

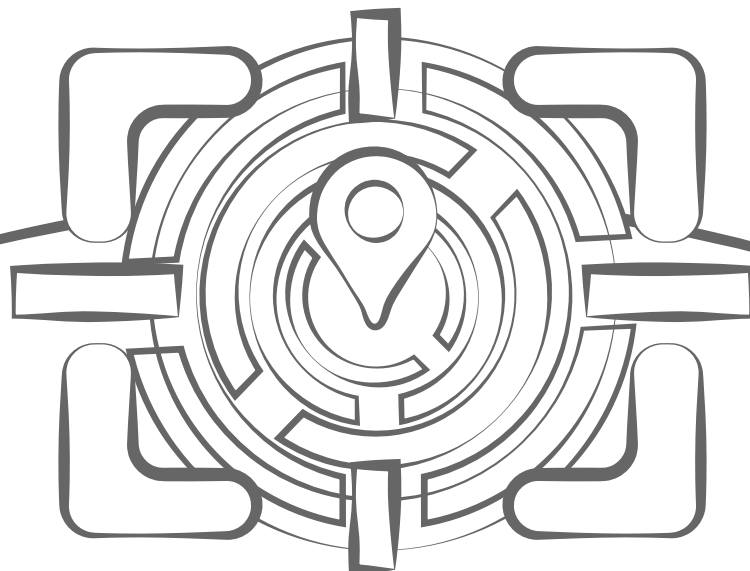
National Aeronautics and Space Administration



NASA'S SEARCH & RESCUE

COLORING BOOK





NASA'S SEARCH AND RESCUE

TAKING THE SEARCH OUT OF SEARCH AND RESCUE

NAME _____

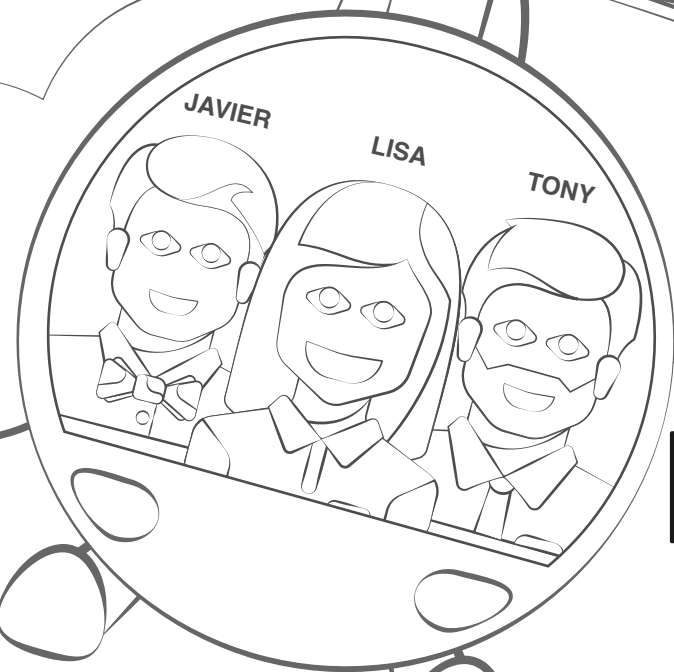
AGE _____

Hello! I'm Lisa Mazzuca, manager of NASA's Search and Rescue office. In this book, you'll learn, through poetry and art, about NASA's work developing search and rescue technologies. We're so excited to share our work with you!



**WHEREVER YOU ARE,
WHEREVER YOU GO,**

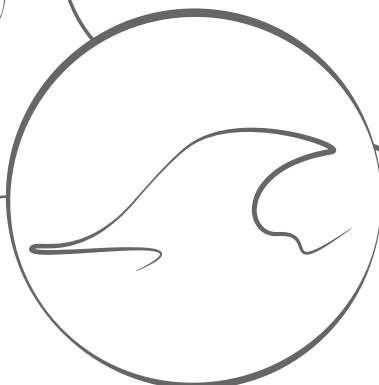
**WHEN YOU'RE IN
DISTRESS
AND NEED A HAND,**



**LISA MAZZUCA,
WITH TEAM IN TOW,
CAN HELP YOU**



BY AIR,



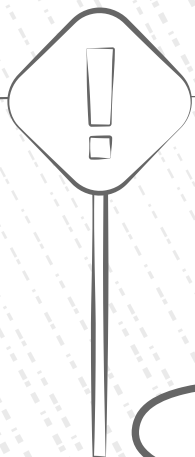
BY SEA



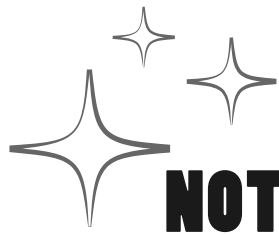
OR BY LAND.

