

# PLANET B?



# PLANET B?

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Niamh O'Kane, Roisin Corr and Ruth Hunter. Art by - Jim Lavery

## **Information about the SPACE project:**

The SPACE (Supportive Environments for Social and Physical Activity, Healthy Ageing and Cognitive Health) project is a research programme funded by the Economic and Social Research Council (<https://www.qub.ac.uk/sites/space/>). The project investigates the impact of different environmental factors, including climate-related factors, on cognitive health and brain health.

Queen's University Belfast are proud to work in partnership with the Armagh Observatory and Planetarium and Revolve Comics to produce the Planet B? comic.

The aim of the comic is about the importance of protecting where we live for human health and animal health in collaboration with the and the Armagh Observatory and Planetarium.

The comic is an opportunity to leave a legacy with the Planetarium to continue to raise awareness about the importance of protecting where we live (i.e. Earth) for human health and animal health.

The comic will explore the ideas of alternative habitable planets to Earth such as Mars and exoplanets. Our key message is that there is no 'Planet B' and we need to look after Earth.

The comic is for young people and has the following objectives:

- 1) to promote space and related topics;
- 2) to promote females in astronomy, academia, research and other industries;
- 3) to promote inter-generational connection;
- 4) to promote positive climate action and its synergy with human health and animal health;
- 5) to leave a legacy of the SPACE project.

*We hope you enjoy and learn a little something along the way too.*

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Economic  
and Social  
Research Council



SO, WHERE ARE WE?

WE ARE IN THE MILKY WAY...

NO, I MEAN WHERE EXACTLY?

WE LIVE ON A PLANET THAT'S HURLING THROUGH SPACE...

WE CALL IT *EARTH*...

IT'S OUR *HOME*...

WE LIVE ON A LITTLE ISLAND ON PLANET EARTH...

AND WE ARE IN THE NORTH OF THAT ISLAND...

...NORTHERN IRELAND.



WHAT A GRAND BIT OF LAND IT IS TOO...



A BEAUTIFUL, ICONIC COUNTRY...

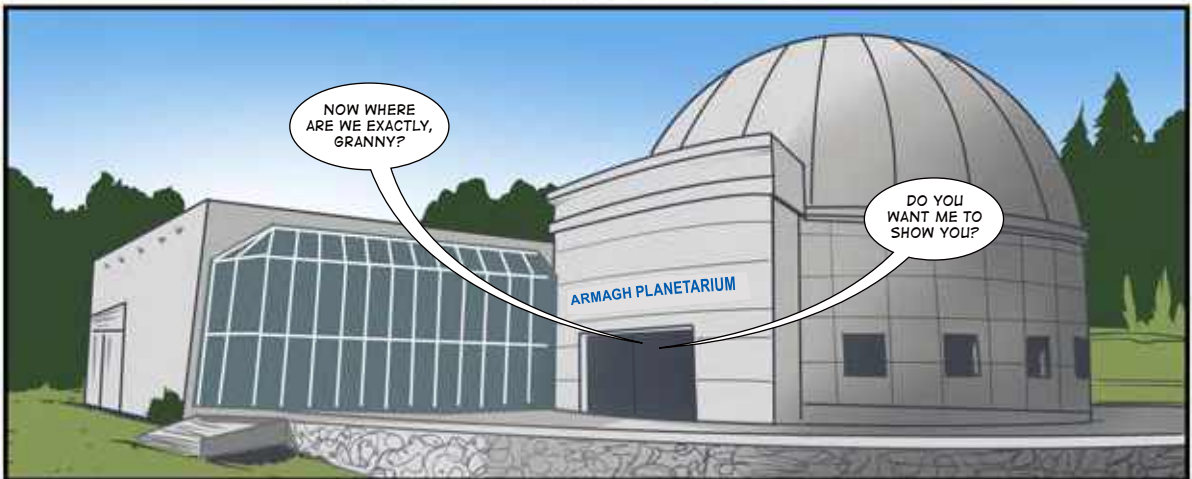


AND PACKED FULL OF HISTORY...



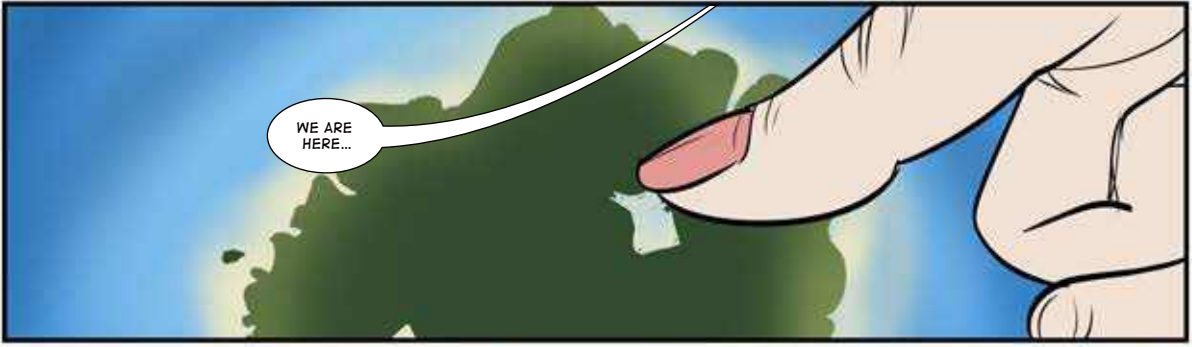
WITH SOME IMPRESSIVE BUILDINGS,

SUCH AS QUEEN'S UNIVERSITY BELFAST...

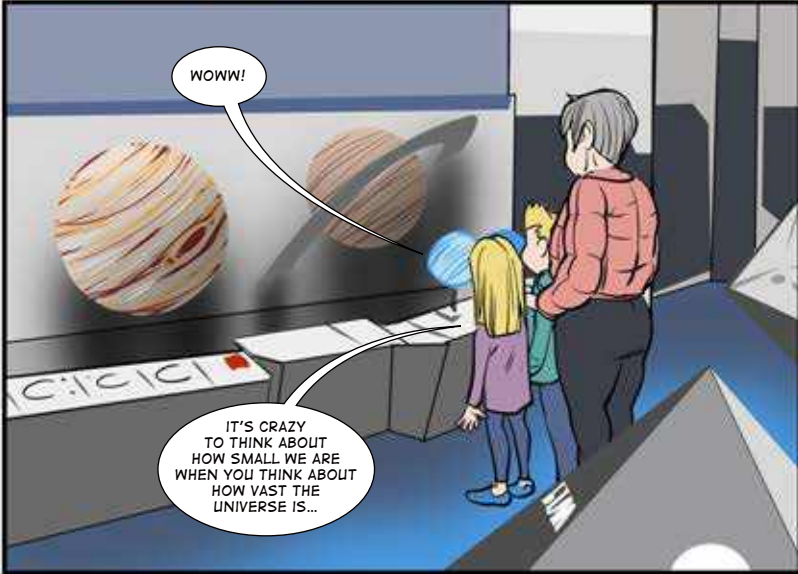


NOW WHERE ARE WE EXACTLY, GRANNY?

DO YOU WANT ME TO SHOW YOU?

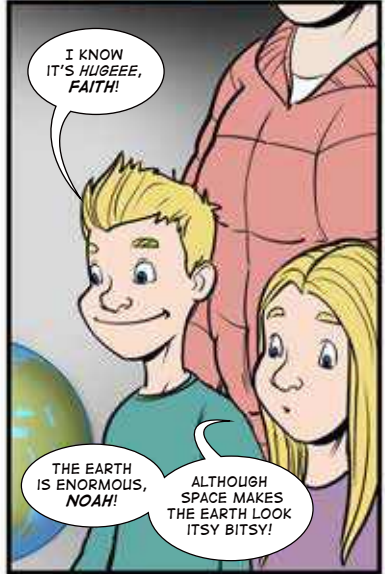


WE ARE  
HERE...



WOWW!

IT'S CRAZY  
TO THINK ABOUT  
HOW SMALL WE ARE  
WHEN YOU THINK ABOUT  
HOW VAST THE  
UNIVERSE IS...



I KNOW  
IT'S HUGEEE,  
FAITH!

THE EARTH  
IS ENORMOUS,  
NOAH!

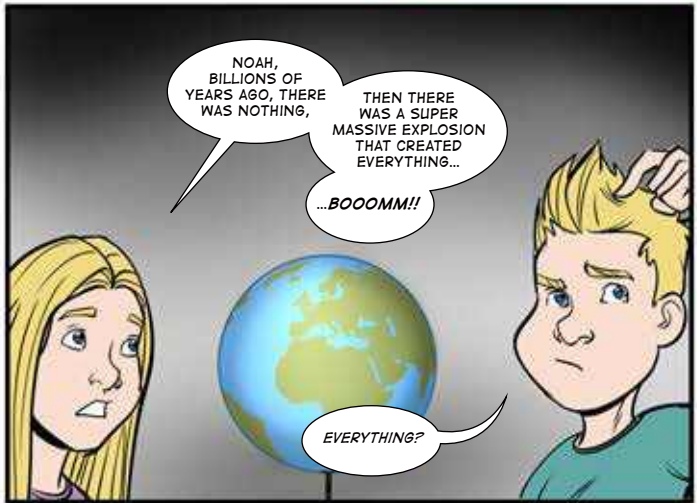
ALTHOUGH  
SPACE MAKES  
THE EARTH LOOK  
ITSY BITSY!



AND IT ALL  
STARTED WITH  
THE BIG  
BANG!

THE  
BIG BANG?  
WHAT'S  
THAT?

I KNOW  
WHAT IT  
IS...

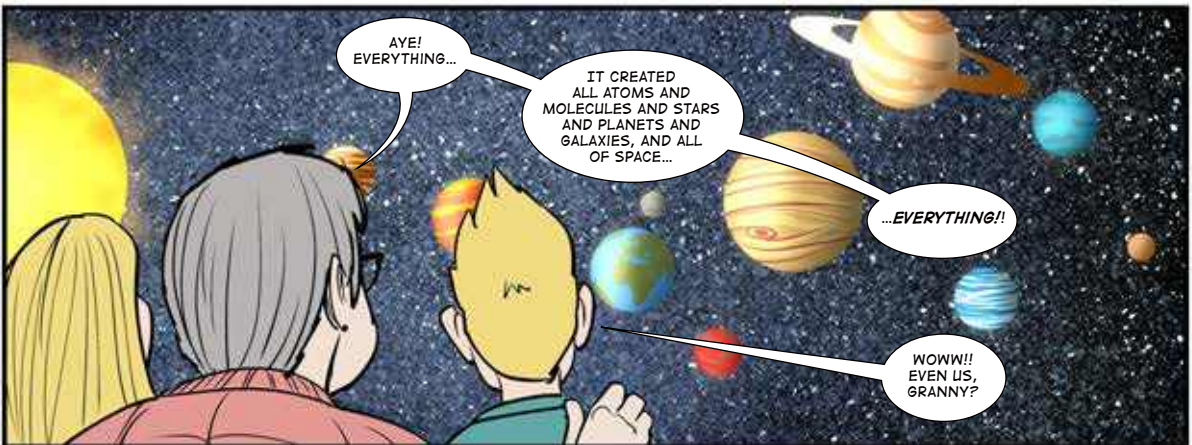


NOAH,  
BILLIONS OF  
YEARS AGO, THERE  
WAS NOTHING,

THEN THERE  
WAS A SUPER  
MASSIVE EXPLOSION  
THAT CREATED  
EVERYTHING...

...BOOOOMM!!

EVERYTHING?

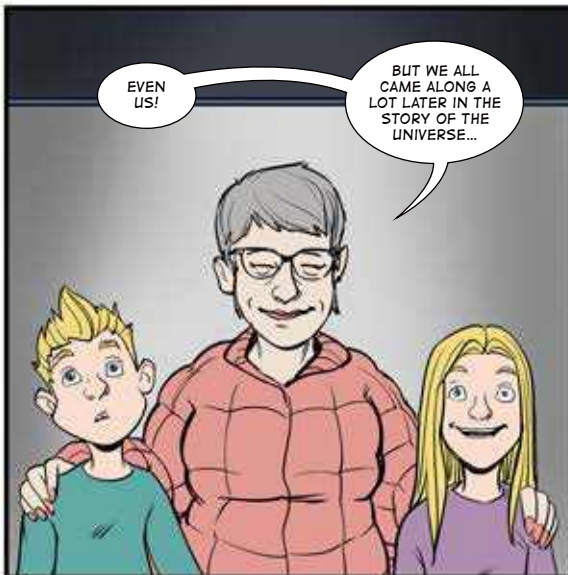


AYE!  
EVERYTHING...

IT CREATED  
ALL ATOMS AND  
MOLECULES AND STARS  
AND PLANETS AND  
GALAXIES, AND ALL  
OF SPACE...

...EVERYTHING!!

WOWW!!  
EVEN US,  
GRANNY?



EVEN US!

BUT WE ALL CAME ALONG A LOT LATER IN THE STORY OF THE UNIVERSE...



IMAGINE...

THE EARTH WAS FORMED AROUND 4.6 BILLION YEARS AGO...

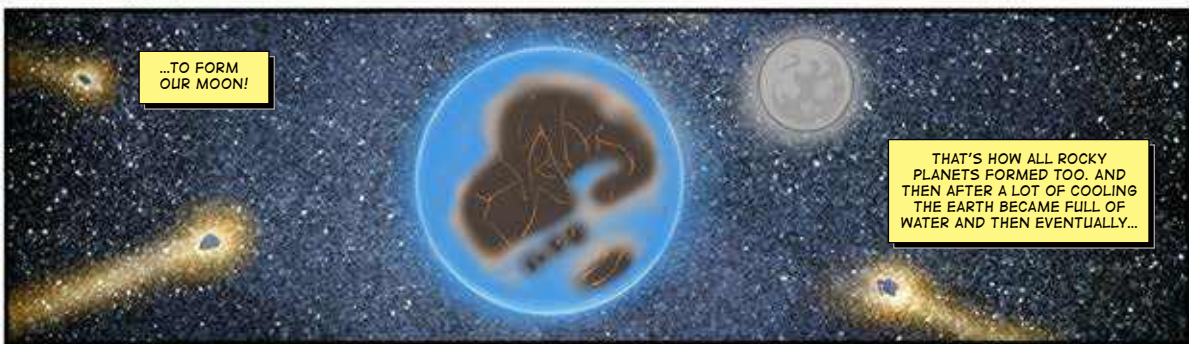
...OUT OF A MIXTURE OF DUST AND GAS AROUND THE YOUNG SUN...



...THE LITTLE LUMP OF EARTH MATTER GREW LARGER THANKS TO COUNTLESS COLLISIONS BETWEEN DUST PARTICLES, ASTEROIDS AND SPACE DEBRIS...



INCLUDING ONE LAST GIANT IMPACT THAT THREW ENOUGH ROCK, GAS, AND DUST INTO SPACE...




...TO FORM OUR MOON!

THAT'S HOW ALL ROCKY PLANETS FORMED TOO. AND THEN AFTER A LOT OF COOLING THE EARTH BECAME FULL OF WATER AND THEN EVENTUALLY...

