ONE OF BRITAIN'S MOST PROMISING JUNIOR SCIENTISTS!

GREAT TO MEET YOU.

NICE TO MEET YOU. THANKS FOR LETTING ME JOIN YOU.

WELCOME TO THE TEAM! IT WILL BE AWESOME TO HAVE YOU ALONG.

YOUR CHAIR IS TOO COOL. DID YOU DESIGN IT?



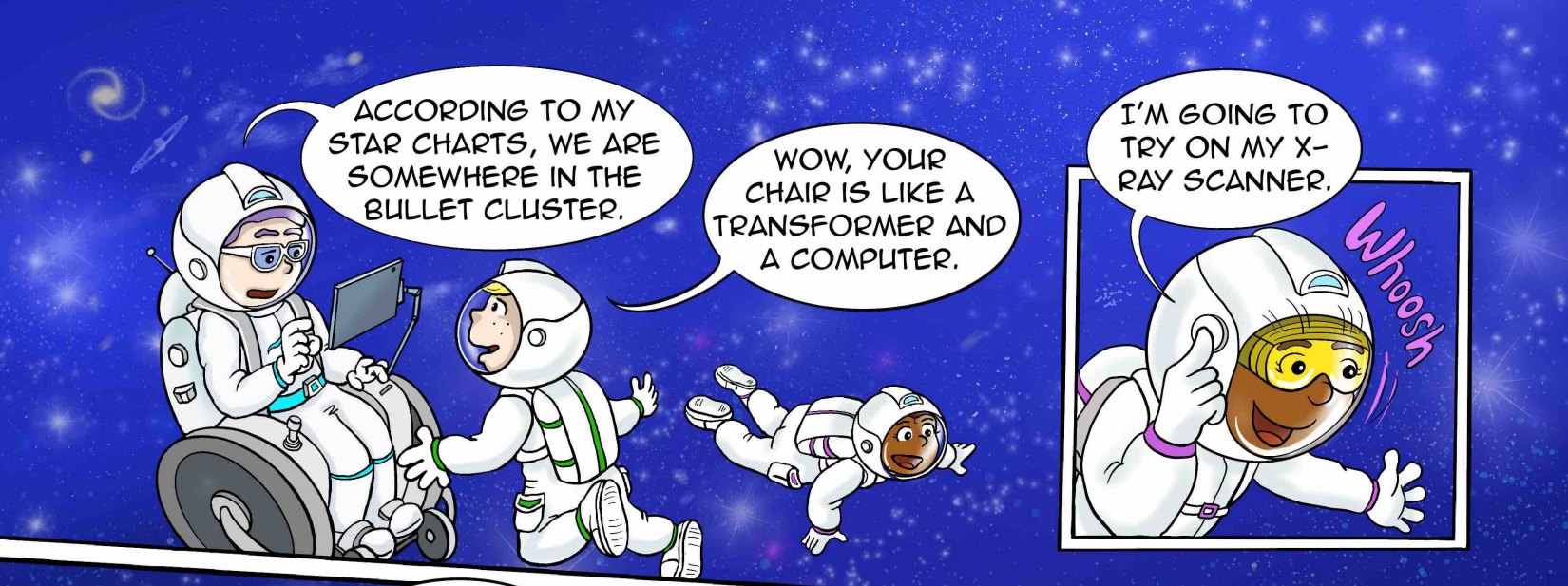
MOST OF IT, BUT I HAD A LOT OF HELP.

MAYBE YOU CAN SHOW ME WHAT IT CAN DO LATER.

GREAT! WE'D BETTER GET READY. THE TOUR WILL BE FINISHED IN ONE AND HALF HOUR. WE DON'T WANT YOU TO BE MISSED, DO WE?

LET'S GO!