**BUT HOW DO THEY DO IT?
AND HOW DO THEY KNOW**

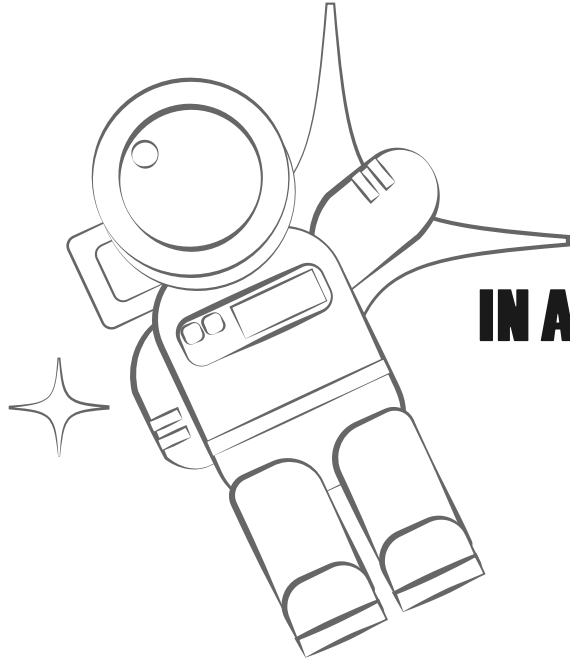
**YOU GOT
TRAPPED IN A
TAR PIT**



**IN WIND,
SLEET
OR SNOW?**

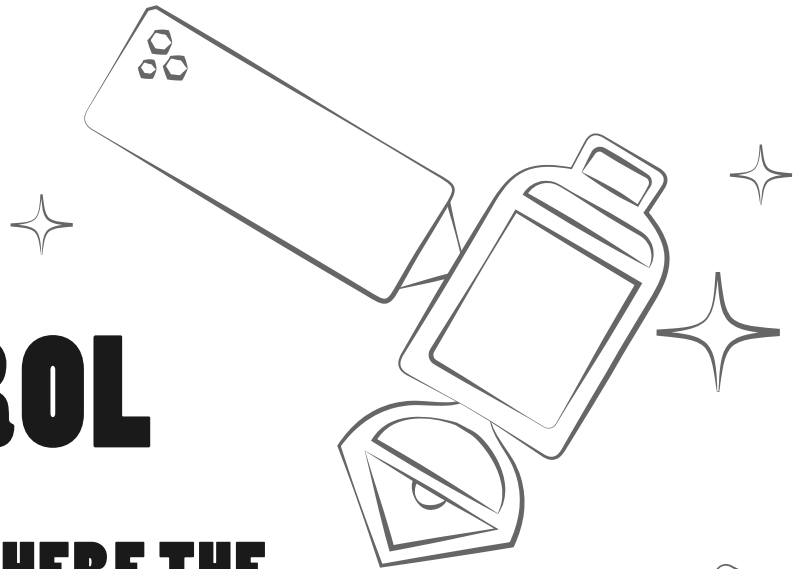


**WELL,
NOT SO LONG AGO**

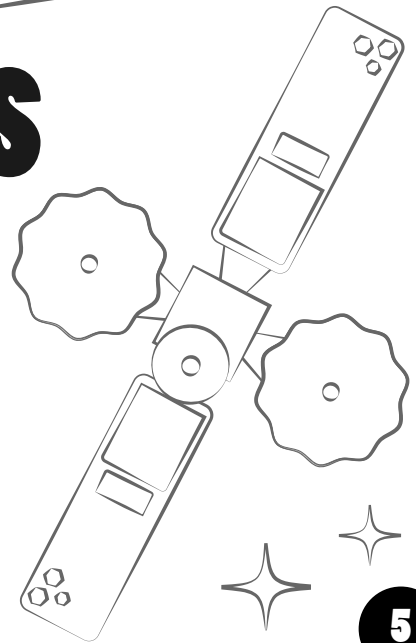
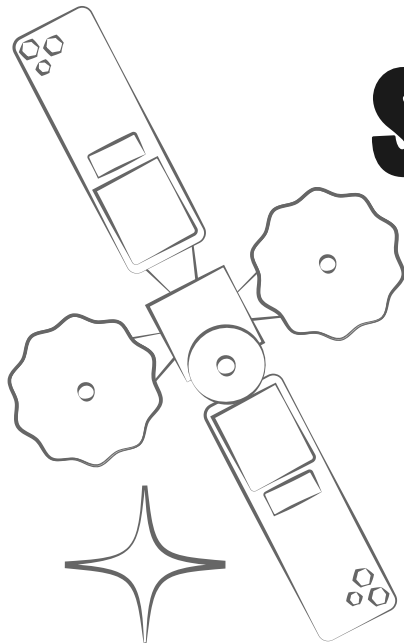


**IN A GALAXY
JUST STEPS AWAY**

**WE PUT
EARS
ON PATROL**



**WHERE THE
SATELLITES
PLAY**

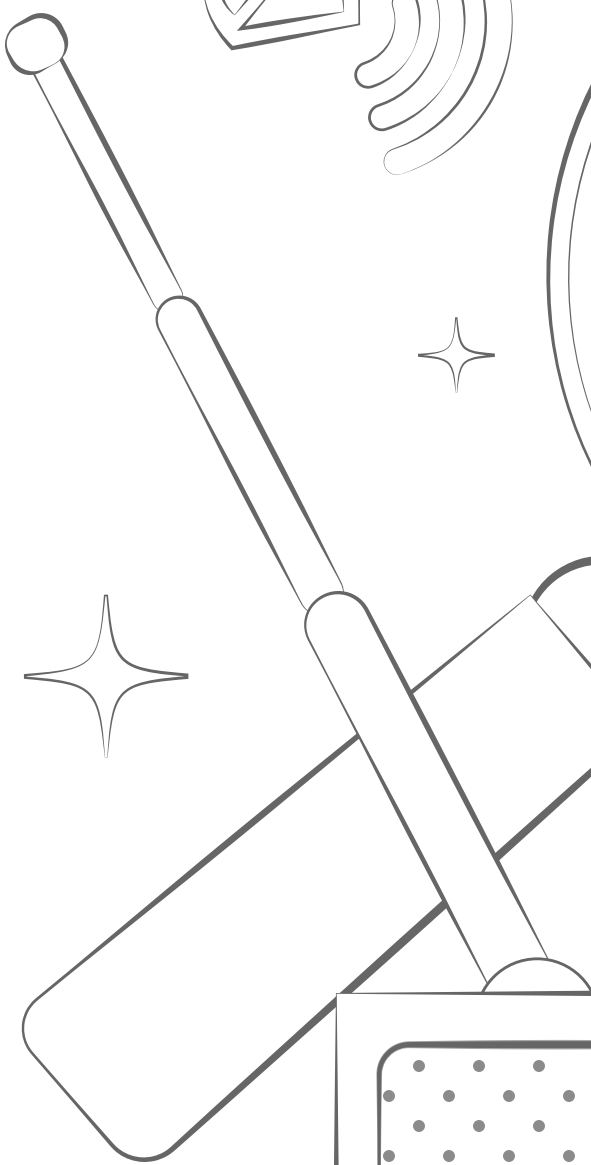
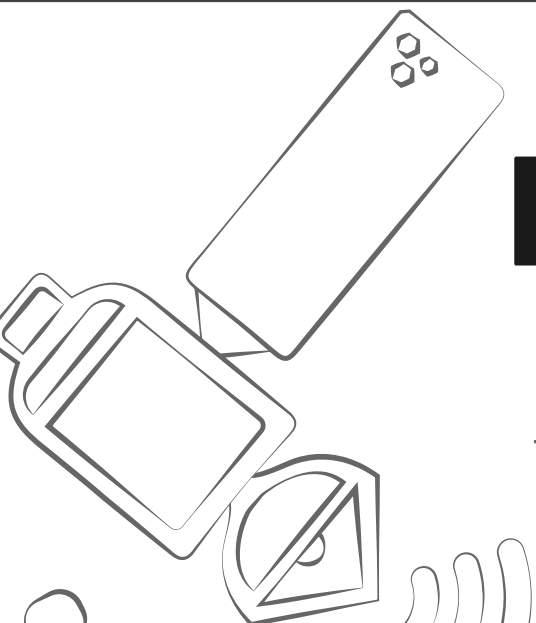