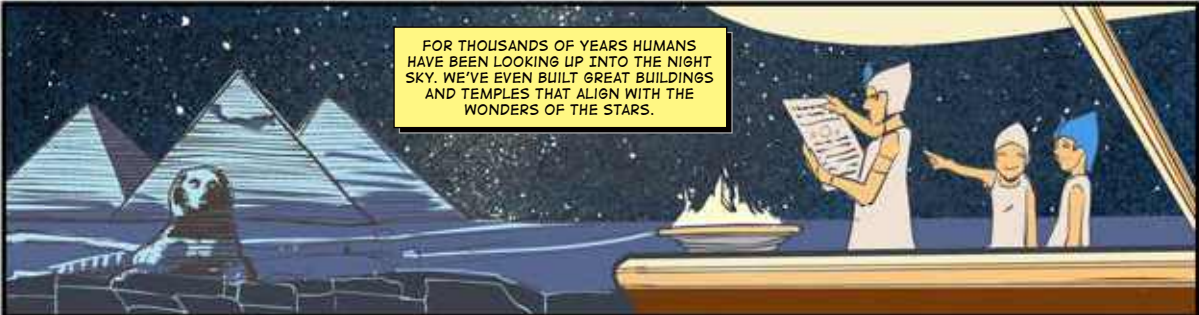


THAT'S WHEN IT BECAME HABITABLE FOR THE FIRST LIFE TO EVOLVE...

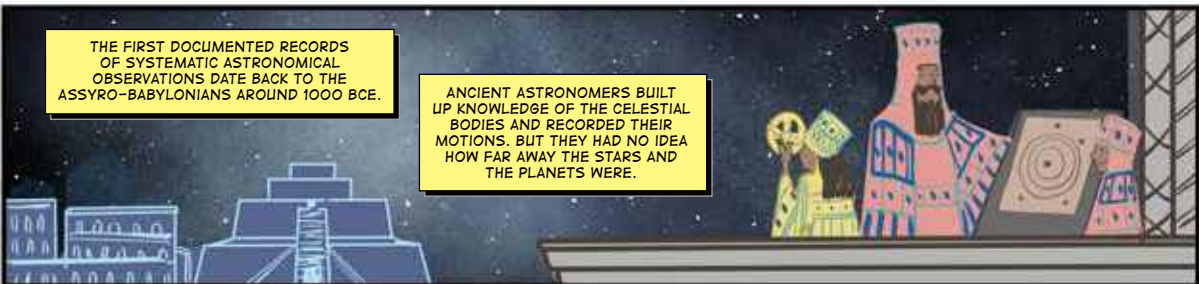
WOWW, THAT'S SOOO COOL!!



EVER SINCE THE FIRST HUMANS APPEARED ON EARTH WE HAVE BEEN GAZING OUT WONDERING WHAT IS UP THERE...




FOR THOUSANDS OF YEARS HUMANS HAVE BEEN LOOKING UP INTO THE NIGHT SKY. WE'VE EVEN BUILT GREAT BUILDINGS AND TEMPLES THAT ALIGN WITH THE WONDERS OF THE STARS.

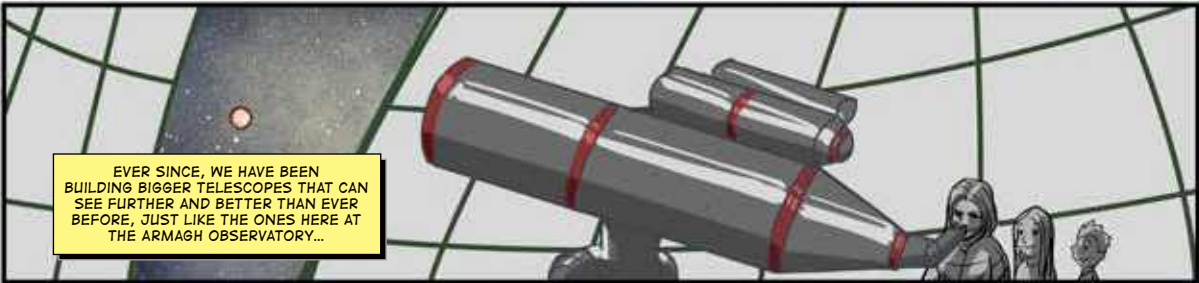


THE FIRST DOCUMENTED RECORDS OF SYSTEMATIC ASTRONOMICAL OBSERVATIONS DATE BACK TO THE ASSYRO-BABYLONIANS AROUND 1000 BCE.


ANCIENT ASTRONOMERS BUILT UP KNOWLEDGE OF THE CELESTIAL BODIES AND RECORDED THEIR MOTIONS. BUT THEY HAD NO IDEA HOW FAR AWAY THE STARS AND THE PLANETS WERE.



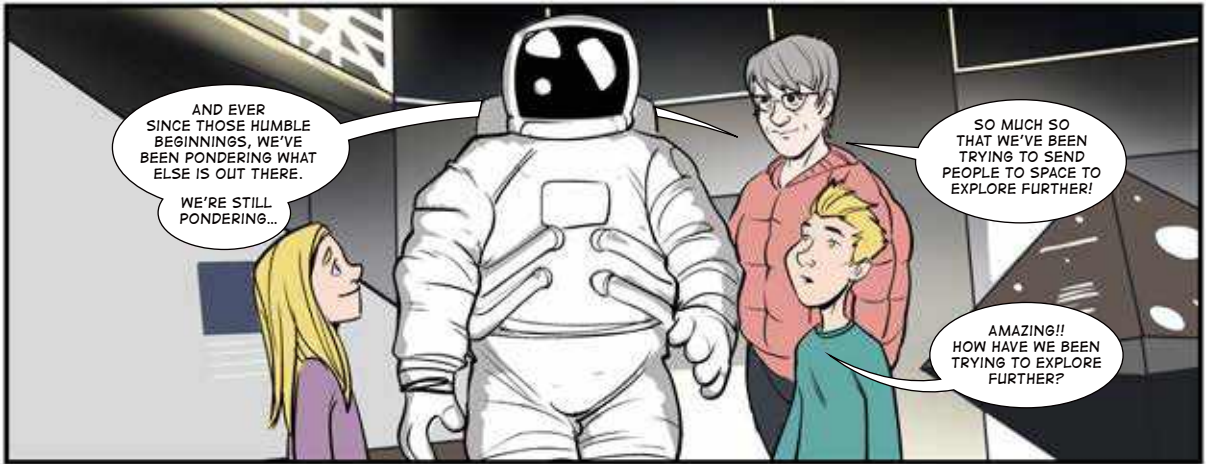
IN 1609 GALILEO MADE A TELESCOPE AND POINTED IT TO THE HEAVENS AND SAW FURTHER THAN ANYONE ELSE BEFORE HIM. HE HELPED RECORD MANY NEW DISCOVERIES.



EVER SINCE, WE HAVE BEEN BUILDING BIGGER TELESCOPES THAT CAN SEE FURTHER AND BETTER THAN EVER BEFORE, JUST LIKE THE ONES HERE AT THE ARMAGH OBSERVATORY...



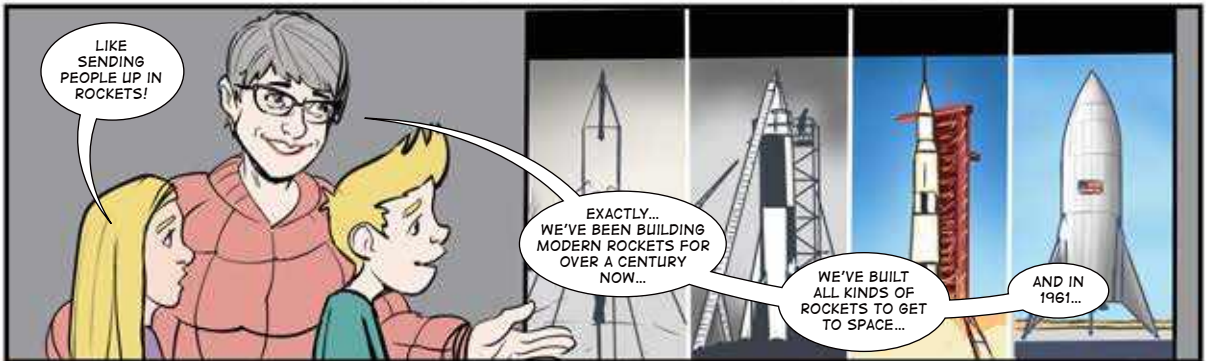
WE NOW HAVE TELESCOPES, JUST LIKE THE ONE WE WERE USING IN THE OBSERVATORY, THAT CAN SEE THE COSMOS EVEN AT HOME...



AND EVER SINCE THOSE HUMBLE BEGINNINGS, WE'VE BEEN PONDERING WHAT ELSE IS OUT THERE. WE'RE STILL PONDERING...

SO MUCH SO THAT WE'VE BEEN TRYING TO SEND PEOPLE TO SPACE TO EXPLORE FURTHER!

AMAZING!! HOW HAVE WE BEEN TRYING TO EXPLORE FURTHER?



LIKE SENDING PEOPLE UP IN ROCKETS!

EXACTLY... WE'VE BEEN BUILDING MODERN ROCKETS FOR OVER A CENTURY NOW...

WE'VE BUILT ALL KINDS OF ROCKETS TO GET TO SPACE...

AND IN 1961...



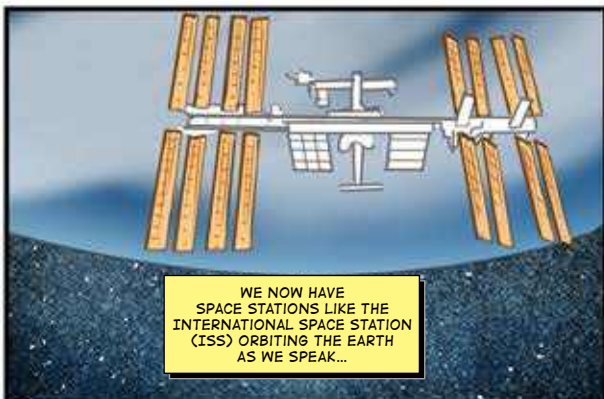
...VOSTOK 1 WAS THE FIRST SUCCESSFUL MANNED SPACEFLIGHT. IT WAS LAUNCHED FROM BAIKONUR COSMODROME ON 12 APRIL 1961.

WITH SOVIET COSMONAUT YURI GAGARIN ABOARD, MAKING HIM THE FIRST HUMAN TO REACH SPACE IN HISTORY AND TO COMPLETE A FULL ORBIT AROUND THE EARTH.

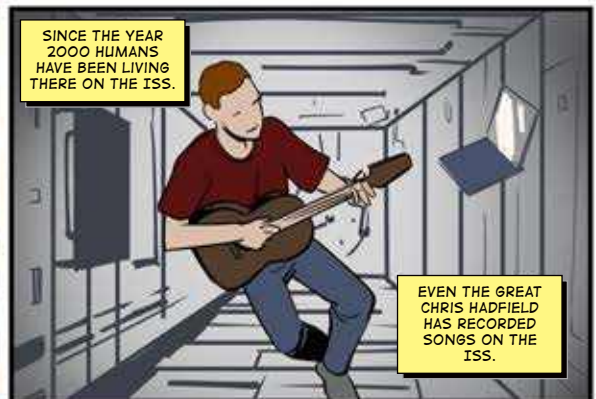


AND THAT GOT EVERYBODY SO EXCITED THAT IT WASN'T LONG UNTIL WE HAD THE FIRST MAN ON THE MOON. THE UNITED STATES' APOLLO 11 WAS THE FIRST CREWED MISSION TO LAND ON THE MOON, ON 20 JULY 1969. NEIL ARMSTRONG WAS THE FIRST HUMAN ON THE MOON, AND SINCE THEN THERE HAS BEEN 11 MORE.

AND SPACE EXPLORATION HAS GROWN SO MUCH THAT...