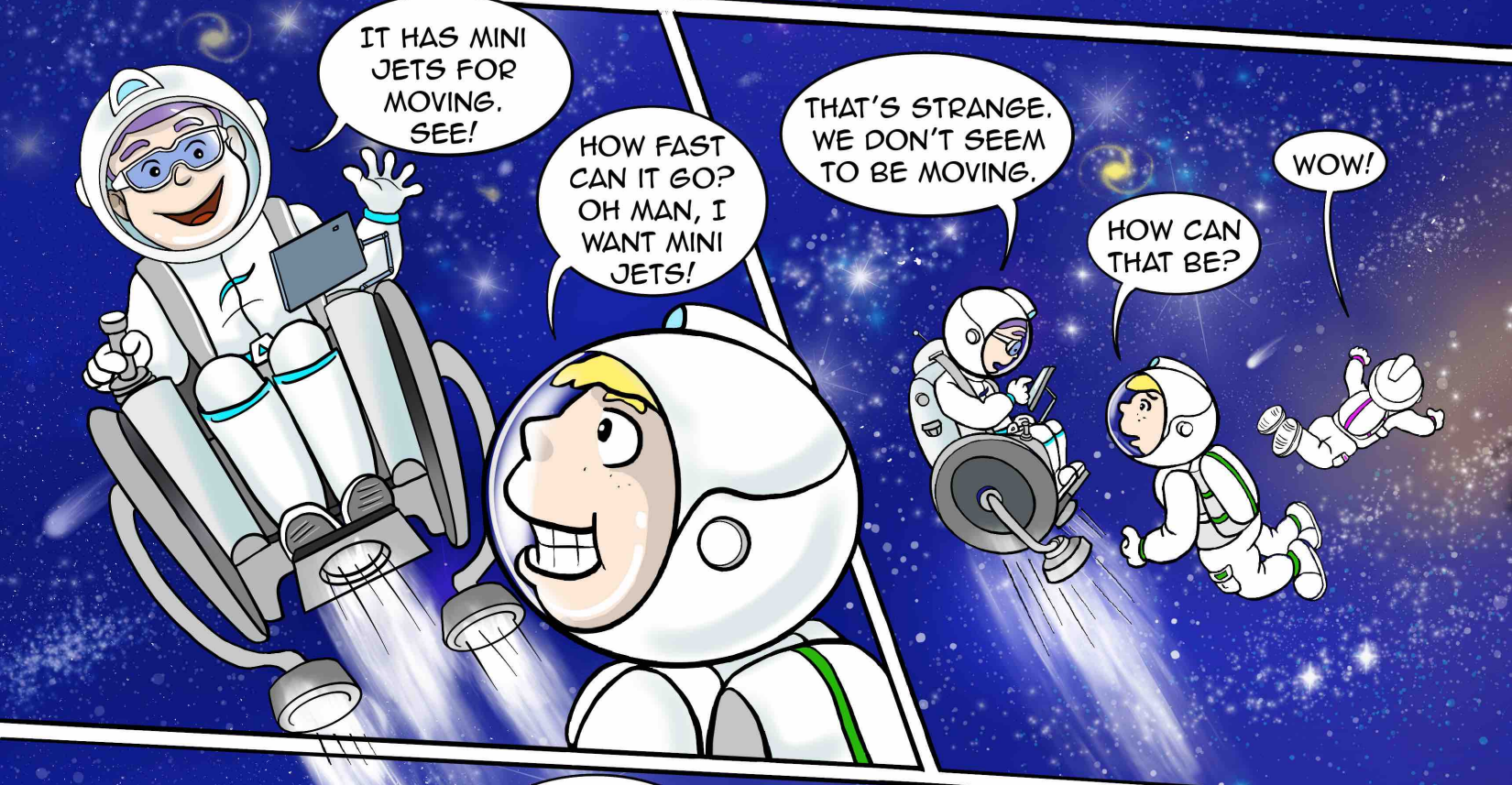
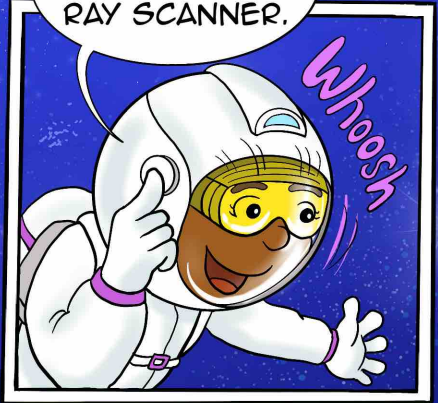
Bullet cluster
Mars
TTT



ACCORDING TO MY STAR CHARTS, WE ARE SOMEWHERE IN THE BULLET CLUSTER.

WOW, YOUR CHAIR IS LIKE A TRANSFORMER AND A COMPUTER.

I'M GOING TO TRY ON MY X-RAY SCANNER.



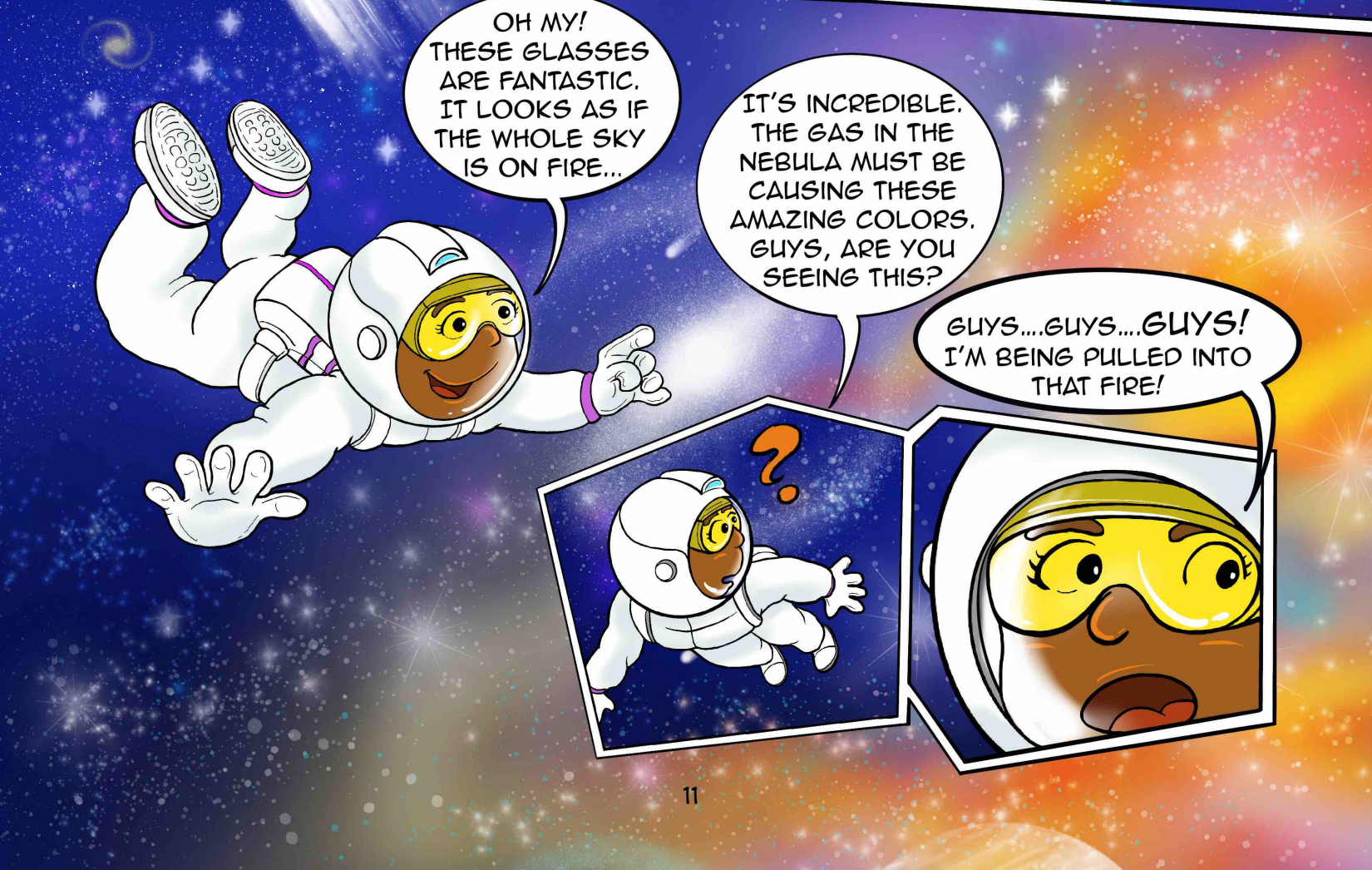
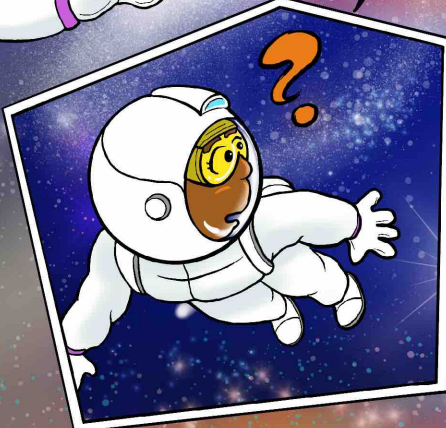
IT HAS MINI JETS FOR MOVING. SEE!