**THESE
EARS** SEARCH FOR
BEACONS

**THAT WHISPER
MAYDAY**

**OVER RADIO
FREQUENCIES**

**WHEN YOU GO
ASTRAY.**



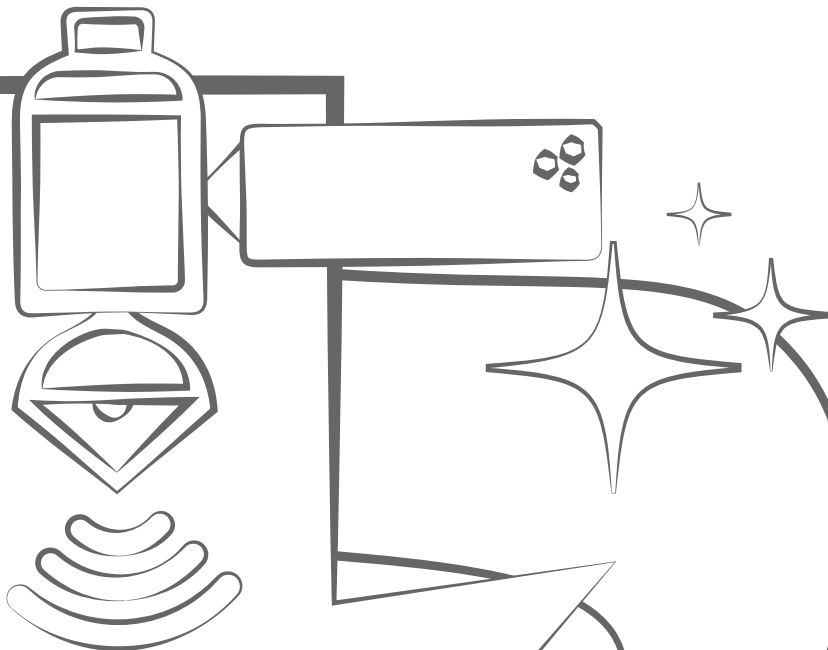
**FROM THE
MOUNTAINS
OF CHILE**

**TO THE
STREETS
OF SHANGHAI,**

**THESE
BEACONS
CAN RELAY**

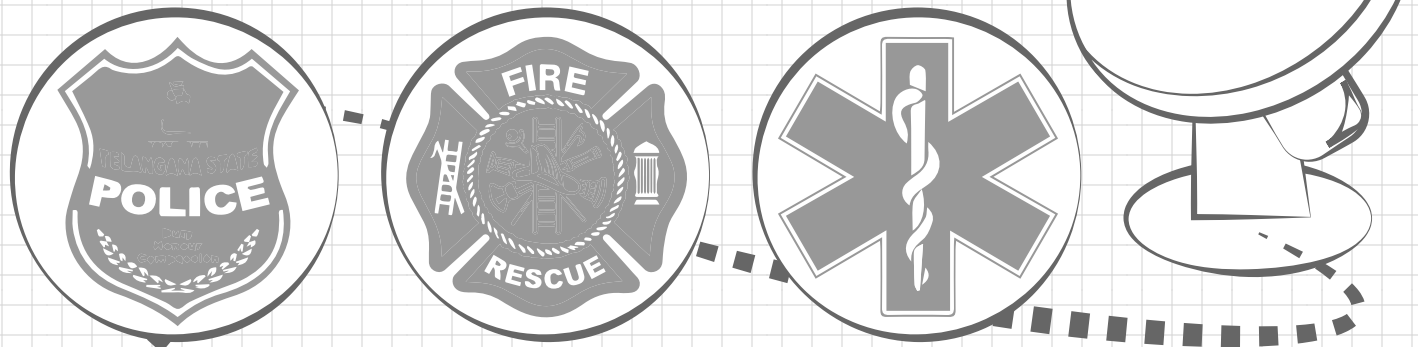
**YOUR CALL
THROUGH THE SKY.**

**FROM THE
SATELLITES'
TRANSPONDERS**



**TO EARS ON THE
GROUND**

**YOUR CALL REACHES
FIRST RESPONDERS**



**BECAUSE THE
CONNECTION IS SOUND.**



**IN THE U.S.
YOUR CALL GOES TO
NOAA,**



**THEY
MANAGE
OUR NETWORK
REGION,**

NEW YORK

**HELPING THE
LOST**

FROM THE SURF IN

SAMOA

TO

NEW YORK

IN THE SMALL TOWN OF EDEN.

AMERICAN SAMOA

IF YOU'RE
LOST IN THE
PARK, THEY'LL



ALERT THE PARK
RANGERS.



IF YOU'RE
LOST IN THE
DARK,



THEY'LL KEEP

YOU FROM
DANGERS.

**IF ADRIFT IN THE
OCEAN,**

**THEY CALL THE
COAST
GUARD.**

**THEY
BRAVE THE
COMMOTION,
BRING YOU BACK TO THE
BOATYARD.**



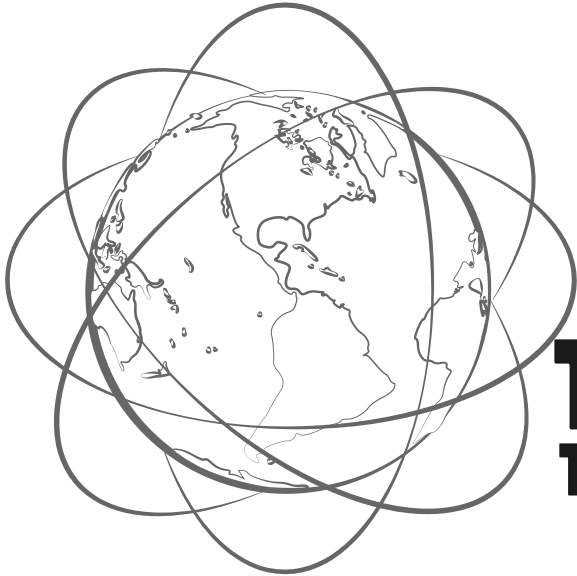
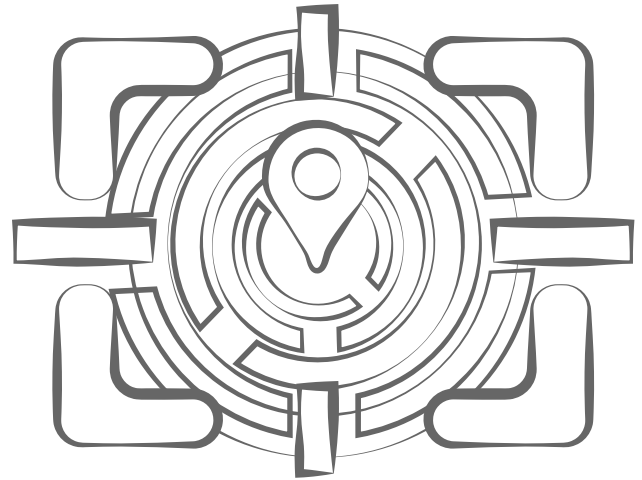
**IF YOUR
PLANE
GOES OFF
COURSE,**

**KEEP A
BEACON
HANDY.**

**ONE CALL TO THE
AIR FORCE**

**AND SOON YOU'LL BE
DANDY.**

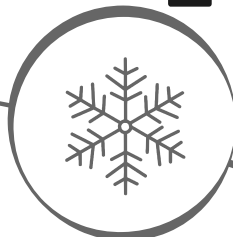
**NASA
DEVELOPED
THESE BEACONS**



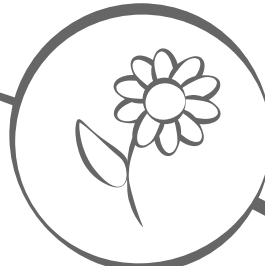
**AND
HELPS THE
TRANSPONDERS
TAKE
FLIGHT.**