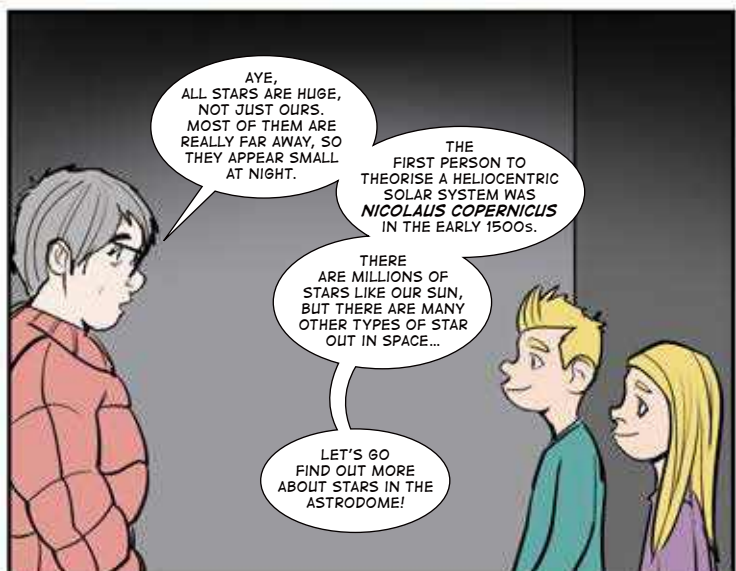
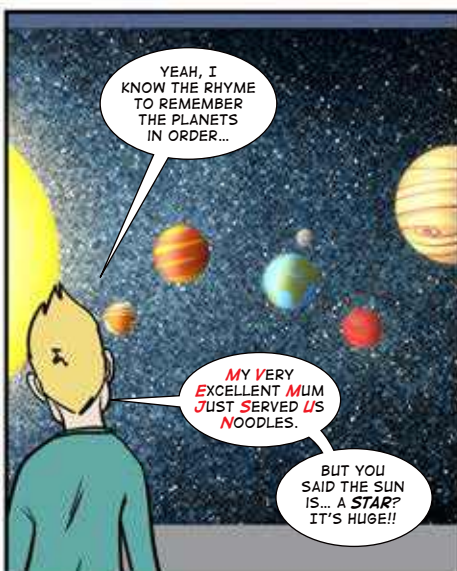
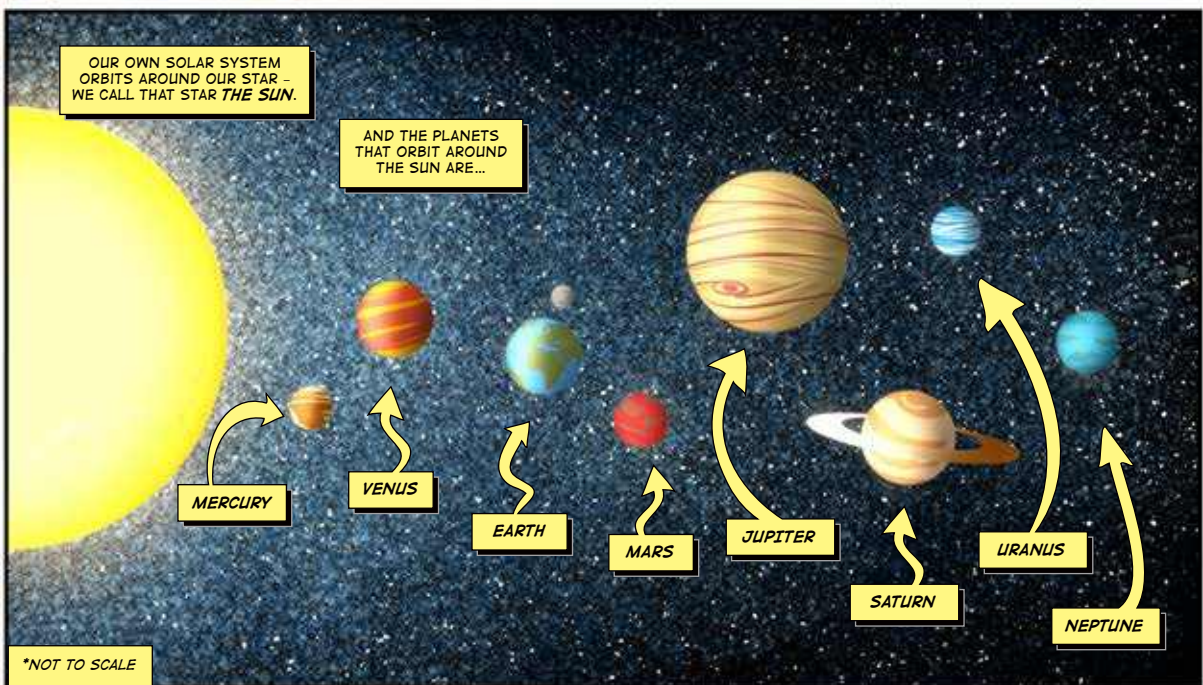
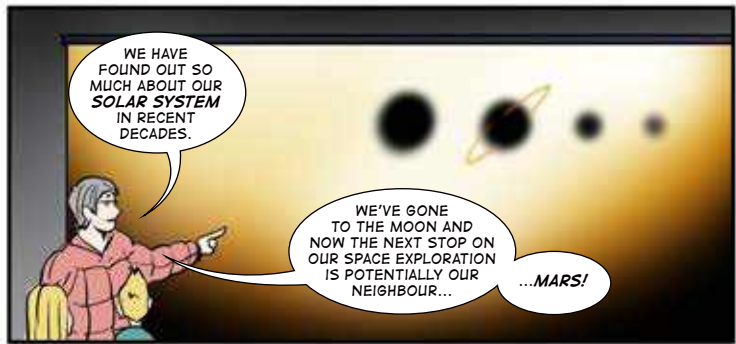
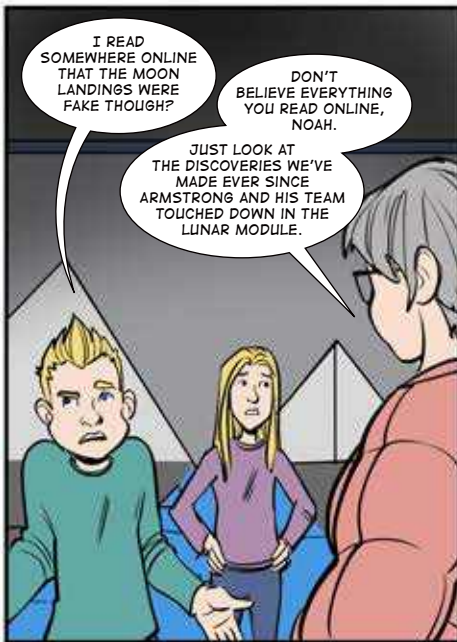
WE NOW HAVE SPACE STATIONS LIKE THE INTERNATIONAL SPACE STATION (ISS) ORBITING THE EARTH AS WE SPEAK...

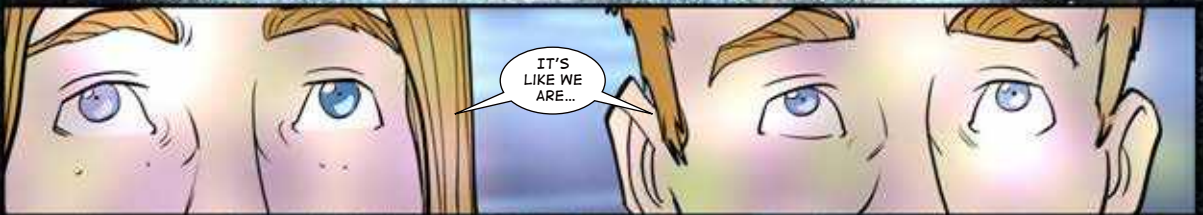
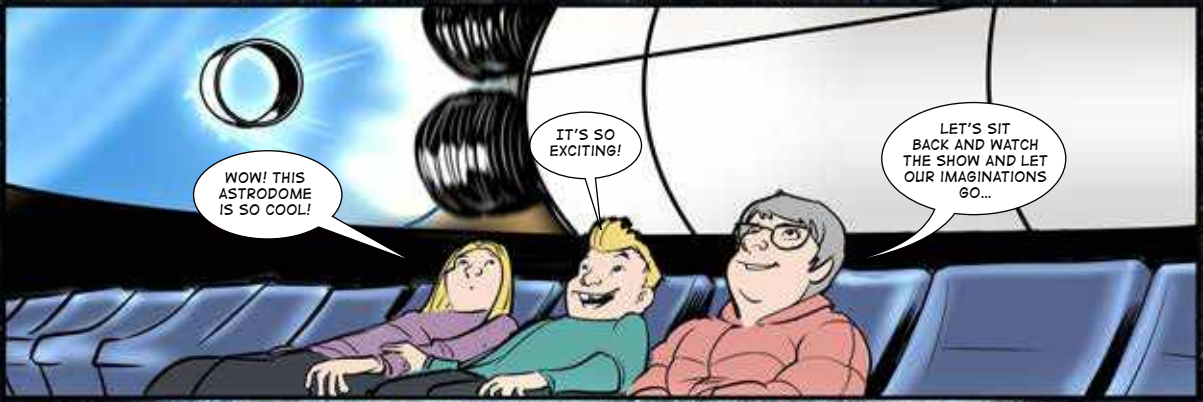


SINCE THE YEAR 2000 HUMANS HAVE BEEN LIVING THERE ON THE ISS.

EVEN THE GREAT CHRIS HADFIELD HAS RECORDED SONGS ON THE ISS.





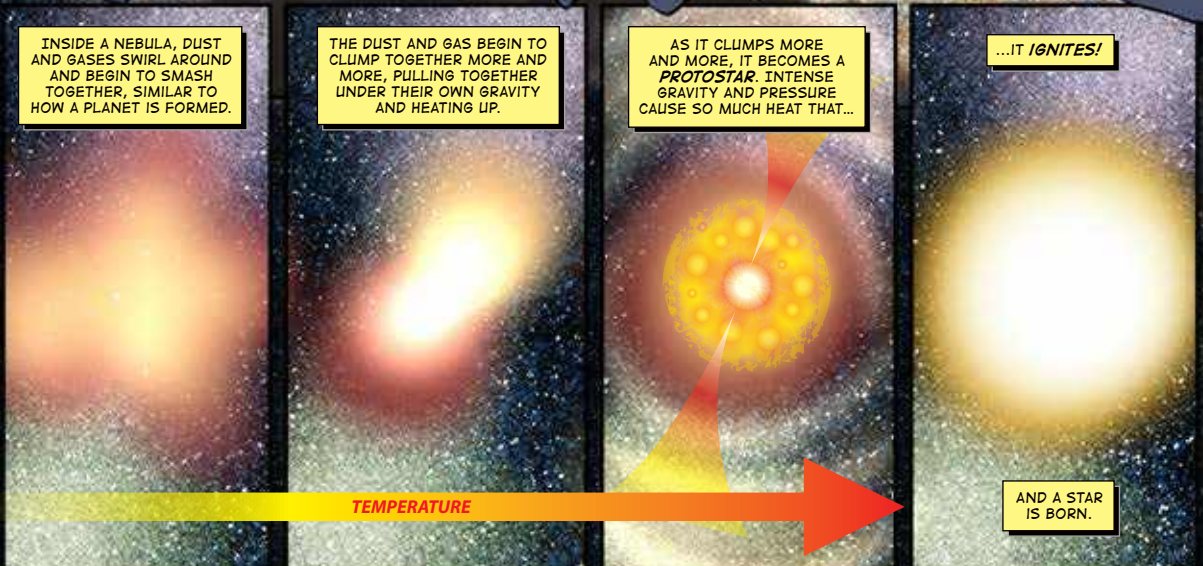


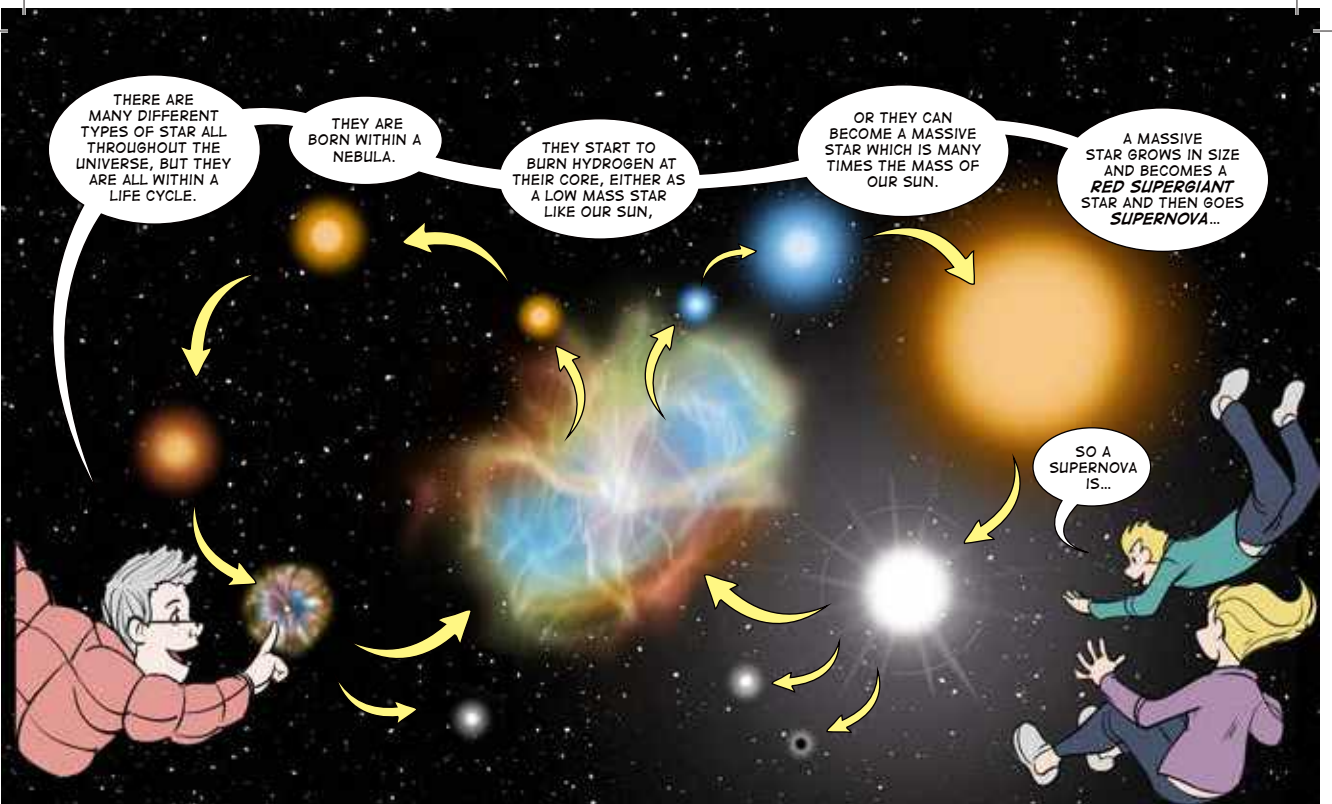
INSIDE A NEBULA, DUST AND GASES SWIRL AROUND AND BEGIN TO SMASH TOGETHER, SIMILAR TO HOW A PLANET IS FORMED.

THE DUST AND GAS BEGIN TO CLUMP TOGETHER MORE AND MORE, PULLING TOGETHER UNDER THEIR OWN GRAVITY AND HEATING UP.

AS IT CLUMPS MORE AND MORE, IT BECOMES A **PROTOSTAR**. INTENSE GRAVITY AND PRESSURE CAUSE SO MUCH HEAT THAT...

...IT **IGNITES!**





THERE ARE MANY DIFFERENT TYPES OF STAR ALL THROUGHOUT THE UNIVERSE, BUT THEY ARE ALL WITHIN A LIFE CYCLE.

THEY ARE BORN WITHIN A NEBULA.

THEY START TO BURN HYDROGEN AT THEIR CORE, EITHER AS A LOW MASS STAR LIKE OUR SUN,

OR THEY CAN BECOME A MASSIVE STAR WHICH IS MANY TIMES THE MASS OF OUR SUN.

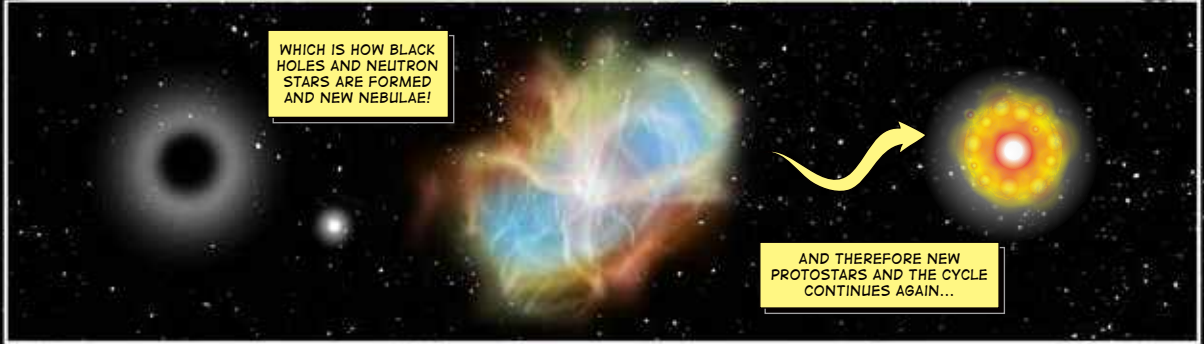
A MASSIVE STAR GROWS IN SIZE AND BECOMES A RED SUPERGIANT STAR AND THEN GOES SUPERNOVA...

SO A SUPERNOVA IS...