HOW FAST CAN IT GO? OH MAN, I WANT MINI JETS!

THAT'S STRANGE. WE DON'T SEEM TO BE MOVING.

HOW CAN THAT BE?

WOW!



OH MY! THESE GLASSES ARE FANTASTIC. IT LOOKS AS IF THE WHOLE SKY IS ON FIRE...

IT'S INCREDIBLE. THE GAS IN THE NEBULA MUST BE CAUSING THESE AMAZING COLORS. GUYS, ARE YOU SEEING THIS?

GUYS...GUYS...GUYS! I'M BEING PULLED INTO THAT FIRE!





ARE YOU GUYS LISTENING? I'M BEING PULLED INTO THAT ENORMOUS FIRE!



WHAT FIRE?

WHAT ARE YOU TALKING ABOUT? STELLA, ARE YOU USING THE X-RAY SCANNER?



TURN ON YOUR X-RAY SCANNER!



LOOK! WHAT IS THAT?

I SEE IT!

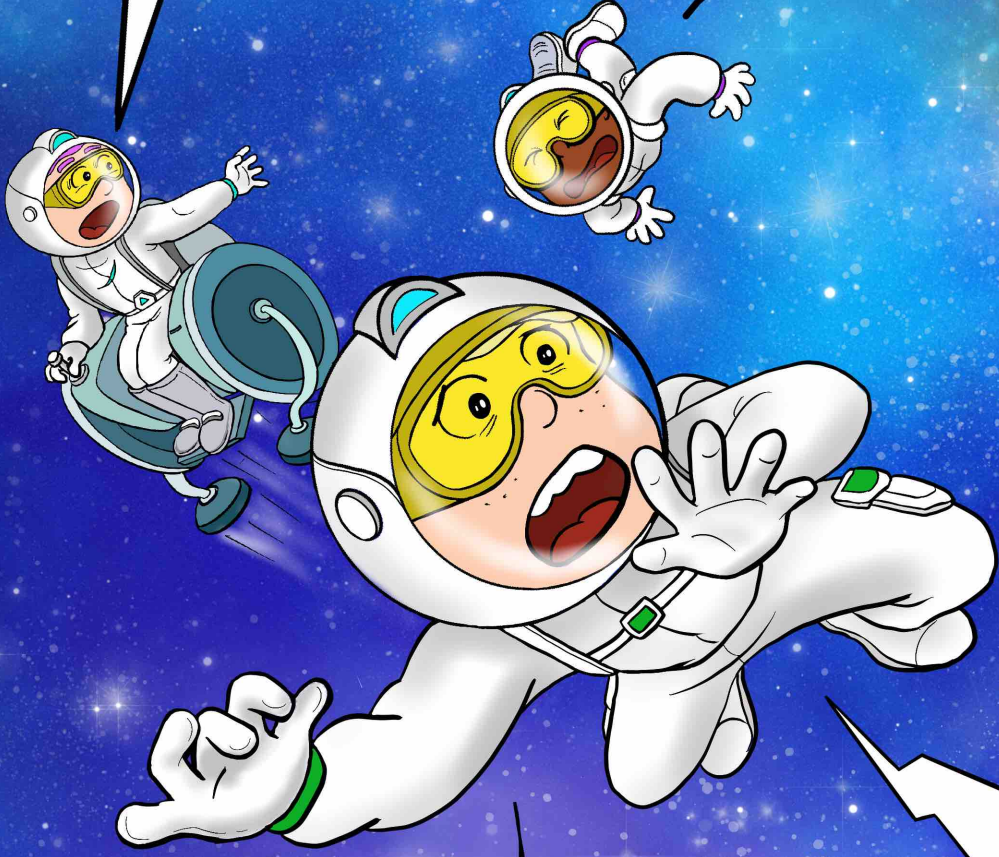
SEE WHAT?! OH, SOMETHING IS HIDING IN THE NEBULA.



LOOK!
A DRAGON!
WE'RE GETTING
PULLED
INTO IT!

IT'S
GONNA
EAT US!

WHAT IS THE
SAFE WORD?
DARK MATTER?
AHHH...WHAT'S
THAT WORD?



WE'D
BETTER GET
OUT OF
HERE!