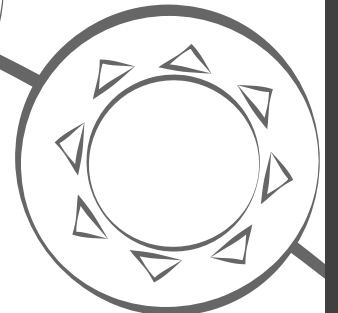
FALL



WINTER

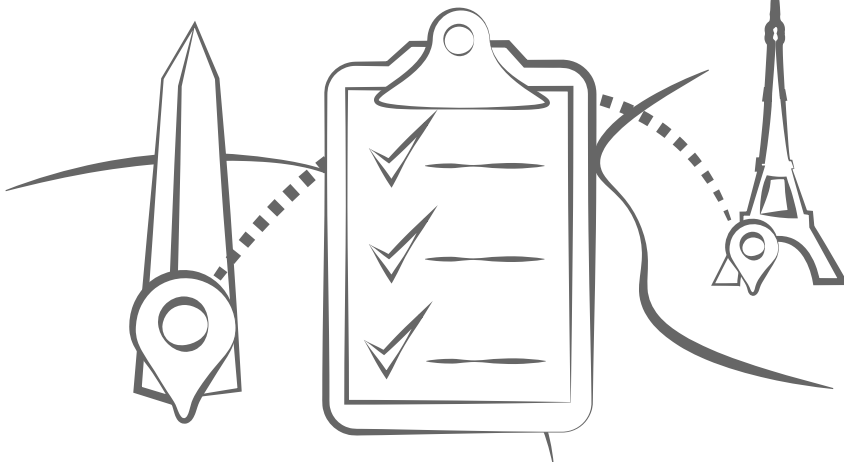


SPRING



SUMMER

**YOU CAN
FIND THEM
NO MATTER
THE SEASON,**



**TESTING THE
SYSTEM
DAY & NIGHT.**

AT **LANGLEY'S**
CANTRY,

THE TEAM
ARRIVED,

VIRGINIA

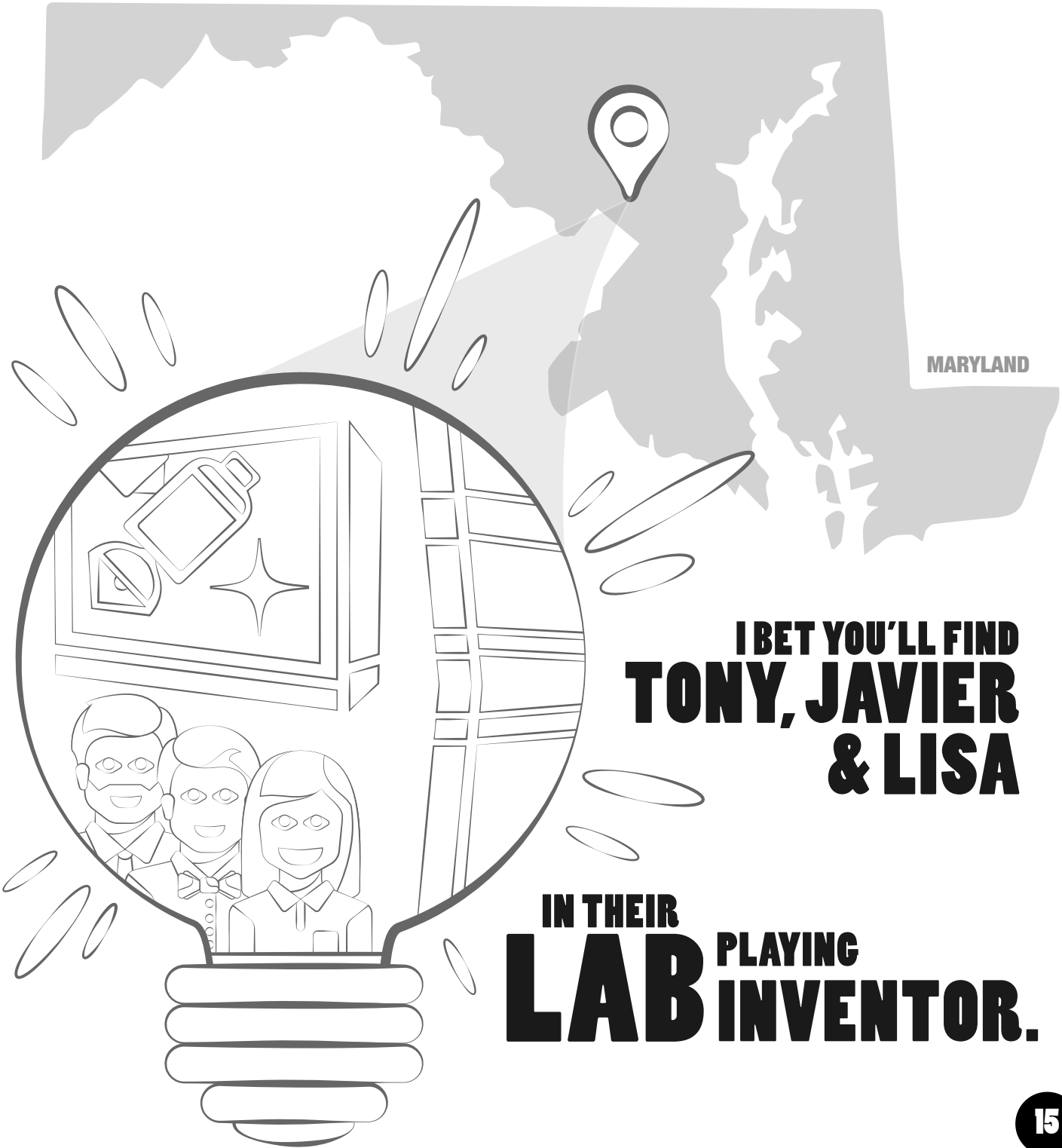
CRASHING
THREE PLANES
TO MAKE SURE

THEIR
BEACONS CAN
THRIVE IN A
CRASH YOU'D
SURVIVE,

N	A	S	A				
I	M	P	A	C	T		
R	E	S	E	A	R	C	H
F	A	C	I	L	I	T	Y

so **YOU** CAN FEEL
SAFE AND
SECURE.

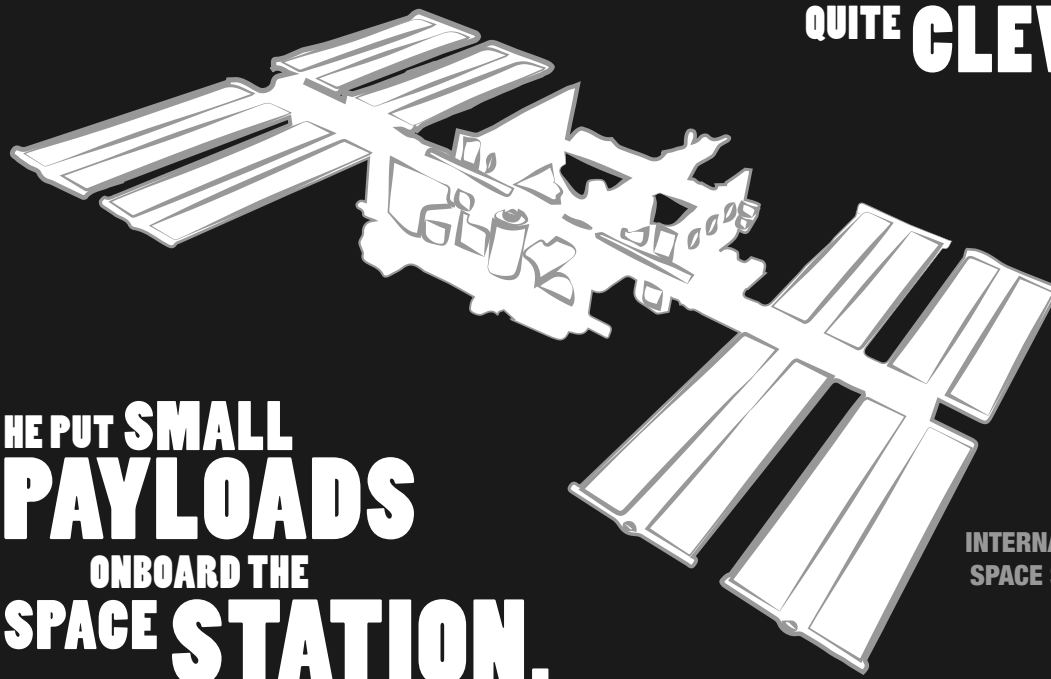
IF EVER YOU HEAR
“EUREKA!” AT
GODDARD SPACE FLIGHT CENTER



I BET YOU'LL FIND
**TONY, JAVIER
& LISA**

IN THEIR
LAB PLAYING
INVENTOR.