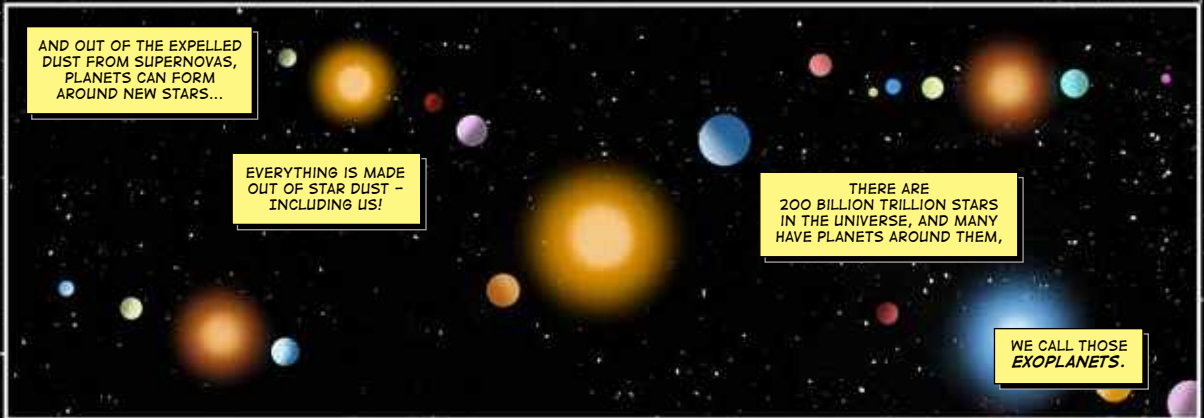
A SUPERMASSIVE EXPLOSION!  
WHEN A RED SUPERGIANT STAR REACHES CRITICAL MASS IT BECOMES UNSTABLE UNDER ITS OWN GRAVITY AND EXPLODES!

WOOWW!



WHICH IS HOW BLACK HOLES AND NEUTRON STARS ARE FORMED AND NEW NEBULAE!

AND THEREFORE NEW PROTOSTARS AND THE CYCLE CONTINUES AGAIN...



AND OUT OF THE EXPELLED DUST FROM SUPERNOVAS, PLANETS CAN FORM AROUND NEW STARS...

EVERYTHING IS MADE OUT OF STAR DUST - INCLUDING US!

THERE ARE 200 BILLION TRILLION STARS IN THE UNIVERSE, AND MANY HAVE PLANETS AROUND THEM,

WE CALL THOSE EXOPLANETS.



WE HAVE PLANETS CIRCLING OUR OWN SUN, BUT EXOPLANETS ARE PLANETS ORBITING A STAR OUTSIDE OF OUR OWN SOLAR SYSTEM.

AND THERE ARE MORE STARS OUT THERE WITH PLANETS ORBITING THEM TOO... BUT THEY ARE VERY FAR AWAY...

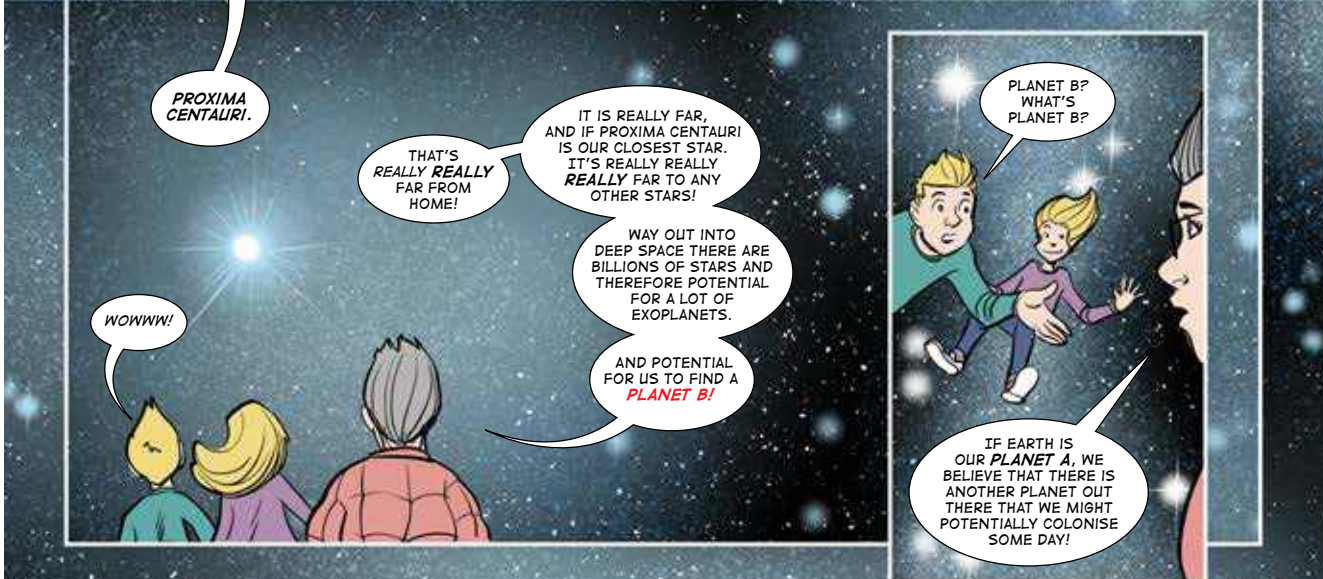


SO IF THERE'S LOADS OF STARS AND PLANETS OUT THERE, ARE THERE ANY ALIENS OUT THERE TOO THEN? AND WOULD THEY BE CLOSE?

IF WE ARE HERE IN THIS UNIVERSE, IT'S POSSIBLE, BUT WE HAVEN'T BEEN ABLE TO SPOT ANY SIGNS OF EXTRATERRESTRIAL LIFE SO FAR. BUT THE UNIVERSE IS SO BIG...



IF WE COULD TRAVEL AT LIGHT SPEED, IT WOULD TAKE US 4.2 YEARS TO GET TO OUR NEAREST STAR...



PROXIMA CENTAURI.

THAT'S REALLY REALLY FAR FROM HOME!

IT IS REALLY FAR, AND IF PROXIMA CENTAURI IS OUR CLOSEST STAR. IT'S REALLY REALLY REALLY FAR TO ANY OTHER STARS!

WAY OUT INTO DEEP SPACE THERE ARE BILLIONS OF STARS AND THEREFORE POTENTIAL FOR A LOT OF EXOPLANETS.

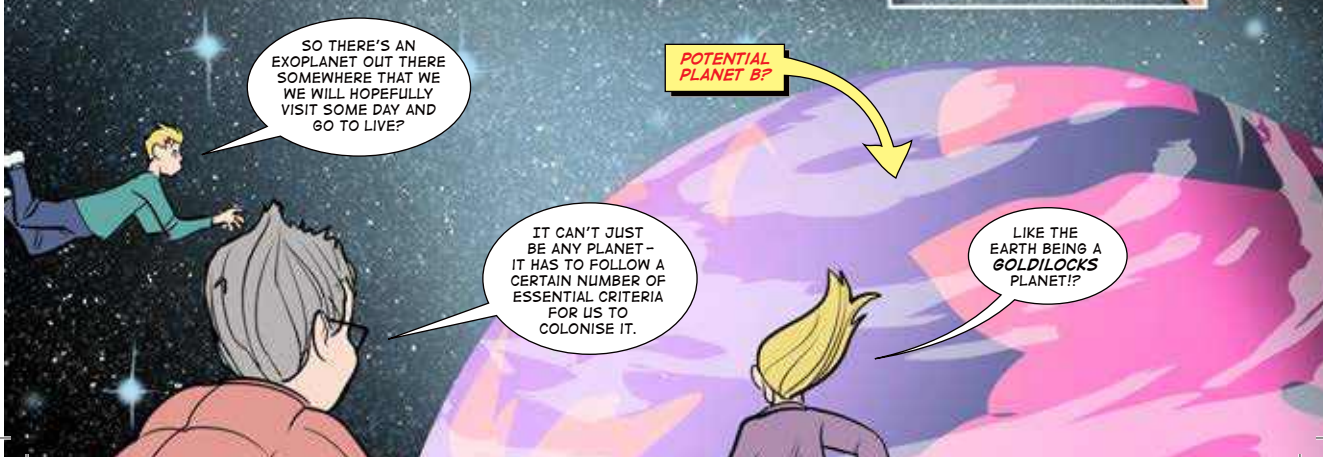
AND POTENTIAL FOR US TO FIND A **PLANET B!**

WOWWWW!



PLANET B? WHAT'S PLANET B?

IF EARTH IS OUR **PLANET A**, WE BELIEVE THAT THERE IS ANOTHER PLANET OUT THERE THAT WE MIGHT POTENTIALLY COLONISE SOME DAY!



POTENTIAL PLANET B?

SO THERE'S AN EXOPLANET OUT THERE SOMEWHERE THAT WE WILL HOPEFULLY VISIT SOME DAY AND GO TO LIVE?

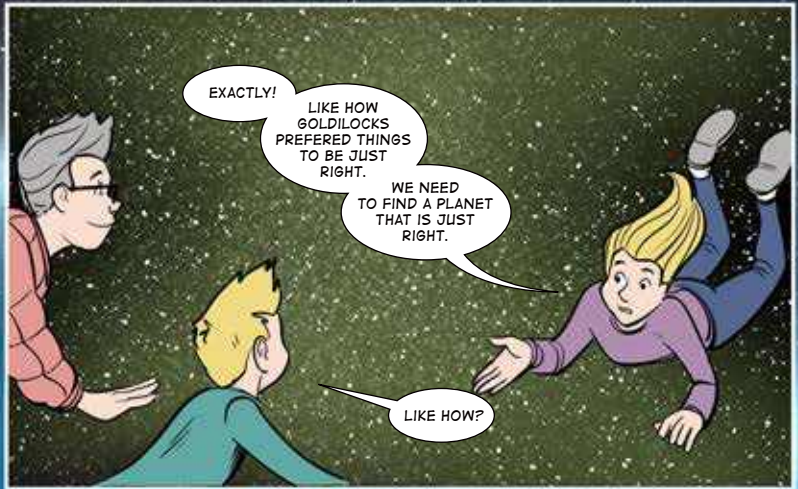
IT CAN'T JUST BE ANY PLANET - IT HAS TO FOLLOW A CERTAIN NUMBER OF ESSENTIAL CRITERIA FOR US TO COLONISE IT.

LIKE THE EARTH BEING A **GOLDBLOCKS** PLANET?!



A GOLDILOCKS PLANET?

LIKE GOLDILOCKS AND THE THREE BEARS?

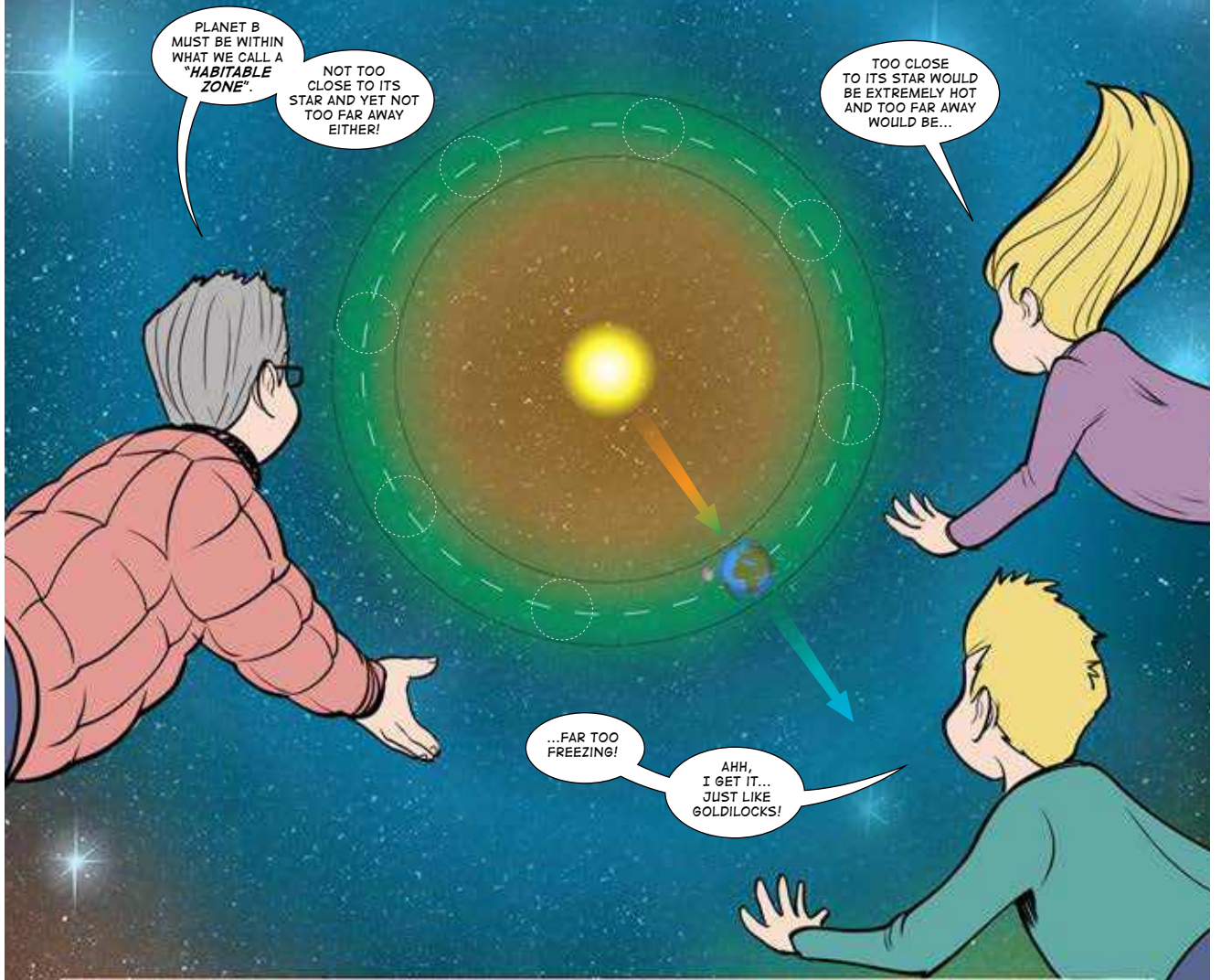


EXACTLY!

LIKE HOW GOLDILOCKS PREFERED THINGS TO BE JUST RIGHT.

WE NEED TO FIND A PLANET THAT IS JUST RIGHT.

LIKE HOW?



PLANET B MUST BE WITHIN WHAT WE CALL A "HABITABLE ZONE".

NOT TOO CLOSE TO ITS STAR AND YET NOT TOO FAR AWAY EITHER!

TOO CLOSE TO ITS STAR WOULD BE EXTREMELY HOT AND TOO FAR AWAY WOULD BE...

...FAR TOO FREEZING!

AHH, I GET IT... JUST LIKE GOLDILOCKS!



IS THAT ALL?

SO TO FIND A PLANET IT MUST BE THE PERFECT DISTANCE FROM ITS STAR?

THAT SHOULD BE EASY ENOUGH! THERE'S LOADS OF PLANETS OUT THERE!

**PLANET B CRITERIA:**  
HABITABLE ZONE

NOT QUITE -  
THERE ARE PLENTY  
MORE FACTORS TO  
CONSIDER.

WE ALSO  
HAVE TO LOOK AT  
THEIR ORBITS  
AROUND THEIR  
PARENT STAR.

ALL PLANETS' ORBITS AREN'T  
EXACTLY PERFECT CIRCLES  
AROUND ITS STAR, BUT IT NEEDS  
TO BE AS CLOSE AS POSSIBLE.