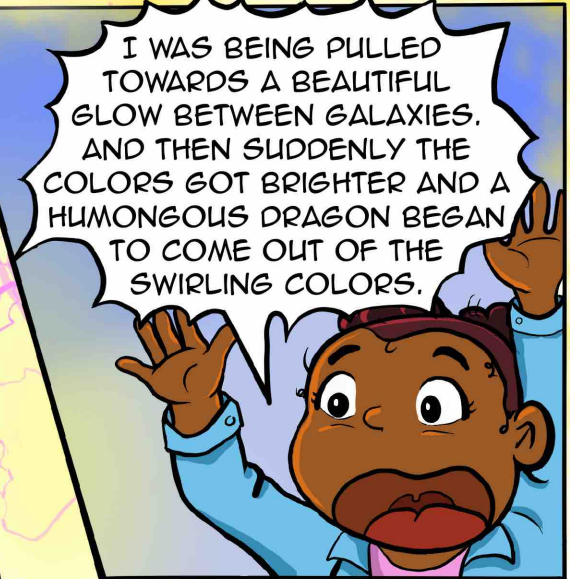
**DARTH
VADER!!**



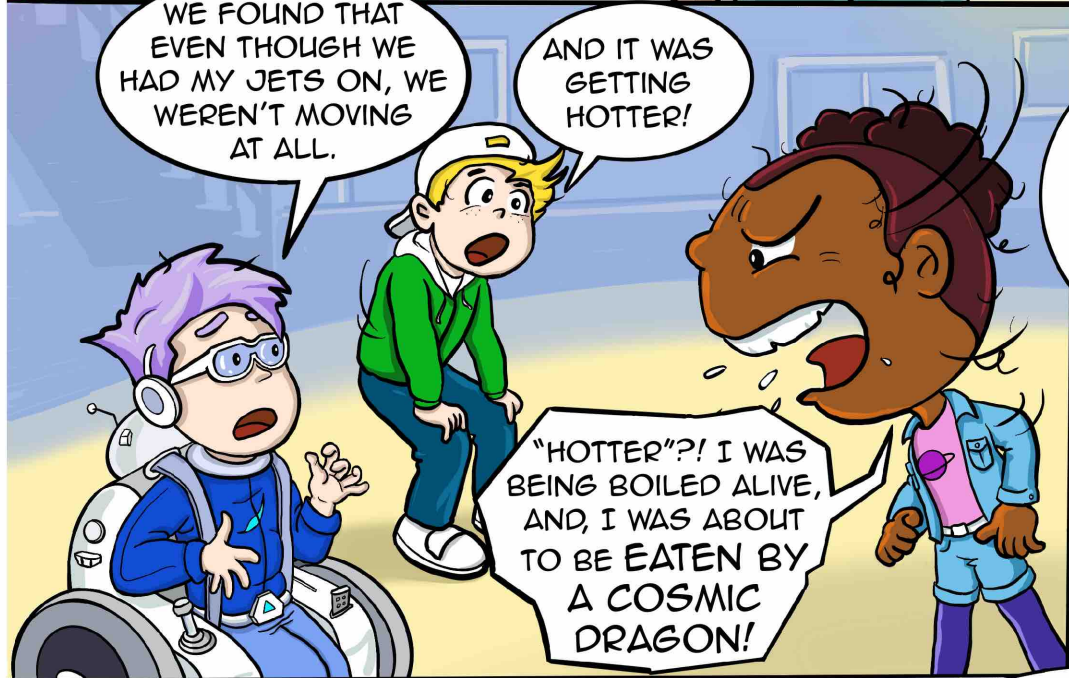
THWP



WELL, THAT WAS A FAST TRIP. WHAT HAPPENED? YOU'VE ONLY BEEN GONE FOR 15 MINUTES!



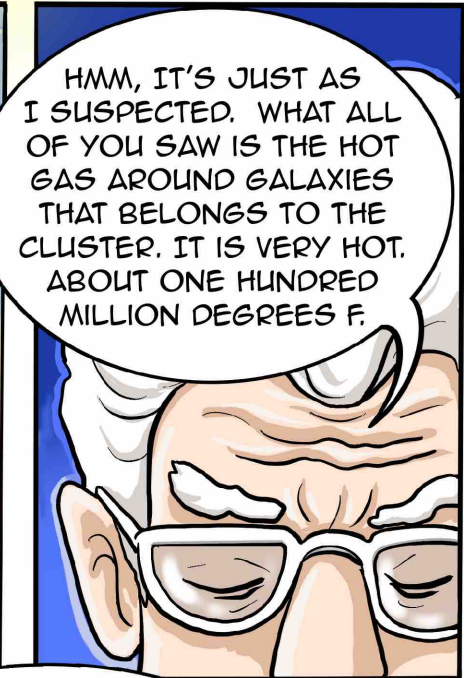
I WAS BEING PULLED TOWARDS A BEAUTIFUL GLOW BETWEEN GALAXIES. AND THEN SUDDENLY THE COLORS GOT BRIGHTER AND A HUMONGOUS DRAGON BEGAN TO COME OUT OF THE SWIRLING COLORS.