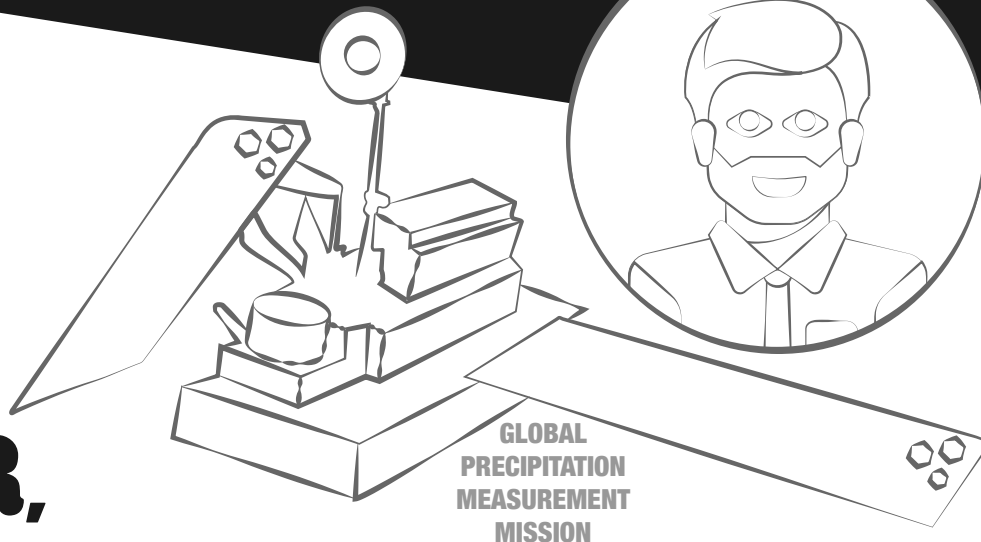
TONY'S **CAREER** HAS SHOWN HE'S
QUITE **CLEVER.**



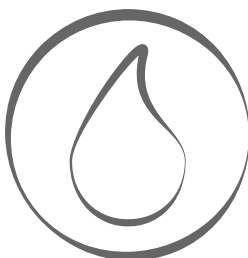
HE PUT **SMALL
PAYLOADS**
ONBOARD THE
SPACE STATION.

INTERNATIONAL
SPACE STATION

HE'S ALSO
HELPED
TO BRING YOU THE
WEATHER,



GLOBAL
PRECIPITATION
MEASUREMENT
MISSION



RAINFALL



SNOWFALL

LAUNCHING A
SATELLITE
THAT TRACKS
PRECIPITATION.

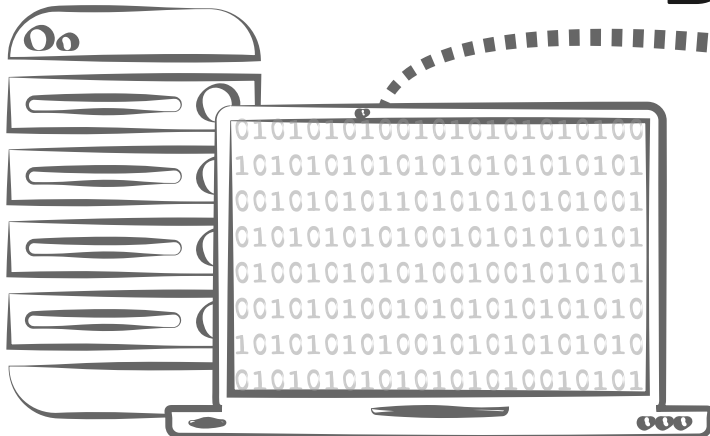
JAVIER HAS SKILLS
THAT MAKE THE TEAM
GREATER

BECAUSE HE'S DEALT WITH
RELAYS
BEFORE.

TRACKING AND
DATA RELAY SATELLITES



HE WORKED ON **SATELLITES**
THAT BRING DOWN THE **DATA**



FROM THE
SPACE STATION,
HUBBLE AND MORE...