IF THE PLANETS' ORBIT WENT BEYOND  
THE HABITABLE ZONE AT ANY POINT, THE  
PLANET WOULD FREEZE AND BECOME  
UNINHABITABLE, EVEN IF IT STAYED  
WITHIN THE ZONE MOST OF THE TIME.

AND IF THE ORBIT CIRCLED  
TOO CLOSE TO THE SUN,  
IT WOULD JUST BURN IT UP.

THE ORBIT MUST  
CONTINUALLY STAY  
WITHIN THE HABITABLE  
ZONE, OTHERWISE...

THERE WOULD BE EXTREME  
CHANGES IN HEAT. IT WOULD BE  
TOO HOT AT TIMES EVEN IF  
SLIGHTLY OUT OF THE ZONE.

AND THEN TOO COLD. IT  
WOULD BE TOO DIFFICULT TO  
LIVE ON A PLANET LIKE THAT.

- PLANET B CRITERIA:**
- HABITABLE ZONE
  - CIRCULAR ORBIT

ANY  
POTENTIAL PLANET B  
MUST STAY WITHIN THE  
HABITABLE ZONE IN A  
STABLE CIRCULAR ORBIT  
IF WE EVER WANT TO  
LIVE ON IT!

JUST  
LIKE EARTH  
DOES!

EXACTLY!  
WE NEED  
SOMETHING ELSE  
JUST LIKE EARTH'S  
TOO...



**GRAVITY!!**

HUMANS EVOLVED ON PLANET EARTH. OUR BODIES DEVELOPED ACCORDING TO THIS SPECIFIC AMOUNT OF GRAVITY.

WHEN LOOKING FOR PLANET B WE MUST BE LOOKING FOR A SIMILAR SIZED PLANET BECAUSE THE BIGGER THE PLANET, THE MORE GRAVITY.

A LARGER PLANET COMPARED TO EARTH WOULD HAVE A HIGHER GRAVITY AND WOULDN'T BE SUITABLE TO INHABIT.

AND JUST LIKE THE GOLDILOCKS PRINCIPLE FOR DISTANCE TO ITS STAR, IT IS THE SAME FOR GRAVITY...

IF A PLANET COMPARED TO EARTH WAS TOO SMALL IT WOULD HAVE LESS GRAVITY AND THEREFORE, IT WOULD ALSO BE UNINHABITABLE.

IF TOO SMALL, THE PLANET WOULDN'T RETAIN AN ATMOSPHERE, EVERYTHING COULD JUST FLOAT AWAY.

IF WE TRIED TO LIVE ON A BIGGER PLANET B, WE WOULD BE CRUSHED UNDER THE WEIGHT OF GRAVITY.

AND ON A SMALLER PLANET, THERE WOULD BE NO AIR AND WE COULD FALL OFF INTO SPACE.

FALL OFF IT UPWARDS? SPACE IS WEIRD!

SO OUT OF ALL THE PLANETS FOR PLANET B, THE GOLDILOCKS PRINCIPLE IS KEY? NOT TOO FAR FROM ITS STAR, IN A CIRCULAR ORBIT AND NEEDS TO BE A SIMILAR SIZE TO EARTH DUE TO GRAVITY...

NOT AS SIMPLE AS I FIRST THOUGHT! AND I BET THERE'S OTHER FACTORS TOO?

**PLANET B CRITERIA:**

HABITABLE ZONE



CIRCULAR ORBIT



SIMILAR GRAVITY



????????????????



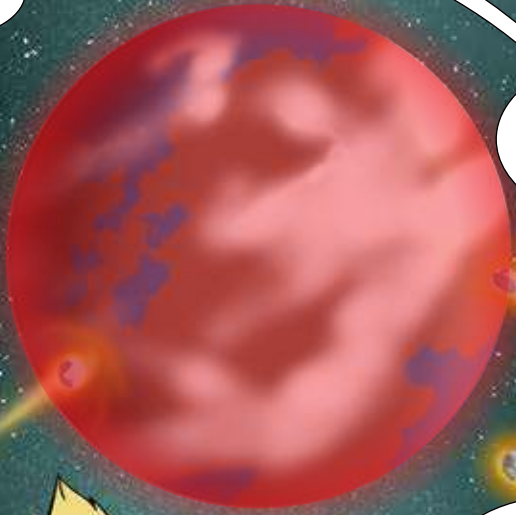
- PLANET B CRITERIA:**
- HABITABLE ZONE
  - CIRCULAR ORBIT
  - SIMILAR GRAVITY
  - WATER

OF COURSE!

WE NEED AN ABUNDANCE OF WATER!

BILLIONS OF YEARS AGO WHEN THE EARTH WAS STILL VERY YOUNG...

THE PLANET WAS HOT AND DRY UNTIL IT WAS BOMBARDED BY LARGE ICY ASTEROIDS AND COMETS. THIS HAPPENED SO MUCH IT BEGAN TURNING INTO OCEANS AND SEAS.

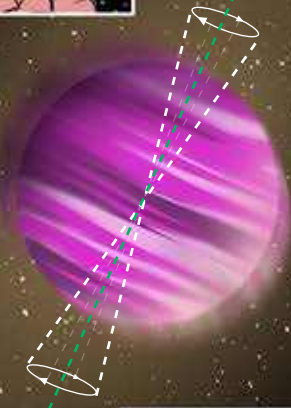


WOWW, COSMIC!

THE WATER WAS WHAT WAS NEEDED TO BE A TRIGGER FOR LIFE TO EVOLVE. SO ANY PLANET B MUST HAVE WATER IF WE ARE TO SURVIVE THERE.

BUT NOT JUST WATER, PLANET B MUST ALSO HAVE A **STABLE AXIS**.

WITHOUT EARTH'S MORE OR LESS STABLE AXIS, LIFE MIGHT HAVE BECOME EXTINCT LONG AGO, OR IT MAY NEVER HAVE EVEN STARTED!



ON MARS, HUGE CHANGES IN THE AXIAL TILT ANGLE MAY HAVE CONTRIBUTED TO THE LOSS OF MOST OF THE RED PLANET'S ATMOSPHERE AND WATER.



SO NO WATER ON PLANET B WOULD BE DISASTROUS FOR HUMANS.

IT WOULD BE TOO DIFFICULT TO BRING A LARGE AMOUNT IF WE EVER FOUND ONE AND AND IF WE EVER GOT THERE.



AND THE GOLDILOCKS PRINCIPLE HOLDS TRUE HERE TOO!

TOO MUCH WATER WOULD MAKE IT DIFFICULT TO LIVE ON, ESPECIALLY WITH AN UNSTABLE AXIS WHICH WOULD CREATE DEVASTATING TIDAL PATTERNS.





AND THE EARTH'S CORE IS MADE OF MOLTEN IRON, WHICH IS MAGNETIC.

AND AS THE EARTH SPINS IT CREATES A **MAGNETIC FIELD** AROUND THE EARTH.

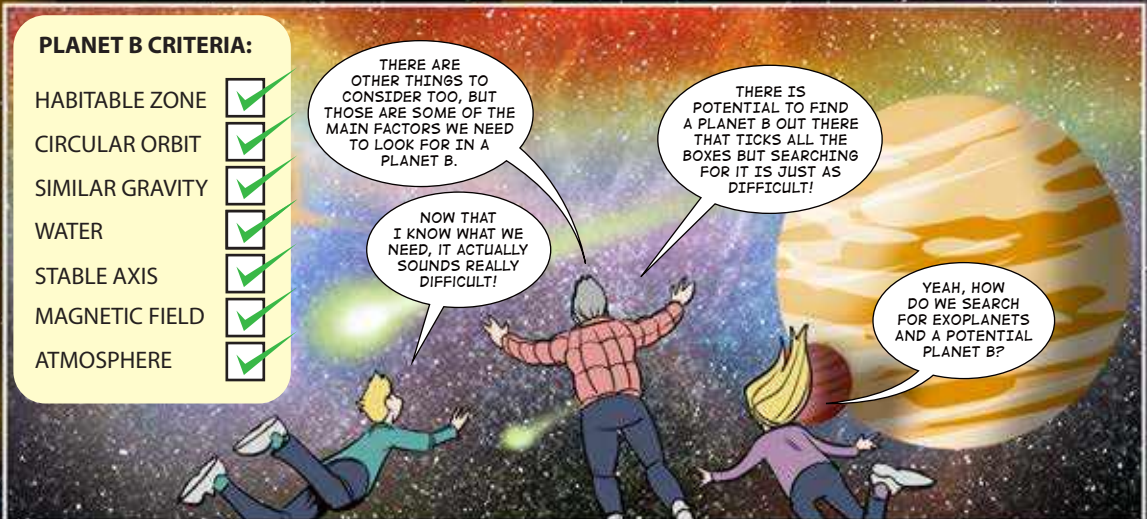
STARS EMIT SOLAR RADIATION WHICH IS DANGEROUS TO HUMANS, SUCH AS VISIBLE LIGHT, ULTRAVIOLET LIGHT, INFRARED, RADIO WAVES, X-RAYS, AND GAMMA RAYS.

OUR EARTH'S MAGNETIC FIELD SHIELDS US FROM THE RAYS THAT WOULD BE DANGEROUS!

PLANET B MUST ALSO HAVE A MAGNETIC FIELD TOO!

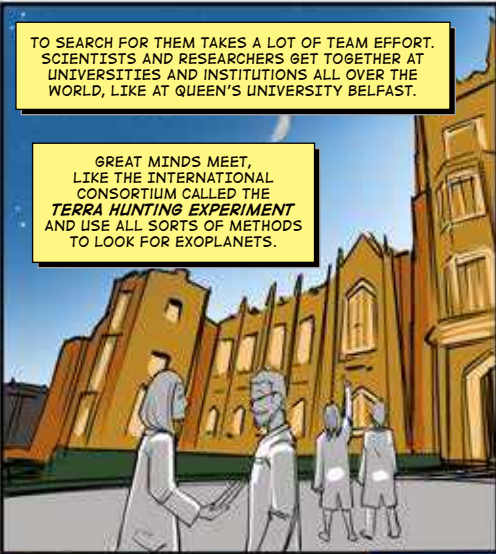
### PLANET B CRITERIA:

- HABITABLE ZONE
- CIRCULAR ORBIT
- SIMILAR GRAVITY
- WATER
- STABLE AXIS
- MAGNETIC FIELD



TO SEARCH FOR THEM TAKES A LOT OF TEAM EFFORT. SCIENTISTS AND RESEARCHERS GET TOGETHER AT UNIVERSITIES AND INSTITUTIONS ALL OVER THE WORLD, LIKE AT QUEEN'S UNIVERSITY BELFAST.

GREAT MINDS MEET, LIKE THE INTERNATIONAL CONSORTIUM CALLED THE **TERRA HUNTING EXPERIMENT** AND USE ALL SORTS OF METHODS TO LOOK FOR EXOPLANETS.

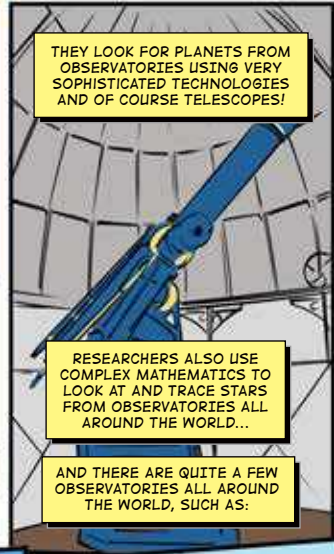


AND AT PLACES SUCH AS THE ARMAGH PLANETARIUM, SCIENTISTS AND RESEARCHERS USE **ASTROMETRY** WHICH MEANS TRACKING THE MOTION OF A STAR USING PRECISE MEASUREMENTS.



THEY LOOK FOR PLANETS THAT ECLIPSE OR 'TRANSIT' THE STAR, WHICH AT TIMES BLOCK OUT A SMALL BIT OF STARLIGHT. THEN BY DETERMINING THE SIZE OF THE PLANET AND ITS MASS, THEY CAN PREDICT WHETHER IT MIGHT BE A POTENTIAL PLANET B.

THEY LOOK FOR PLANETS FROM OBSERVATORIES USING VERY SOPHISTICATED TECHNOLOGIES AND OF COURSE TELESCOPES!



RESEARCHERS ALSO USE COMPLEX MATHEMATICS TO LOOK AT AND TRACE STARS FROM OBSERVATORIES ALL AROUND THE WORLD...

AND THERE ARE QUITE A FEW OBSERVATORIES ALL AROUND THE WORLD, SUCH AS:

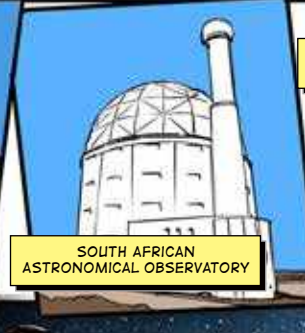
ROYAL OBSERVATORY GREENWICH, LONDON



PALOMAR OBSERVATORY CALIFORNIA, USA



SOUTH AFRICAN ASTRONOMICAL OBSERVATORY



LA SILLA OBSERVATORY, CHILE TO NAME BUT A FEW.



WE HAVE ALSO LAUNCHED SPACE TELESCOPES. TELESCOPES THAT STAY IN SPACE WHERE THEY GET BETTER IMAGES.



THE **HUBBLE SPACE TELESCOPE** WAS LAUNCHED INTO LOW EARTH ORBIT IN 1990 AND REMAINS IN OPERATION. IT WAS NOT THE FIRST SPACE TELESCOPE, BUT IT IS ONE OF THE LARGEST AND MOST VERSATILE.

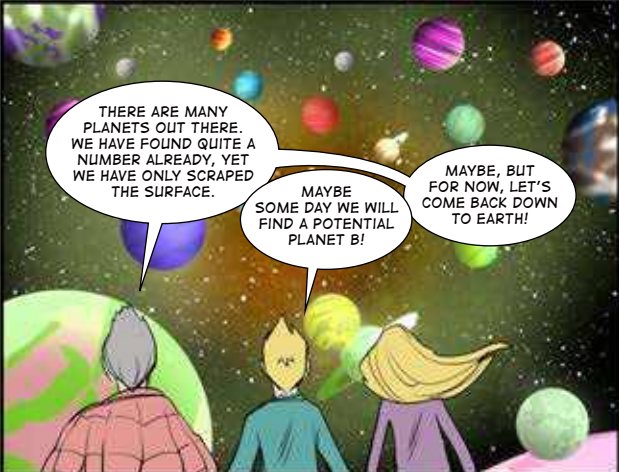
THE **KEPLER SPACE TELESCOPE** WAS LAUNCHED BY NASA IN 2009 TO DISCOVER EARTH-SIZED PLANETS ORBITING OTHER STARS. IT IS NAMED AFTER ASTRONOMER JOHANNES KEPLER AND TO DATE KEPLER HAS OBSERVED 530,506 STARS AND DETECTED 2,778 CONFIRMED PLANETS.



THERE ARE MANY PLANETS OUT THERE. WE HAVE FOUND QUITE A NUMBER ALREADY, YET WE HAVE ONLY SCRAPPED THE SURFACE.