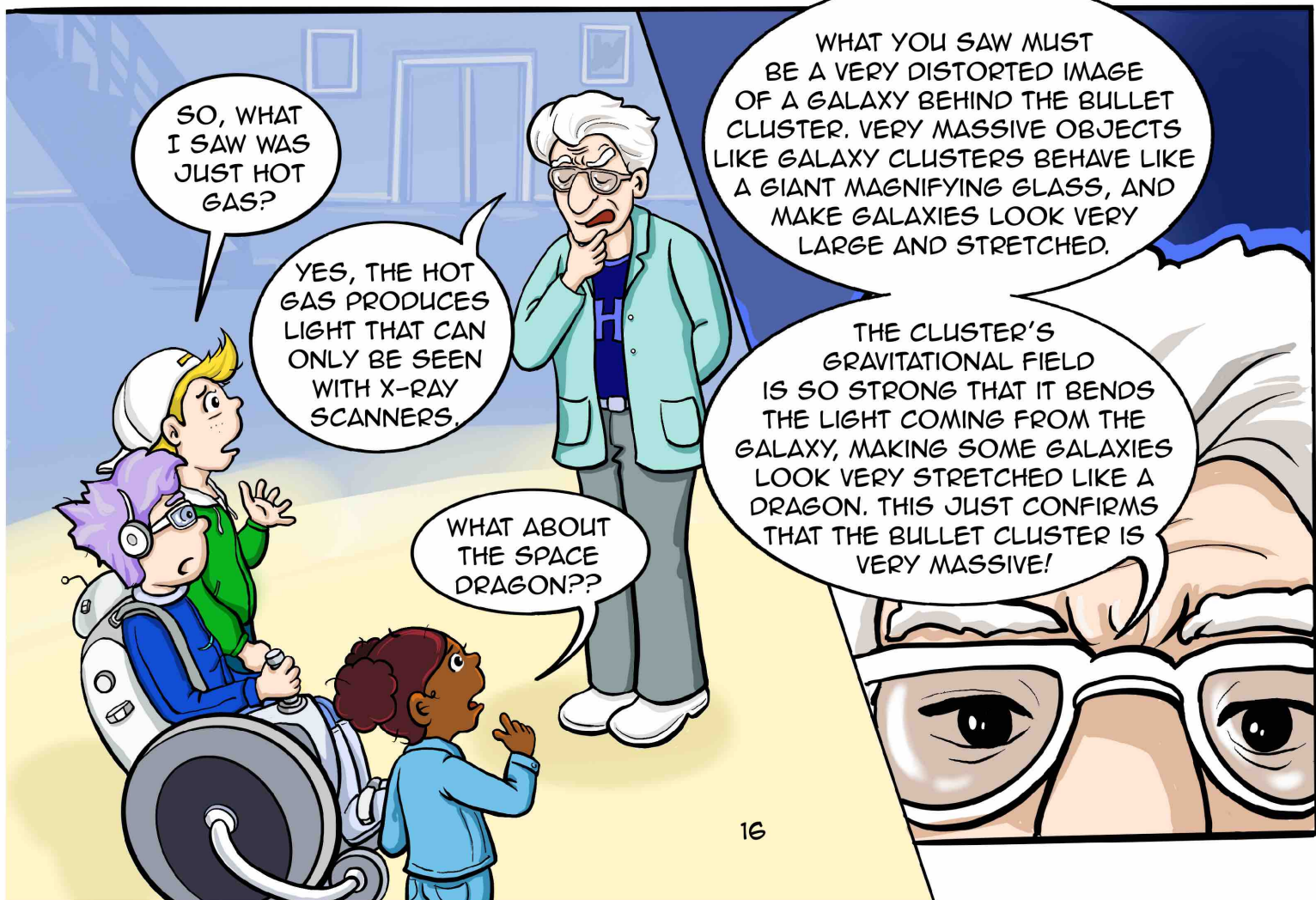
WE FOUND THAT EVEN THOUGH WE HAD MY JETS ON, WE WEREN'T MOVING AT ALL.

AND IT WAS GETTING HOTTER!

"HOTTER"?! I WAS BEING BOILED ALIVE, AND, I WAS ABOUT TO BE EATEN BY A COSMIC DRAGON!



HMM, IT'S JUST AS I SUSPECTED. WHAT ALL OF YOU SAW IS THE HOT GAS AROUND GALAXIES THAT BELONGS TO THE CLUSTER. IT IS VERY HOT. ABOUT ONE HUNDRED MILLION DEGREES F.



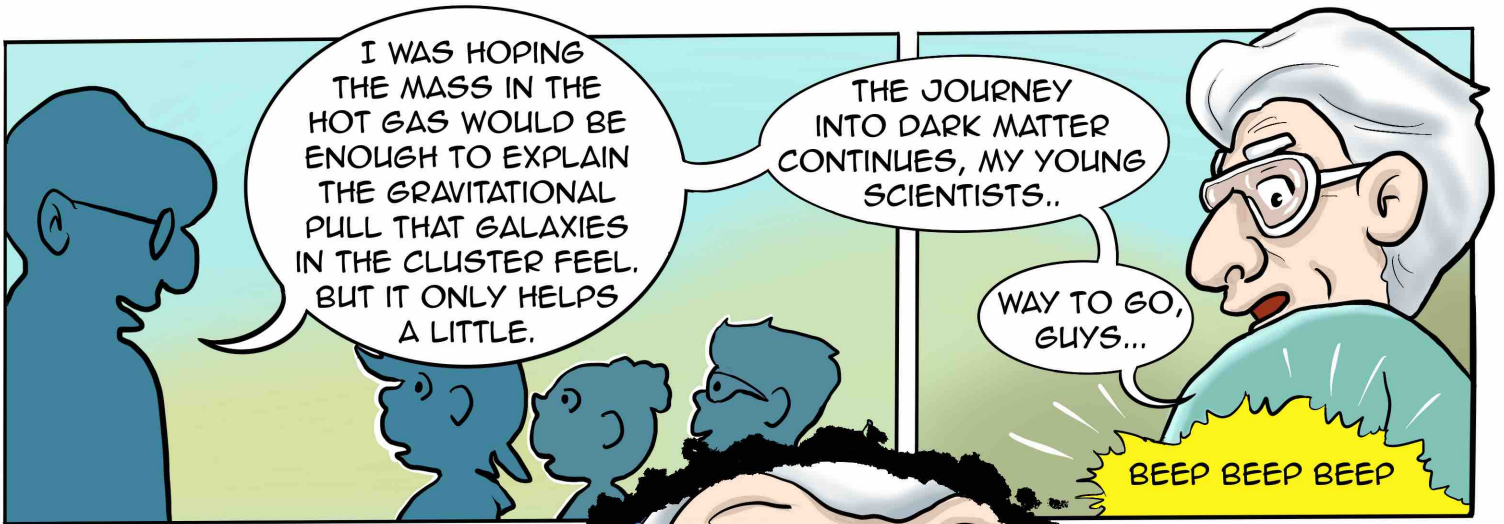
SO, WHAT I SAW WAS JUST HOT GAS?