**LISA'S A
PHYSICIST AND FINE
ENGINEER**

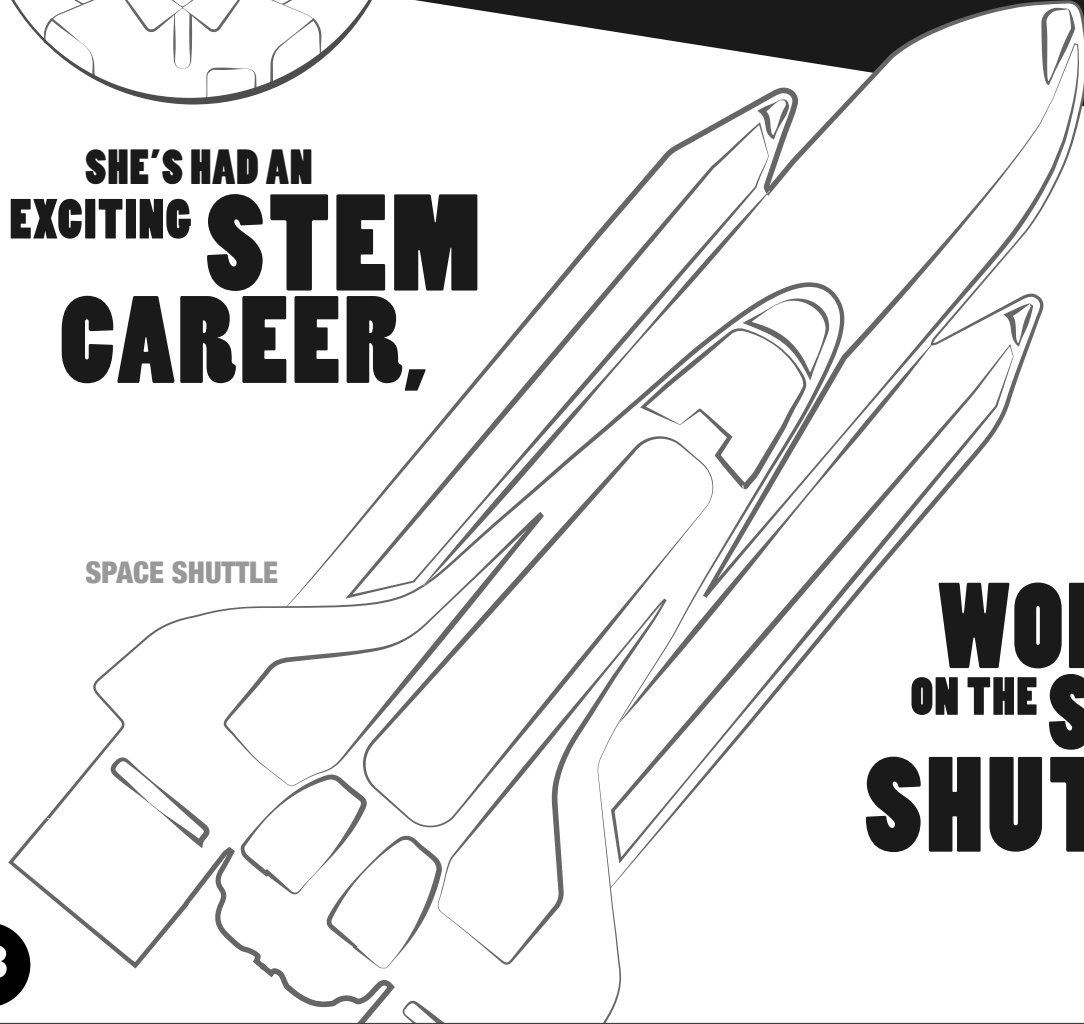


HUBBLE
SPACE TELESCOPE



**WHO GOT HER
START
WORKING ON
HUBBLE.**

**SHE'S HAD AN
EXCITING STEM
CAREER,**



SPACE SHUTTLE

**SHE EVEN
WORKED
ON THE SPACE
SHUTTLE.**

**NOW, THEY'RE DEVISING
NEW TECH
THAT SEEKS TO
REFINE**



**406MHZ
PLB**

**CURRENT BEACON
SPECS
ON WHICH WE'VE
RELIED.**

**THEIR BRAND NEW
BEACONS
HAVE POWER**

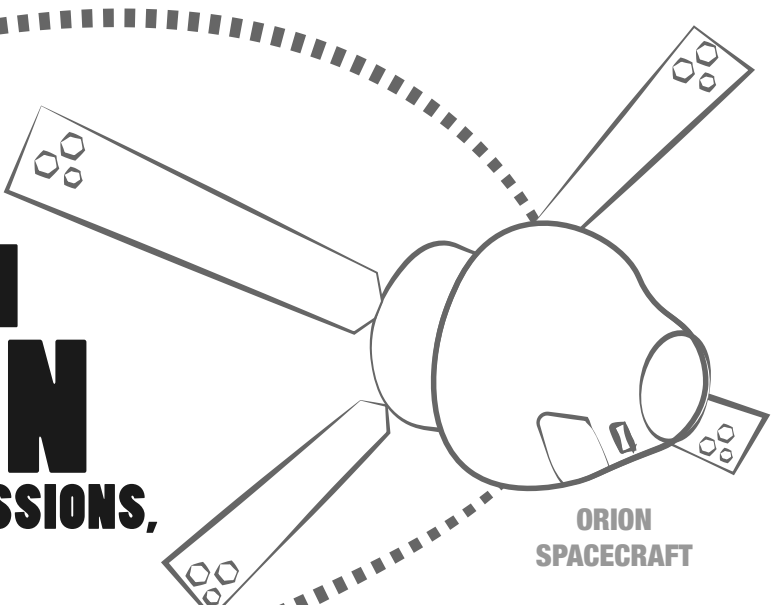
**TO REACH WAY, WAY
UP TO NEW
HEIGHTS,**