MAYBE SOME DAY WE WILL FIND A POTENTIAL PLANET B!

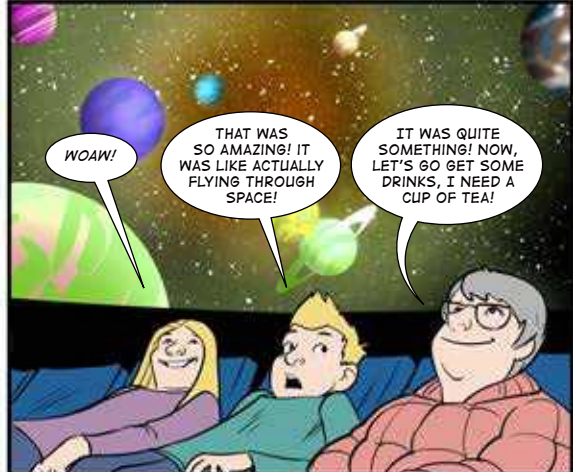
MAYBE, BUT FOR NOW, LET'S COME BACK DOWN TO EARTH!

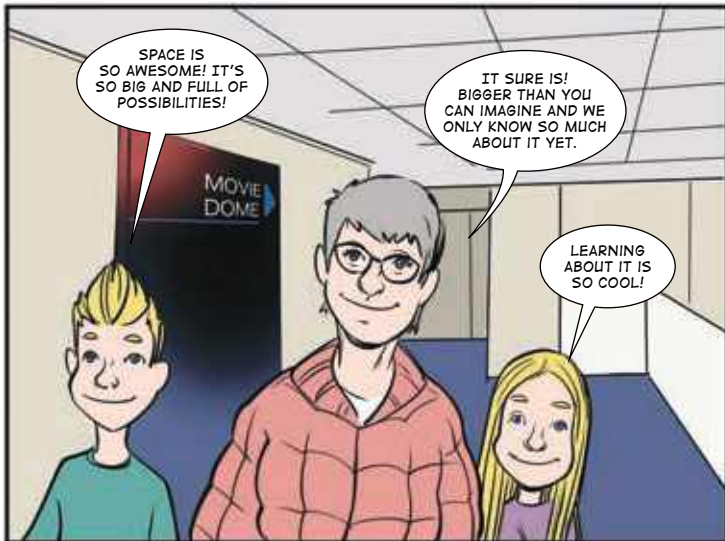


WOAH!

THAT WAS SO AMAZING! IT WAS LIKE ACTUALLY FLYING THROUGH SPACE!

IT WAS QUITE SOMETHING! NOW, LET'S GO GET SOME DRINKS, I NEED A CLIP OF TEA!





SPACE IS SO AWESOME! IT'S SO BIG AND FULL OF POSSIBILITIES!

IT SURE IS! BIGGER THAN YOU CAN IMAGINE AND WE ONLY KNOW SO MUCH ABOUT IT YET.

LEARNING ABOUT IT IS SO COOL!



...THEY ARE RAPIDLY ROTATING HIGHLY MAGNETISED NEUTRON STARS!

MY GOODNESS! IS THAT WHO I THINK IT IS?



JOCELYN?

IT IS YOU, JOCELYN... I MEAN... DAME JOCELYN BELL BURNELL?

IT'S ME, KATHLEEN!

IT'S BEEN A LONG TIME SINCE I LAST SAW YOU.



AH HELLO, KATHLEEN - IT HAS BEEN A VERY LONG TIME HASN'T IT?

HOW'VE YOU BEEN KEEPING?

VERY WELL. THANK YOU. I JUST WANTED TO SAY THANK YOU FOR EVERYTHING YOU'VE DONE FOR SCIENCE...

AND PARTICULARLY WOMEN IN SCIENCE.

AH, THANK YOU, KATHLEEN! THAT MEANS A LOT COMING FROM YOU. IT'S BEEN A JOURNEY BUT WE'RE NOT DONE YET!

I SEE YOU'RE ALSO INSPIRING THE NEXT GENERATION OF SCIENTISTS AND ASTRONOMERS?



AS ALWAYS! AS YOU SAY, WE'RE NOT DONE YET!

BUT WE MUST BE OFF, I'VE PROMISED THESE TWO SOME TREATS IN THE CAFE.

LOVELY TO SEE YOU AGAIN, TAKE CARE, JOCELYN.

AND YOU, KATHLEEN!



WOAW... DAME JOCELYN BELL BURNELL.

WHO IS DAME JOCELYN BELL BURNELL?

SHE'S ONE OF THE FINEST ASTROPHYSICISTS EVER.

SHE WAS THE PERSON WHO FIRST DISCOVERED PULSARS!

PULSARS ARE RAPIDLY ROTATING HIGHLY MAGNETISED NEUTRON STARS.

SHE DISCOVERED THEM WHEN SHE WAS A POSTGRADUATE STUDENT IN 1967.

SHE CHECKED OUT THEIR LOCATION AMONGST THE CONSTELLATIONS USING THIS PLANETARIUM!

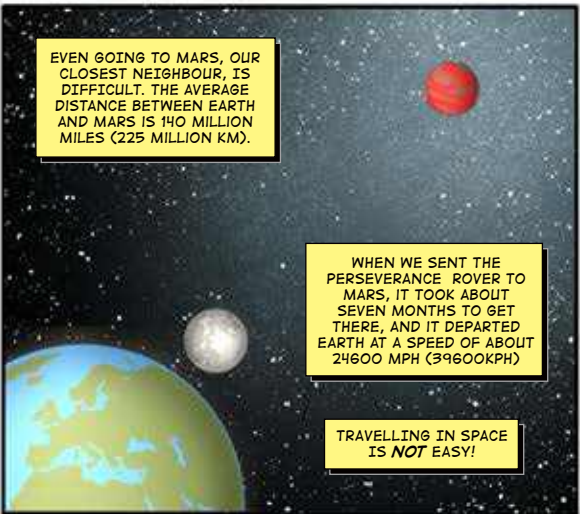
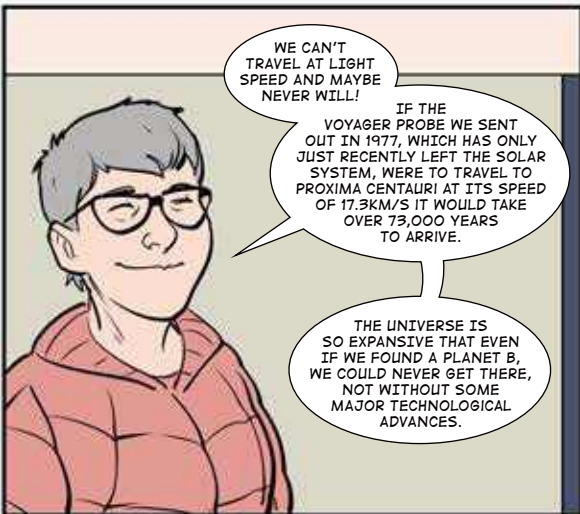
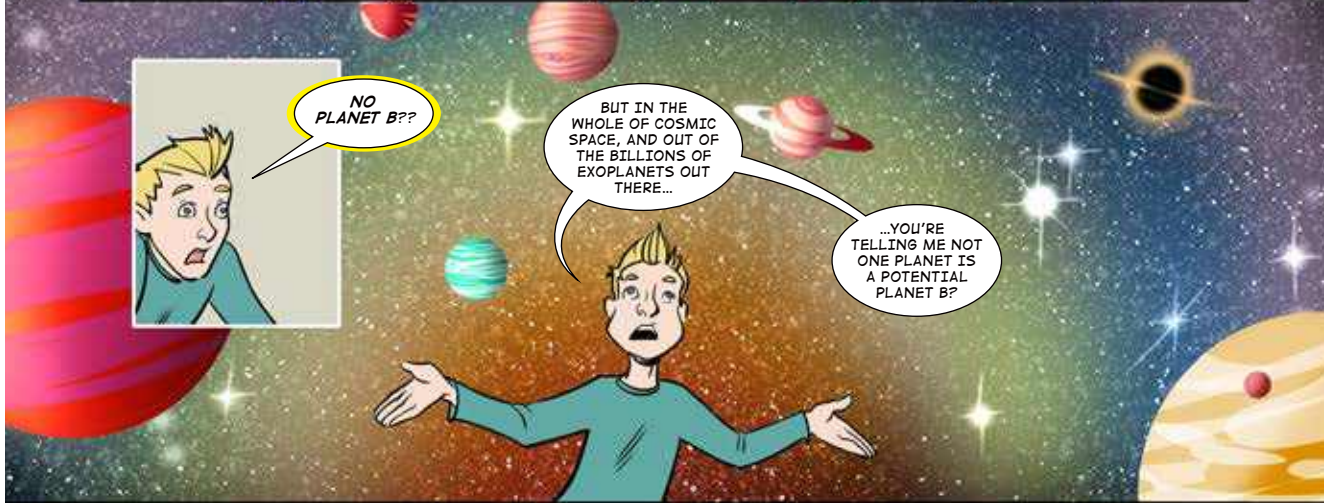
SHE WAS PRESIDENT OF THE ROYAL ASTRONOMICAL SOCIETY AND PRESIDENT OF THE INSTITUTE OF PHYSICS AND HAS WON MANY PRESTIGIOUS AWARDS.

HER FATHER WAS THE ARCHITECT OF THE ARMAGH PLANETARIUM. SHE SAW IT BEING BUILT AND VISITED IT MANY TIMES AS A YOUNG GIRL.

SHE'S AN INSPIRATION TO MANY PEOPLE, ESPECIALLY YOUNG WOMEN.

AND BETTER YET, SHE'S FROM NORTHERN IRELAND!

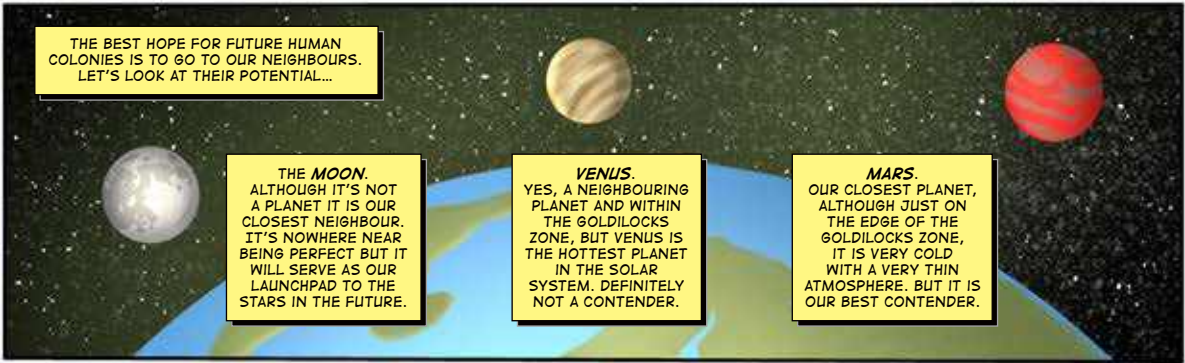






WE WILL KEEP LOOKING UP TOWARDS THE STARS AS WE HAVE ALWAYS DONE, STILL SEARCHING FOR A POTENTIAL PLANET B OF COURSE.

BUT THE CHANCES OF FINDING A PLANET EXACTLY LIKE EARTH THAT WE COULD EVER LIVE ON SEEMS VERY SLIM FOR THE NEAR FUTURE.



THE BEST HOPE FOR FUTURE HUMAN COLONIES IS TO GO TO OUR NEIGHBOURS. LET'S LOOK AT THEIR POTENTIAL...

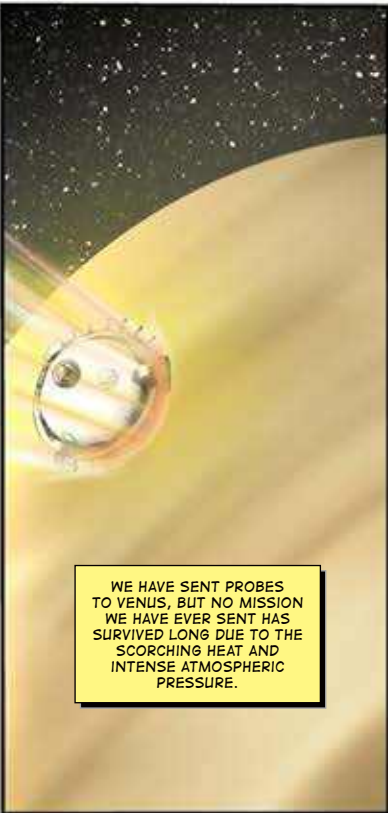
**THE MOON.**  
ALTHOUGH IT'S NOT A PLANET IT IS OUR CLOSEST NEIGHBOUR. IT'S NOWHERE NEAR BEING PERFECT BUT IT WILL SERVE AS OUR LAUNCHPAD TO THE STARS IN THE FUTURE.

**VENUS.**  
YES, A NEIGHBOURING PLANET AND WITHIN THE GOLDILOCKS ZONE, BUT VENUS IS THE HOTTEST PLANET IN THE SOLAR SYSTEM. DEFINITELY NOT A CONTENDER.

**MARS.**  
OUR CLOSEST PLANET, ALTHOUGH JUST ON THE EDGE OF THE GOLDILOCKS ZONE, IT IS VERY COLD WITH A VERY THIN ATMOSPHERE. BUT IT IS OUR BEST CONTENDER.



WE'VE BEEN TO THE MOON BEFORE. IT HAS LOW GRAVITY, NO WATER OR ATMOSPHERE, BUT IT IS THE CLOSEST BODY TO THE EARTH.



WE HAVE SENT PROBES TO VENUS, BUT NO MISSION WE HAVE EVER SENT HAS SURVIVED LONG DUE TO THE SCORCHING HEAT AND INTENSE ATMOSPHERIC PRESSURE.



WE HAVE A ROVER, PERSEVERANCE, ON MARS RIGHT NOW. IT'S ONE OF OUR CLOSEST PLANETS. IT HAS LOW ATMOSPHERE, AND ONCE HAD LIQUID WATER. IT'S OUR BEST CHANCE OF A COLONY.



THERE IS NO PLANET B IN THE NEAR FUTURE... BUT WE DO HAVE SOMETHING ELSE...

WE HAVE PLANET A...

THE EARTH!



OUR HOME!

WHY LOOK FOR PLANET B WHEN WE ALREADY HAVE A PLANET A?

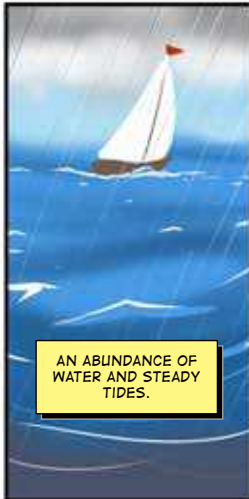


IT HAS EVERYTHING WE NEED IN A PLANET RIGHT HERE...

IT'S IN THE GOLDILOCKS ZONE, AND HAS A CIRCULAR ORBIT AND A STABLE AXIS.



AN ABUNDANCE OF WATER AND STEADY TIDES.



AN ATMOSPHERE WITH PLENTY OF OXYGEN.