YES, THE HOT GAS PRODUCES LIGHT THAT CAN ONLY BE SEEN WITH X-RAY SCANNERS.

WHAT ABOUT THE SPACE DRAGON??

WHAT YOU SAW MUST BE A VERY DISTORTED IMAGE OF A GALAXY BEHIND THE BULLET CLUSTER. VERY MASSIVE OBJECTS LIKE GALAXY CLUSTERS BEHAVE LIKE A GIANT MAGNIFYING GLASS, AND MAKE GALAXIES LOOK VERY LARGE AND STRETCHED.

THE CLUSTER'S GRAVITATIONAL FIELD IS SO STRONG THAT IT BENDS THE LIGHT COMING FROM THE GALAXY, MAKING SOME GALAXIES LOOK VERY STRETCHED LIKE A DRAGON. THIS JUST CONFIRMS THAT THE BULLET CLUSTER IS VERY MASSIVE!

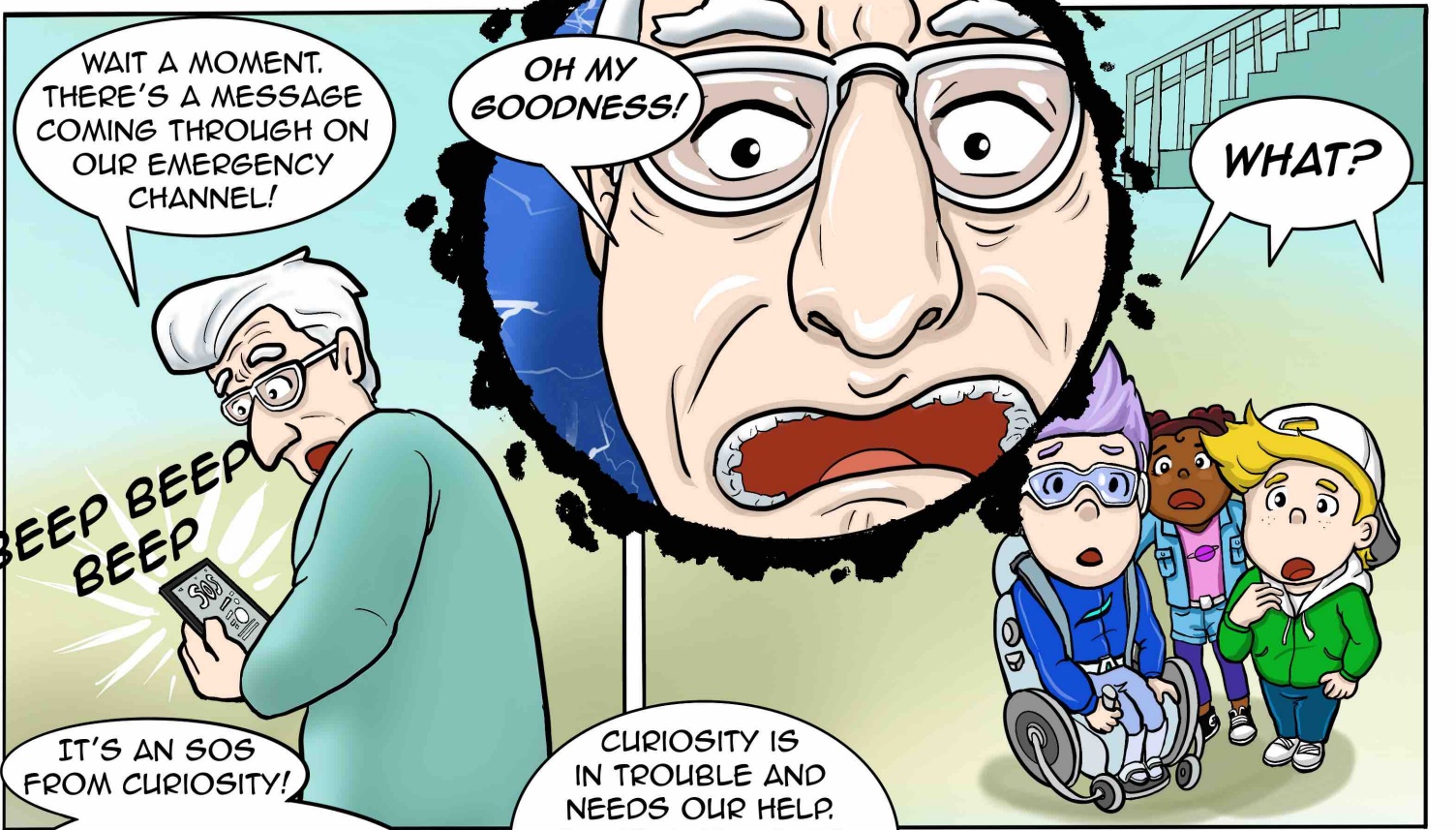


I WAS HOPING THE MASS IN THE HOT GAS WOULD BE ENOUGH TO EXPLAIN THE GRAVITATIONAL PULL THAT GALAXIES IN THE CLUSTER FEEL. BUT IT ONLY HELPS A LITTLE.

THE JOURNEY INTO DARK MATTER CONTINUES, MY YOUNG SCIENTISTS..

WAY TO GO, GUYS...

BEEP BEEP BEEP



WAIT A MOMENT. THERE'S A MESSAGE COMING THROUGH ON OUR EMERGENCY CHANNEL!

OH MY GOODNESS!