**TO
SATELLITES
SO HIGH THAT THEY
SCOUR**

**MORE OF
EARTH'S SURFACE
IN THEIR
SIGHTS.**

DURING
SPLASHDOWN
FOR **ORION**

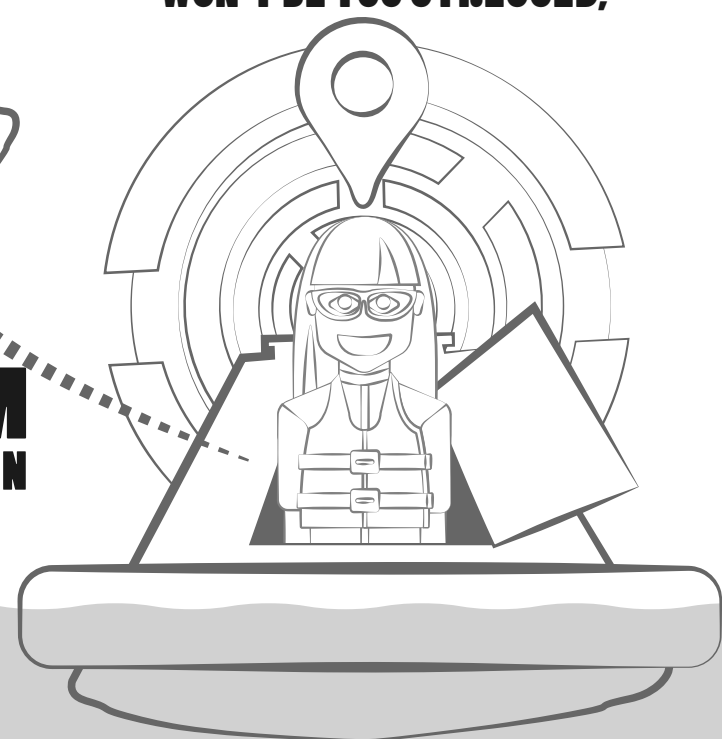
MISSIONS,



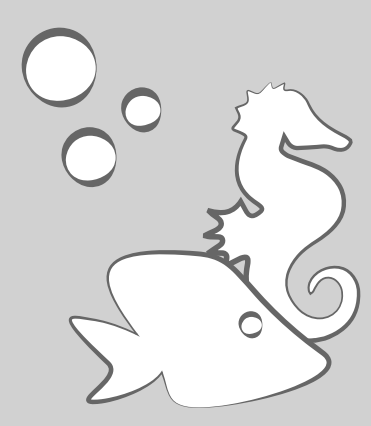
ORION
SPACECRAFT

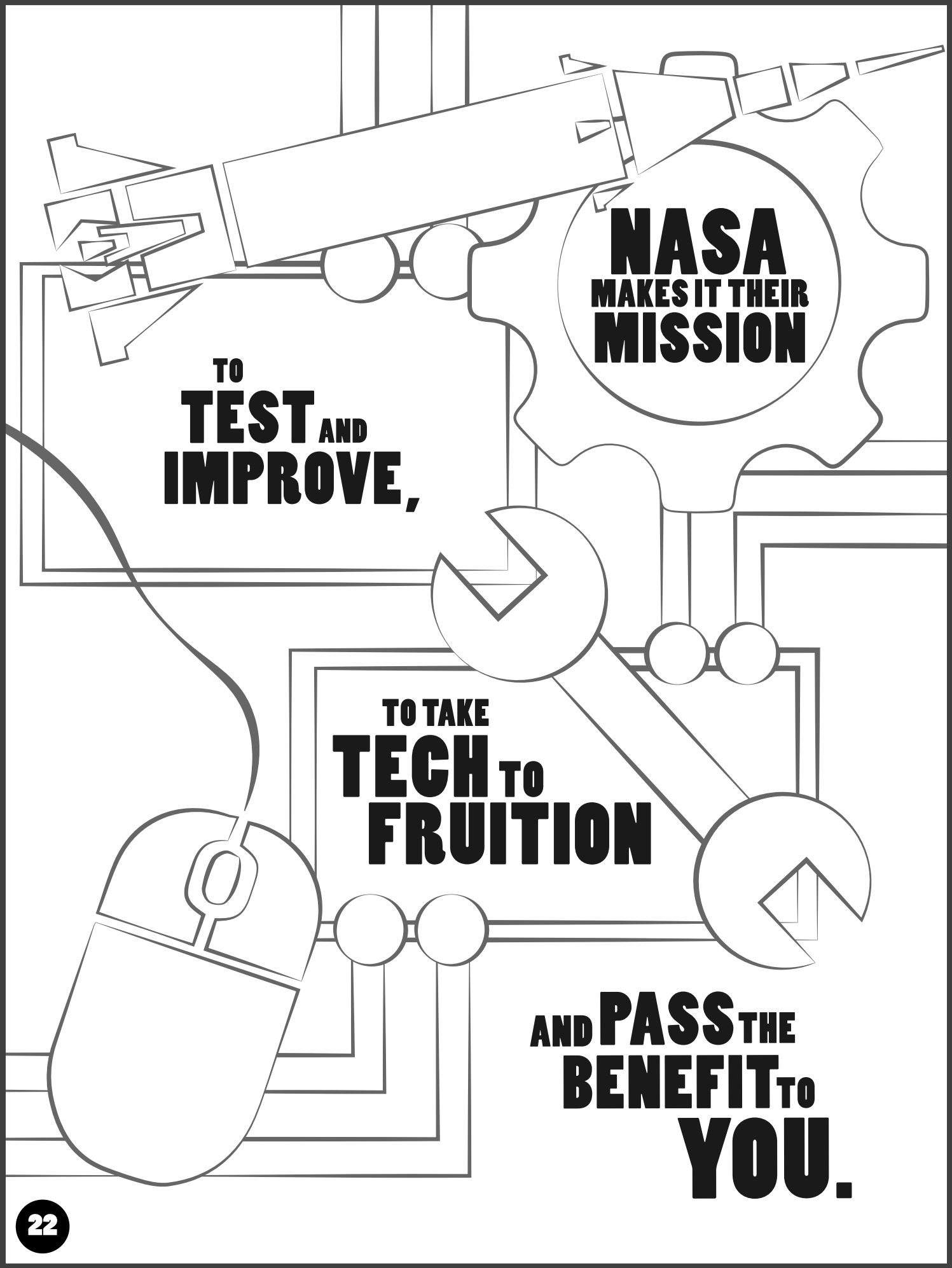
OUR
ASTRONAUTS
WON'T BE TOO STRESSED,

BECAUSE THEIR
SUPPORT SYSTEM
HAS THE ADDITION



OF THESE
BEACONS ON THEIR
LIFE VESTS.



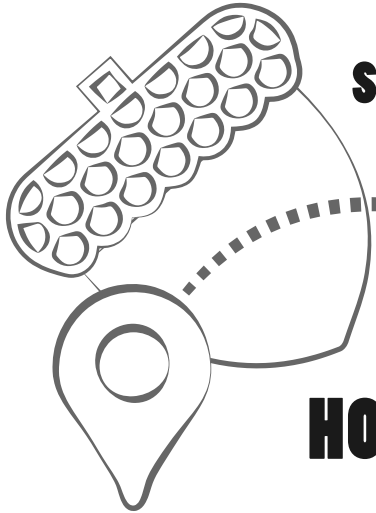


**NASA
MAKES IT THEIR
MISSION**

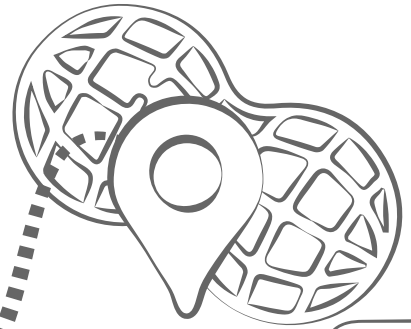
**TO
TEST AND
IMPROVE,**

**TO TAKE
TECH TO
FRUITION**

**AND PASS THE
BENEFIT TO
YOU.**



**SO, THAT'S IT
IN A NUTSHELL,**



**HOW THE LOST
CAN BE FOUND**

**BY SATELLITES UP IN THE
SKY.**

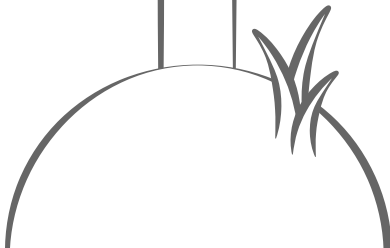


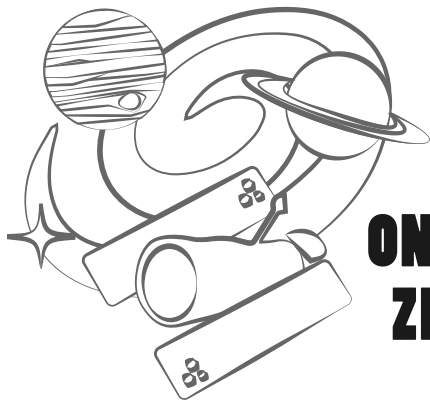
HERE

THERE

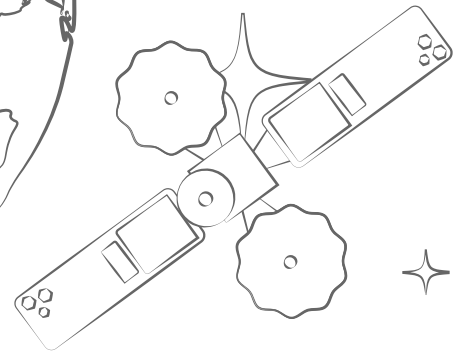
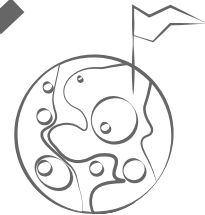
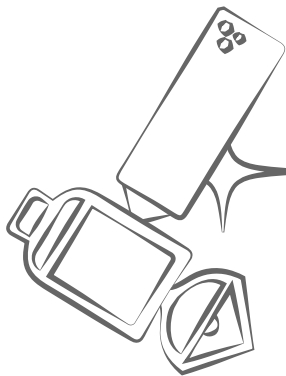
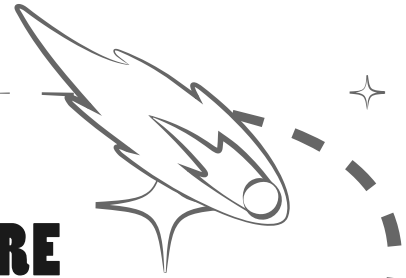
**IT'S A TALE
YOU CAN
TELL**

**THE WHOLE WIDE
WORLD ROUND
WHEN THINGS MIGHT FEEL
AWRY.**

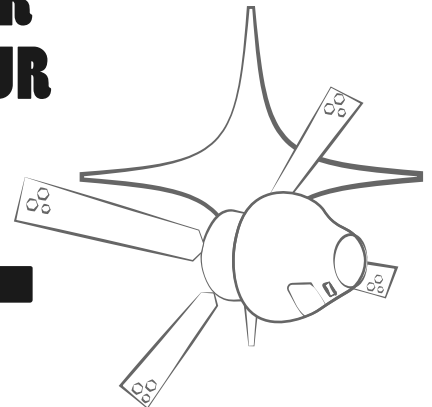
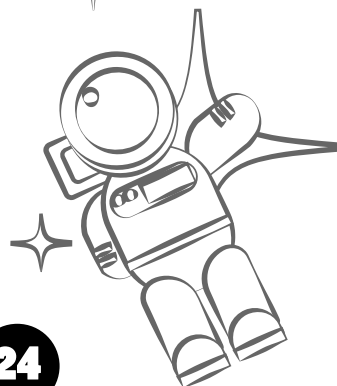