AND A MAGNETIC FIELD TO SHIELD US FROM THE SUN.



AND IT'S GOT CITIES, TOWNS, RIVERS, FARMS AND COMMUNITIES ALREADY AND MOST IMPORTANTLY...



...**HUMANS!** IT HAS OUR FAMILY AND FRIENDS AND EVERYONE WE LOVE RIGHT HERE.

WE HAVE FOUND A NUMBER OF POTENTIAL PLANETS THAT COULD BE A PLANET B IN THE FUTURE BUT THEY ARE VERY FAR AWAY.



THE CLOSEST ONE IN OUR NEIGHBOURING SOLAR SYSTEM IS *PROXIMA CENTAURI B*, BUT WE STILL NEED TO KNOW IF IT COULD SUPPORT LIFE AS IT RECEIVES ABOUT 10-60 TIMES AS MUCH RADIATION AS THE EARTH DOES.

ANOTHER IS *TRAPPIST-1E*, IT SEEMS TO TICK A FEW OF THE BOXES NEEDED BUT IT IS STILL 40.7 LIGHT-YEARS AWAY FROM EARTH



DUE TO THE MAKE UP OF ITS RED DWARF HOST STAR, IT IS LIKELY THAT TRAPPIST-1 WILL BE ONE OF THE LAST REMAINING STARS IN THE UNIVERSE.

OTHER POTENTIAL EXOPLANETS WE'VE NOTED ARE:

GLIESE 667CC



KEPLER-22B



KEPLER-69C



KEPLER-1649C



ALL OF WHICH, NO MATTER HOW GOOD THEY MAY SEEM, ARE EXTREMELY FAR AWAY.

ONE CONCEPT TO REACH ANY NEW EXOPLANET IS A *GENERATION SHIP*.



A SHIP WHICH IS A SUPERCITY IN SPACE WHICH COULD TAKE HUNDREDS TO THOUSANDS OF YEARS TO REACH NEARBY STARS, LEAVING THEIR DESCENDANTS OF THE FUTURE TO BE THE ONES TO ARRIVE.

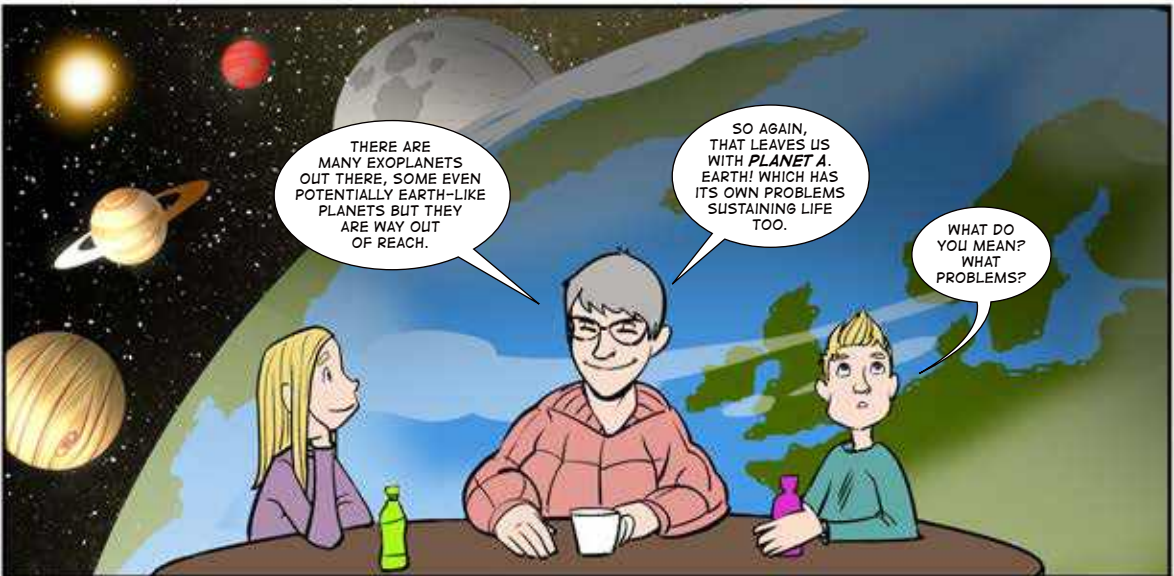


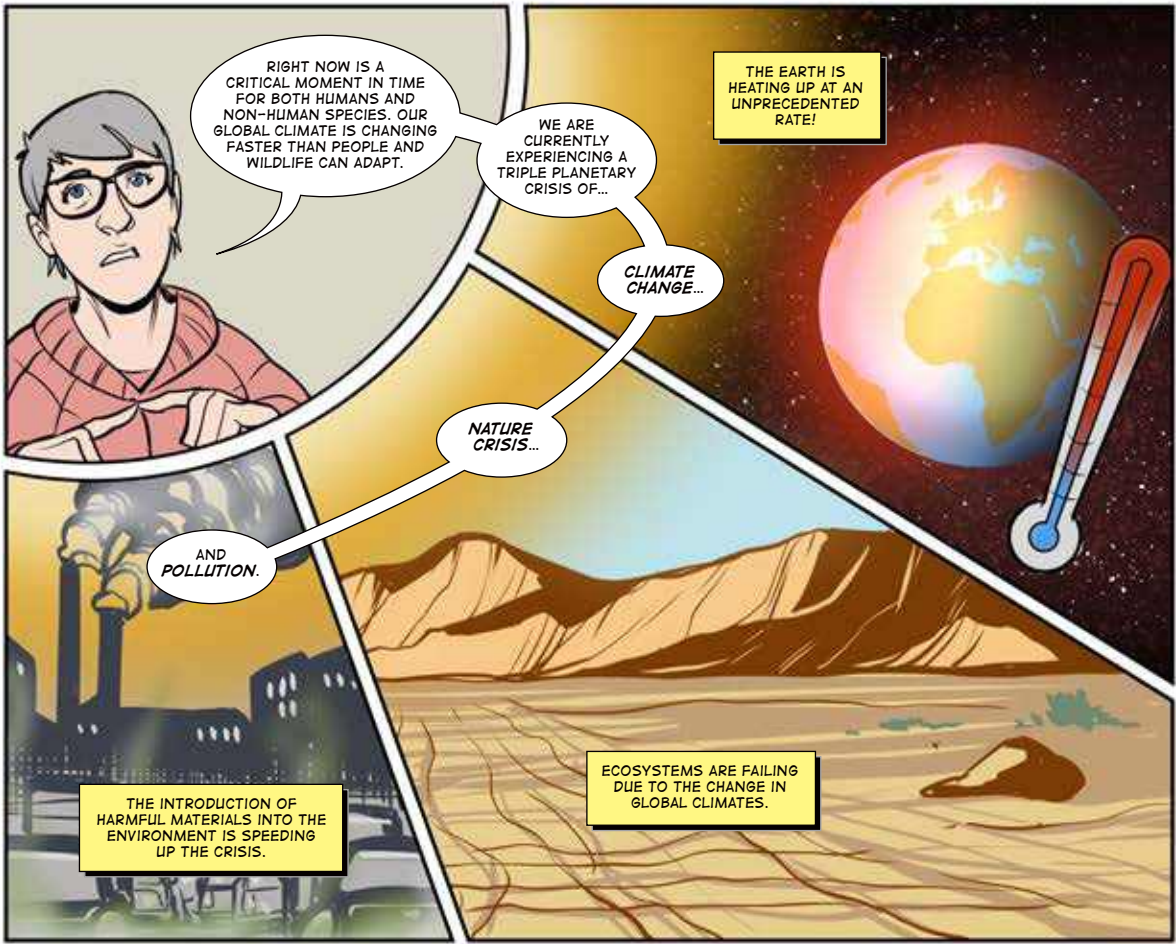
THIS IS HYPOTHETICAL, ALONG WITH ANY OTHER MEANS OF INTERSTELLAR TRAVEL. WE JUST DO NOT POSSESS THE TECHNOLOGY NEEDED.

THERE ARE MANY EXOPLANETS OUT THERE, SOME EVEN POTENTIALLY EARTH-LIKE PLANETS BUT THEY ARE WAY OUT OF REACH.

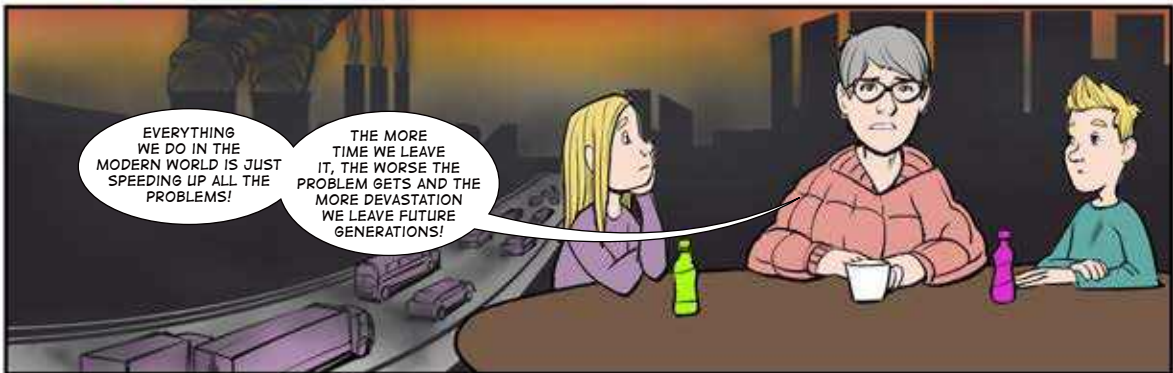
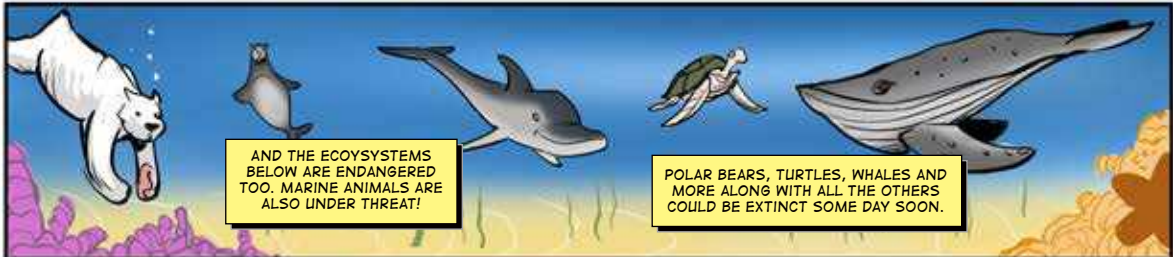
SO AGAIN, THAT LEAVES US WITH *PLANET A*. EARTH! WHICH HAS ITS OWN PROBLEMS SUSTAINING LIFE TOO.

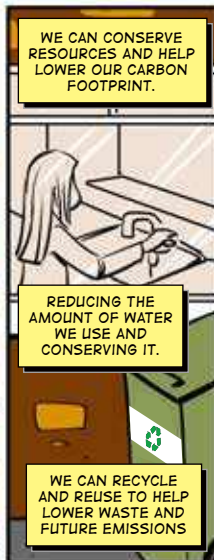
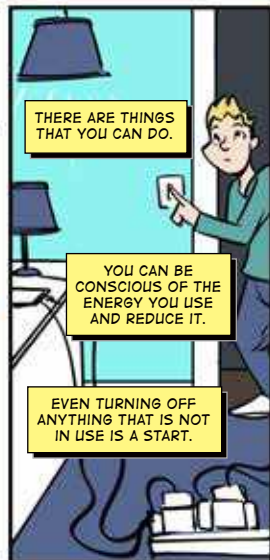
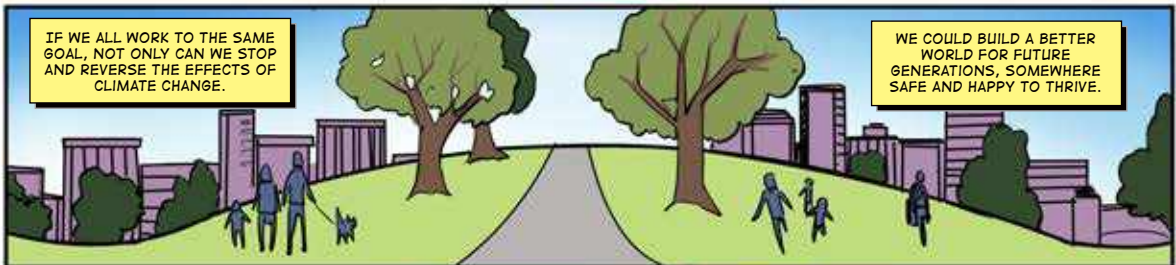
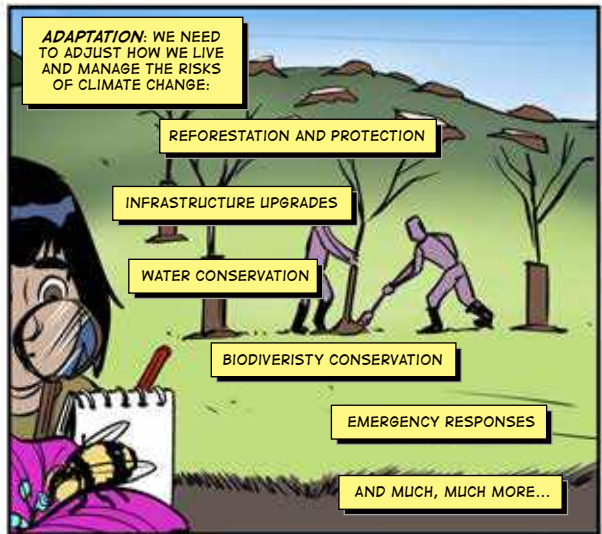
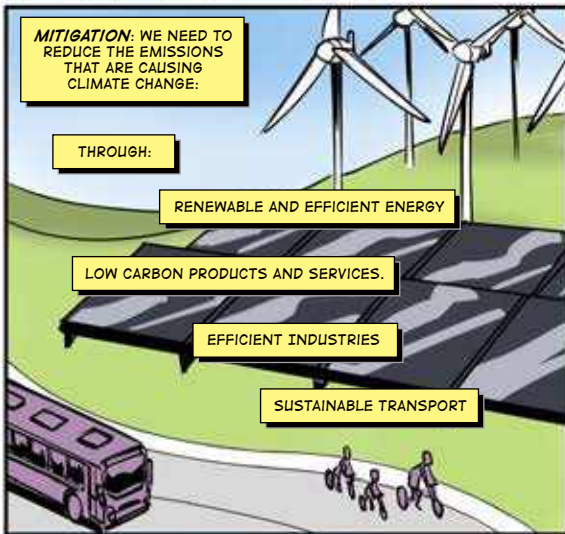
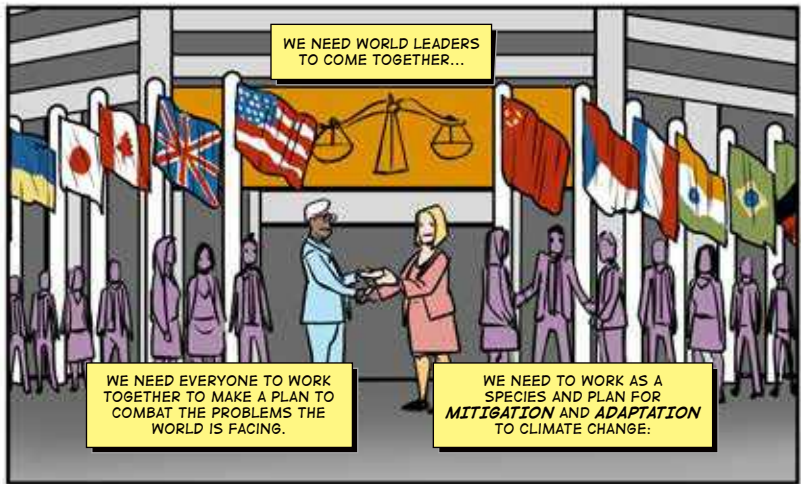
WHAT DO YOU MEAN? WHAT PROBLEMS?