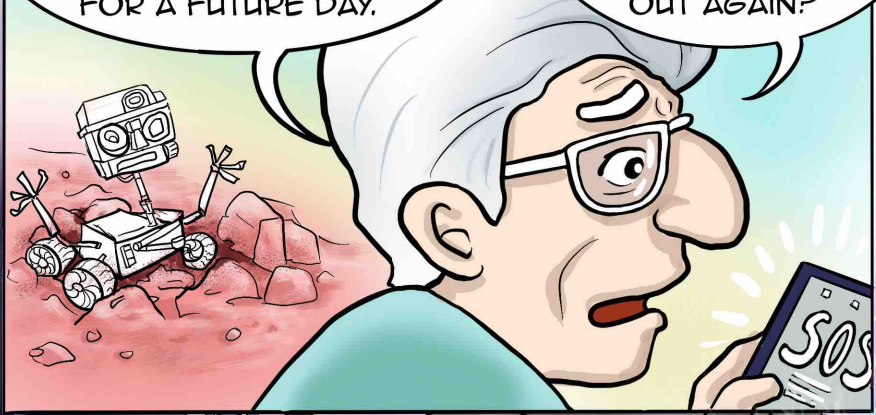
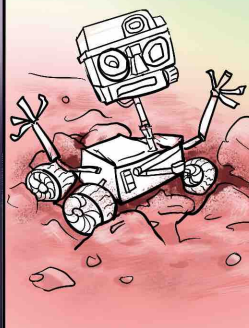
WHAT?

BEEP BEEP BEEP

IT'S AN SOS FROM CURIOSITY!

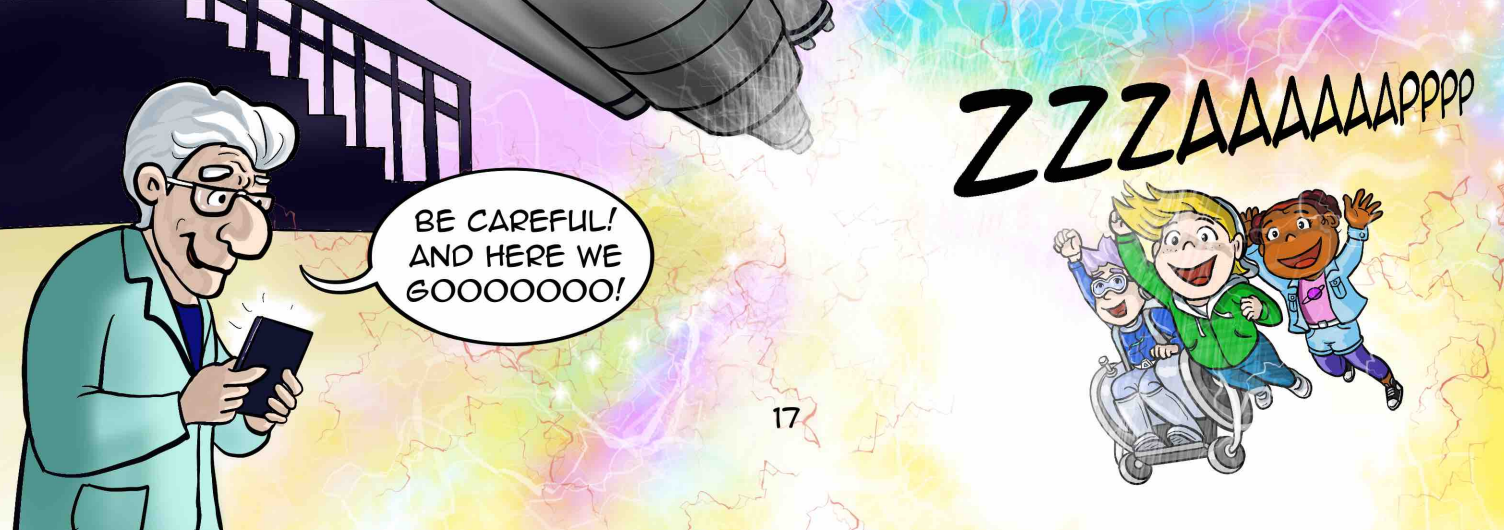
CURIOSITY IS IN TROUBLE AND NEEDS OUR HELP. I KNOW YOU JUST GOT BACK, BUT ARE YOU WILLING TO GO OUT AGAIN?

UNFORTUNATELY, OUR RESEARCH INTO DARK MATTER WILL HAVE TO WAIT FOR A FUTURE DAY.



ANYTHING FOR OUR BUDDY CURIOSITY..

LET'S DO IT!



BE CAREFUL! AND HERE WE GOOOOOOO!

ZZZAAAAAAPP



OK, LET'S GET TO WORK.



I THINK IT'S TIME WE GIVE OUR FRIENDS A SPECIAL SURPRISE!



THIS IS THE MOMENT I'VE BEEN WAITING FOR. I CAN FINALLY HAVE THE GALAXY SCOUTS TEST MY NEW INVENTION. IT COULD BE THE BEGINNING OF MANKIND'S COLONIZATION OF THE RED PLANET.



COME ON, LUNA! LET'S GET THEM READY!

Glossary

Planets visible to the naked eye: Five planets in the solar system are visible to the naked eye: Mercury, Venus, Mars, Jupiter, and Saturn.

Mars “the red planet”: The surface material (or regolith) of Mars contains a lot of iron oxide (FeO), and it is what gives Mars its red color. Earth also has a lot of FeO but most of it sunk to the core of the planet; while Mars, due to its smaller size and weaker gravity, has much more FeO on its surface.

Trappist-1 planets: Trappist-1 is a star in the Milky Way with a planetary system consisting of seven planets. Four of the seven planets are located in the star’s habitable zone and are potentially hospitable for life.

Griffith Observatory: An observatory in Los Angeles, USA. It is named after its benefactor, Griffith J. Griffith. The observatory was opened in 1935. Griffith's objective was to make astronomy accessible to the public, as opposed to the dominant idea that observatories should be located on remote mountaintops and restricted to scientists.