**IF YOU EVER FEEL LOST
ON THIS BIG, LONELY SPHERE
ZIPPING ITS WAY THROUGH
SPACE,**



**KNOW SCIENCE AND TECH
CAN MAKE THE WAY CLEAR
AND HELP YOU TO FIND YOUR
PLACE.**

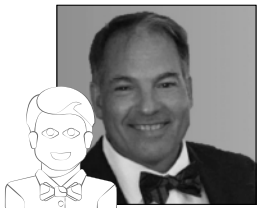
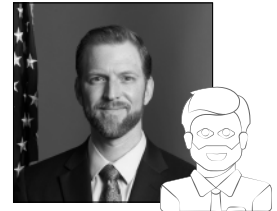


CAST OF CHARACTERS



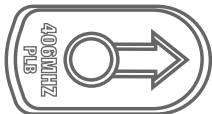
Lisa Mazzuca serves as NASA's mission manager for the Search and Rescue office. She previously supported servicing missions for the Hubble Space Telescope as operations instrument manager and oversaw the installation of Hubble to Space Shuttle Atlantis to ground communications link. Lisa is also an astrophysicist with research specialties in extragalactic astronomy focused on star formation. She advocates passionately for the next generation of NASA professionals, particularly for young women pursuing careers in engineering. On her time away from NASA, Lisa is a helicopter flight officer for the Baltimore County police department.

Tony Foster serves as NASA's deputy mission manager for international affairs in the Search and Rescue office. He previously supported servicing missions for the Hubble Space Telescope and helped launch the Global Precipitation Measurement (GPM) mission, which has expanded scientists' understanding of weather systems. He's received masters degrees in both aerospace engineering and business administration. A father of four, Tony believes wholeheartedly that the education of the next generation ensures a better, safer future.



Javier Lecha serves as NASA's deputy mission manager for national affairs in the Search and Rescue office. He previously supported missions like the Cosmic Background Explorer (COBE), the Tropical Rainfall Measuring Mission (TRMM), Rossi X-Ray Timing Explorer, Landsat-5 and Tracking and Data Relay Satellites (TDRS). A proud Hispanic American, Javier serves on Goddard Space Flight Center's Hispanic advisory committee, advocating for the recruitment, retention and advancement of Hispanic employees at NASA.

KEY TAKEAWAYS



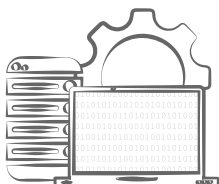
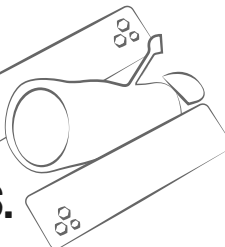
NASA'S SEARCH & RESCUE OFFICE DEVELOPS AND TESTS RESCUE BEACONS FOR AIR, SEA AND LAND.



THESE BEACONS ARE PART OF A RELAY SYSTEM THAT POINTS FIRST RESPONDERS TO YOUR LOCATION.



NASA ENGINEERS DON'T JUST LOOK TO THE STARS.



THE SEARCH AND RESCUE OFFICE USES TECHNOLOGY TO KEEP PEOPLE SAFE.



SAR IN A NUTSHELL

Satellite-aided search and rescue is a collaborative effort involving a number of national and international organizations. The International Cospas-Sarsat Programme was founded in 1979 to provide timely, accurate and reliable location data to first responders. The U.S. serves on the Cospas-Sarsat Council and a number of U.S. agencies are instrumental in ensuring the robustness of the search and rescue network. NASA lends its expertise in technology development through their Search and Rescue (SAR) office.

NASA's SAR team researches and develops technologies that help first responders locate people in distress worldwide, whether from a plane crash, a boating accident or other emergencies. Helmed by mission manager, Dr. Lisa Mazzuca, SAR designs emergency locator beacons for personal, nautical and aeronautical use and commissions the space systems that support them.

The emergency beacons transmit a 406 MHz frequency that can be "heard" by satellites hundreds to thousands of miles above the ground. The 406 MHz frequency is internationally recognized and designated for search and rescue. Beacon technology, spearheaded by NASA, is passed from SAR to commercial entities, who manufacture the beacons and make them available at retail stores and online worldwide.

The current search and rescue network relies on instruments in space onboard low-Earth-orbiting and geostationary satellites. These instruments relay distress signals to the SAR ground segment, operated by partner organizations that manage specific regions of the network. The National Oceanic and Atmospheric Administration (NOAA) operates the region of the network that spans over North and South America as well as over much of the Pacific and Atlantic Oceans.

NOAA maintains relationships with organizations that coordinate search and rescue efforts. They notify these organizations of a distress beacon's activation and location. Within the U.S., the U.S. Air Force coordinates the response to land-based emergencies and the U.S. Coast Guard responds to water-based emergencies. Local public service organizations like police and fire departments, as well as volunteer search and rescue pilots, serve as first responders.

The SAR office works tirelessly, developing and testing search and rescue instruments and refining the existing network. Notably, in 2015, testing of aeronautical beacons took place at NASA's Langley Research Center in Hampton, Virginia. Using the gantry, a 240-foot-high structure originally designed to test Apollo spacecraft, the SAR team crashed a number of planes to test the survivability of these beacons, developing new requirements and guidelines for their manufacture and installation.

Additionally, the SAR office works with national and international lawmakers to develop search and rescue policy that ensures the network remains robust for generations to come. NASA's SAR team also engages in outreach within the search and rescue community, encouraging proper beacon use and maintenance.

In the future, first responders will rely on a new constellation of instruments on GPS and other global navigation satellite systems in medium-Earth orbit. These new instruments will enable the SAR network to locate a distress signal more quickly than the current system and achieve accuracy an order of magnitude better, from miles to approximately 300 feet. Second-generation beacon technology, currently in development by the SAR office, will enable users to take advantage of this new system.

NASA's Johnson Space Center in Houston, Texas, is working with the SAR office to adapt this new beacon technology for use in human spaceflight. Advanced Next-Generation Emergency Locator (ANGEL) beacons will be attached to life preservers of astronauts aboard the Orion spacecraft. After splashdown, if the Orion crew must exit the capsule due to an emergency, these beacons will make sure NASA knows the exact location of the floating astronauts.

NASA's SAR office is based out of NASA's Goddard Space Flight Center in Greenbelt, Maryland, and is a project of their Exploration and Space Communications projects division. Programmatic oversight is provided by NASA's Space Communications and Navigation program office at NASA Headquarters in Washington. The search and rescue network is a collaboration of NASA, NOAA and numerous international partners. For more information, visit: esc.gsfc.nasa.gov/sar





**NASA'S
SPACE COMMUNICATIONS
AND NAVIGATION
PROGRAM OFFICE**



**GODDARD SPACE FLIGHT CENTER'S
EXPLORATION AND
SPACE COMMUNICATIONS
PROJECTS DIVISION**

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COMMUNICATIONS**

GO.NASA.GOV/ESCACTIVITIES

**SPACE OPERATIONS
LEARNING CENTER**

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**SPACE COMMUNICATIONS
& NAVIGATION**

GO.NASA.GOV/SCANACTIVITIES

St. Bernards are recognized as an unofficial mascot of the search and rescue community. In the early 18th century, monks living in a dangerous pass through the Alps between Italy and Switzerland began using the dogs in rescue efforts. The dogs' keen sense of smell enabled them to find travelers buried deep in the snow!



National Aeronautics and Space Administration
Goddard Space Flight Center
8800 Greenbelt Road
Greenbelt, MD 20771
sar.gsfc.nasa.gov

www.nasa.gov

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