AND IT'S NOT JUST THESE WAYS AND EVERYTHING GETS FIXED, WE HAVE TO KEEP LOOKING DEEPER TO MAKE THE WORLD BETTER AND NOT JUST STOP CLIMATE CHANGE

WE HAVE TO GET BETTER AT INTERACTING WITH OUR ENVIRONMENT AND HOW WE LIVE IN IT FOR THE GOOD OF US ALL NOW AND IN THE FUTURE AND KEEP IMPROVING!

**AWARENESS**

**ASSESSMENT**

**PLANNING**

**IMPLEMENTATION**

**MONITORING & EVALUATION**

**AIR POLLUTION:** WE SHOULD LOOK AT HOW OUR INDUSTRIES BEHAVE.

**NOISE POLLUTION:** LOOKING AT HOW TO REDUCE EXCESSIVE NOISE.

VROOM  
VROOM  
BEEP  
BEEP

**LIGHT POLLUTION:** REDUCING THE AMOUNT OF LIGHT THAT FLOODS OUR WORLD.

**SOIL POLLUTION:** BEING AWARE OF WHAT AFFECTS OUR FOOD SUPPLY.

HAVING ACCESS TO **GREEN SPACES**.

**CONNSWATER COMMUNITY GREENWAY** FOR EXAMPLE.

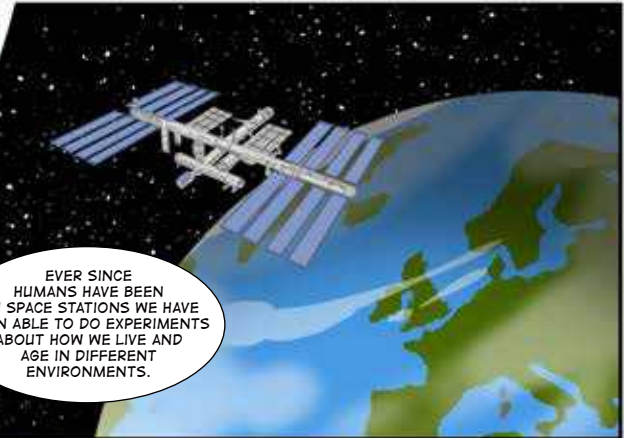
HAVING ACCESS TO **BLUE SPACES**.

IT'S NOT JUST ABOUT THE HEALTH OF OUR PLANET. WE HAVE TO BECOME AWARE OF THE WORLD AROUND US AND HOW WE INTERACT WITH THE WORLD...

EVER SINCE WE STARTED LOOKING AT LIVING IN SPACE WE REALISED A LOT ABOUT HOW WE LIVE HERE ON EARTH!



AS HUMANS, WE'VE ALWAYS BEEN LEARNING ABOUT OURSELVES WHICH HAS BEEN A BIG JUMP, BUT TRYING TO LIVE IN SPACE HAS BEEN A GIANT LEAP.

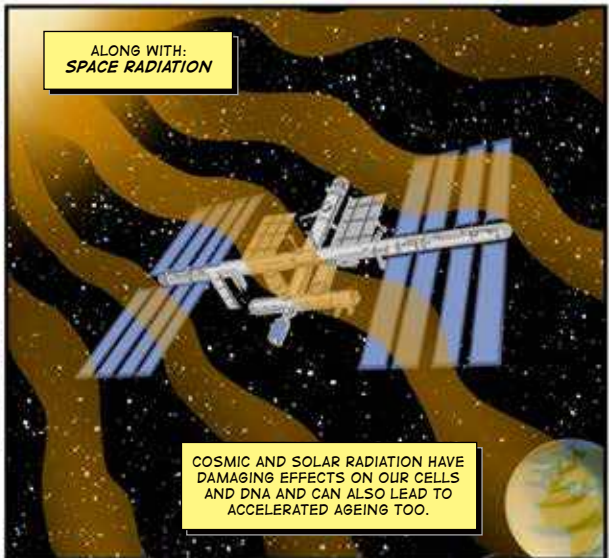


EVER SINCE HUMANS HAVE BEEN ON SPACE STATIONS WE HAVE BEEN ABLE TO DO EXPERIMENTS ABOUT HOW WE LIVE AND AGE IN DIFFERENT ENVIRONMENTS.



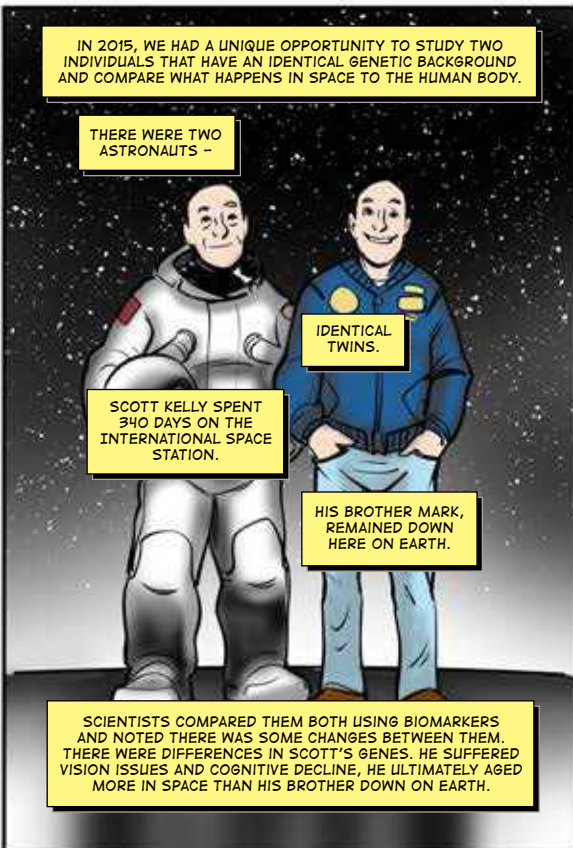
FOR EXAMPLE: **MICROGRAVITY**

THE HUMAN BODY DIDN'T EVOLVE TO LIVE IN MICROGRAVITY. ANY POTENTIAL HABITATION IN MICROGRAVITY WOULD HAVE SERIOUS EFFECTS SUCH AS ACCELERATED AGEING...



ALONG WITH: **SPACE RADIATION**

COSMIC AND SOLAR RADIATION HAVE DAMAGING EFFECTS ON OUR CELLS AND DNA AND CAN ALSO LEAD TO ACCELERATED AGEING TOO.



IN 2015, WE HAD A UNIQUE OPPORTUNITY TO STUDY TWO INDIVIDUALS THAT HAVE AN IDENTICAL GENETIC BACKGROUND AND COMPARE WHAT HAPPENS IN SPACE TO THE HUMAN BODY.

THERE WERE TWO ASTRONAUTS -

IDENTICAL TWINS.

SCOTT KELLY SPENT 340 DAYS ON THE INTERNATIONAL SPACE STATION.

HIS BROTHER MARK, REMAINED DOWN HERE ON EARTH.

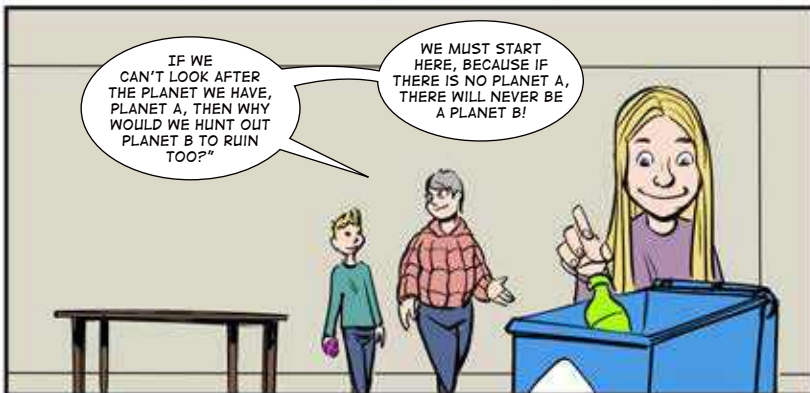
SCIENTISTS COMPARED THEM BOTH USING BIOMARKERS AND NOTED THERE WAS SOME CHANGES BETWEEN THEM. THERE WERE DIFFERENCES IN SCOTT'S GENES. HE SUFFERED VISION ISSUES AND COGNITIVE DECLINE, HE ULTIMATELY AGED MORE IN SPACE THAN HIS BROTHER DOWN ON EARTH.



IN THE SPACE RESEARCH PROJECT, WE'RE EXPLORING HOW THE ENVIRONMENT WHERE WE LIVE CAN IMPACT OUR BRAIN OR COGNITIVE HEALTH.

ALL THIS RESEARCH HAS GIVEN US INSIGHT AND HELPED US BE AWARE OF HOW THE ENVIRONMENT IMPACTS US AND HOW WE LIVE AND AGE HERE ON EARTH.

AND HOW WE CAN BUILD A WORLD WHERE WE CAN LIVE AND AGE BETTER AS WE ADAPT OUR ENVIRONMENTS TO SUIT.



IF, IN THE FUTURE, WE EVER FIND A SUITABLE PLANET B, AND HAVE THE TECHNOLOGY TO GET THERE...

WE HAVE TO TAKE WHAT WE'VE LEARNED ABOUT BUILDING A HEALTHY SUSTAINABLE LIFE HERE, IF WE ARE EVER TO...

...BUILD A NEW WORLD ON **PLANET B** WHERE WE CAN **THRIVE!**

VERY TRUE, GRANNY!

BUT GRANNY, HOW DO YOU KNOW ALL THIS STUFF ABOUT SPACE?

GRANNY WAS A LECTURER IN ASTROPHYSICS IN QUEEN'S UNIVERSITY BELFAST!

AYE, I'VE BEEN INSPIRING YOUNG MINDS FOR A LONG TIME NOW...

...AND TEACHING GENERATIONS OF SCIENTISTS AND RESEARCHERS.

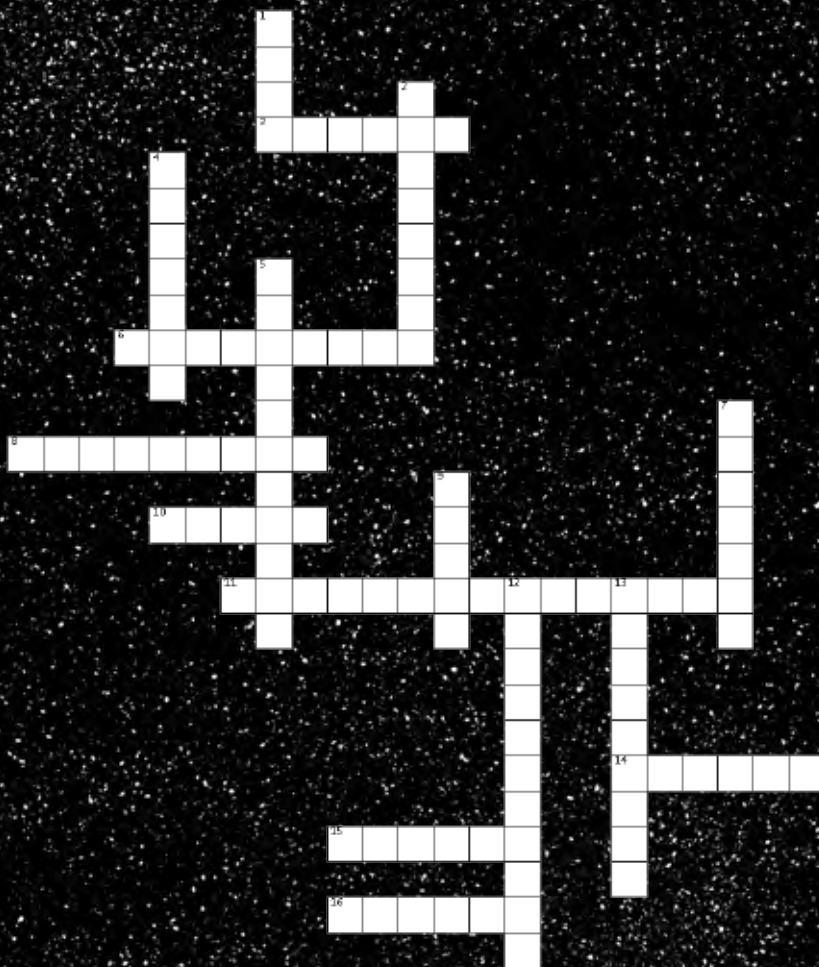
INSPIRING THEM TO SHOOT FOR THE STARS!

COOL! I WANT TO BE AN ASTRONAUT SOMEDAY!

I WANT TO BE A RESEARCHER ON HEALTH AND ENVIRONMENT!

AND YOU CAN BE, IF YOU LOOK UP TO THE STARS AND DREAM!

THE BEGINNING OF A NEW ERA...



ACROSS

- 2. What we do when we look at the night sky?
- 4. Where stars are born?
- 6. The cosmos and everything in it?
- 8. How we find out more about space?
- 10. US Mission to the moon?
- 14. Our home planet?
- 16. Where we can observe the universe from?

DOWN

- 1. The big...?
- 3. First man in space, Yuri...?
- 5. When a star explodes?
- 7. Our closest star?
- 9. A collection of planets orbiting a star, a ... System?
- 11. The largest of our neighbouring planets?
- 12. The study of the Cosmos?
- 13. Object to help see the stars?
- 15. How we sent man into space?

# PLANET B?

You can find out more about the SPACE research on our website:

<https://www.qub.ac.uk/sites/space/>

and by watching this video: [https://youtu.be/1SEEL\\_oD7nk](https://youtu.be/1SEEL_oD7nk)

We have also created some fact sheets and short videos about how where we live can improve our health and wellbeing here:

<https://www.qub.ac.uk/sites/space/VideosandFactsheets/>

Acknowledgements: We wish to acknowledge funding support from the UKRI Healthy Ageing Challenge Social, Behavioural and Design Research (ES/V016075/1) and Economic and Social Research Council (ESRC) Impact Acceleration Account.

We wish to express our sincere thanks to Dame Jocelyn Bell Burnell who gave so generously with her time to contribute to the content of the Planet B? comic.



Economic and Social Research Council





ISBN 978-0-99-702549-1



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