Zeiss telescope: The 12-inch (30.5 cm) optical refracting telescope at the Griffith Observatory. Refracting telescopes use lenses to focus the light and form images of astronomical sources.

Mars rovers: Motor vehicles designed to travel on the surface of Mars, collecting information and exploring the planet. As of 2022, there have been six Mars rovers: Sojourner (1997), Spirit (2004–2010), Opportunity (2004–2018), Curiosity (2012–), Perseverance (2021–), and Zhurong (2021–).

Christmas star: Refers to Jupiter and Saturn when they cross paths so close to each other that they are barely distinguishable from one another to the naked eye. One such event happened on December 21st, 2020 when Jupiter and Saturn were so close in the sky that they appeared as one bright shining star in the sky, which we call the Christmas star. We will have to wait until the year 2080 for this to happen again.

Evening star: As the planet Venus always appears close to the Sun in the sky, it is visible usually soon after sunset in the evening or in the morning just before sunrise. This is why Venus is frequently called the Evening or Morning star.

Dark matter: An invisible, mysterious type of matter in the universe that scientists have not been able to detect directly, using existing telescopes. It is called “dark” because it does not interact with light and is therefore impossible to detect directly. However, we can sense its presence through the gravitational force it exerts. For example, due to the presence of dark matter, galaxies revolve or orbit around their centers much faster than would be expected, if we account for all the matter that can be directly measured (e.g. stars, gas). The presence of dark matter explains why galaxies orbit so fast.

Glossary

X-ray: A type of light. There are several types of light, each having different wavelengths of radiation. X-ray light has a smaller wavelength and carries more energy than the visual light that we can see (colors of the rainbow). Many astronomical sources, such as disks around black holes, neutron stars, binary star systems, supernova remnants, and stars, give off X-ray light.

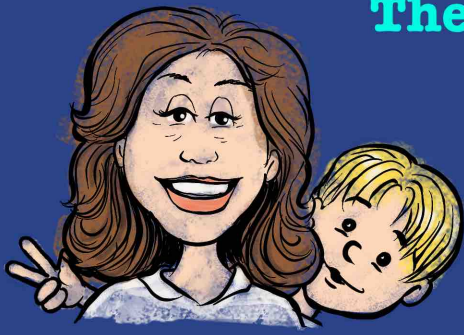
Bullet Cluster of galaxies: Galaxies exist in a group or cluster of other galaxies. The Bullet Cluster of galaxies is one of those large groups. It consists of two colliding smaller clusters of galaxies. It is especially well known for providing important evidence of the existence of dark matter.

Intercluster gas: The matter that exists in between galaxies in galaxy clusters. This medium mainly consists of very hot gas that has a temperature of millions of degrees. Intercluster gas can be studied using X-ray telescopes.

Gravitational lensing: The effect that gravity has on the light that travels from distant sources and passes by a massive object. The strong gravitational force of the massive object bends the light, causing multiple images of the distant sources.



The Galaxy Scouts Team



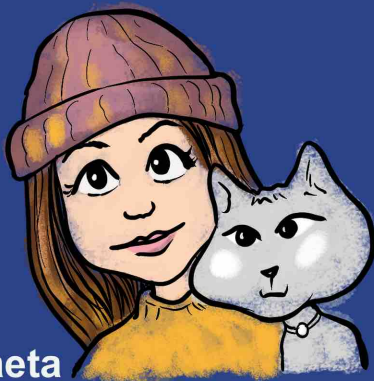
Snežana Stanimirović

- From Kruševac, Serbia
- Astronomy professor at UW-Madison
- Creator and advisor for the comic
- Likes figure skating and comics



Rebecca Cors

- From Milwaukee, WI and Liechtenstein
- Research and Evaluation Scientist
- Wisconsin Master Naturalist
- Likes hiking, reading, and learning languages



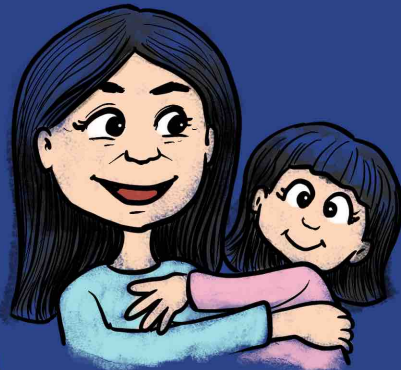
Amy Gaeta

- From Boston, MA
- Proofreader and editor for the comic
- Likes traveling, cats, and robots



Kay Kriewald

- From Merrill, WI
- Science teacher
- Field testing for the comic and activities
- Likes playing with her dog Luna



Jan Lin

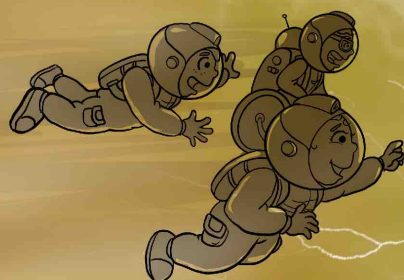
- From Taipei, Taiwan
- Artist and illustrator
- Creative director for the comic
- Likes travel, movies and music



Robert Tetzner

- From Thorp, WI
- Artist and ESL teacher
- Chief writer and activity designer for the comic
- Likes drawing, painting, and comic book collecting

STELLA, RILEY AND DANIEL ARE RUSHING
TO CURIOSITY'S RESCUE. WHAT WILL
HAPPEN WHEN THEY GET TO MARS?
WHAT HAPPENED TO CURIOSITY?
FOLLOW THEIR ADVENTURES
IN BOOK 3!



THIS BOOK IS PART OF THE COMIC BOOK
SERIES, GALAXY SCOUTS, SPACE-VENTURES
OF STELLA AND RILEY, WHICH CONSIST OF
COMIC AND ACTIVITY BOOKS.
CHECK THEM OUT HERE.
[HTTPS://GALAXYSCOUTS.WISC.EDU](https://galaxyscouts.wisc.edu)

