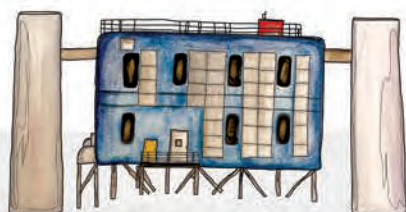
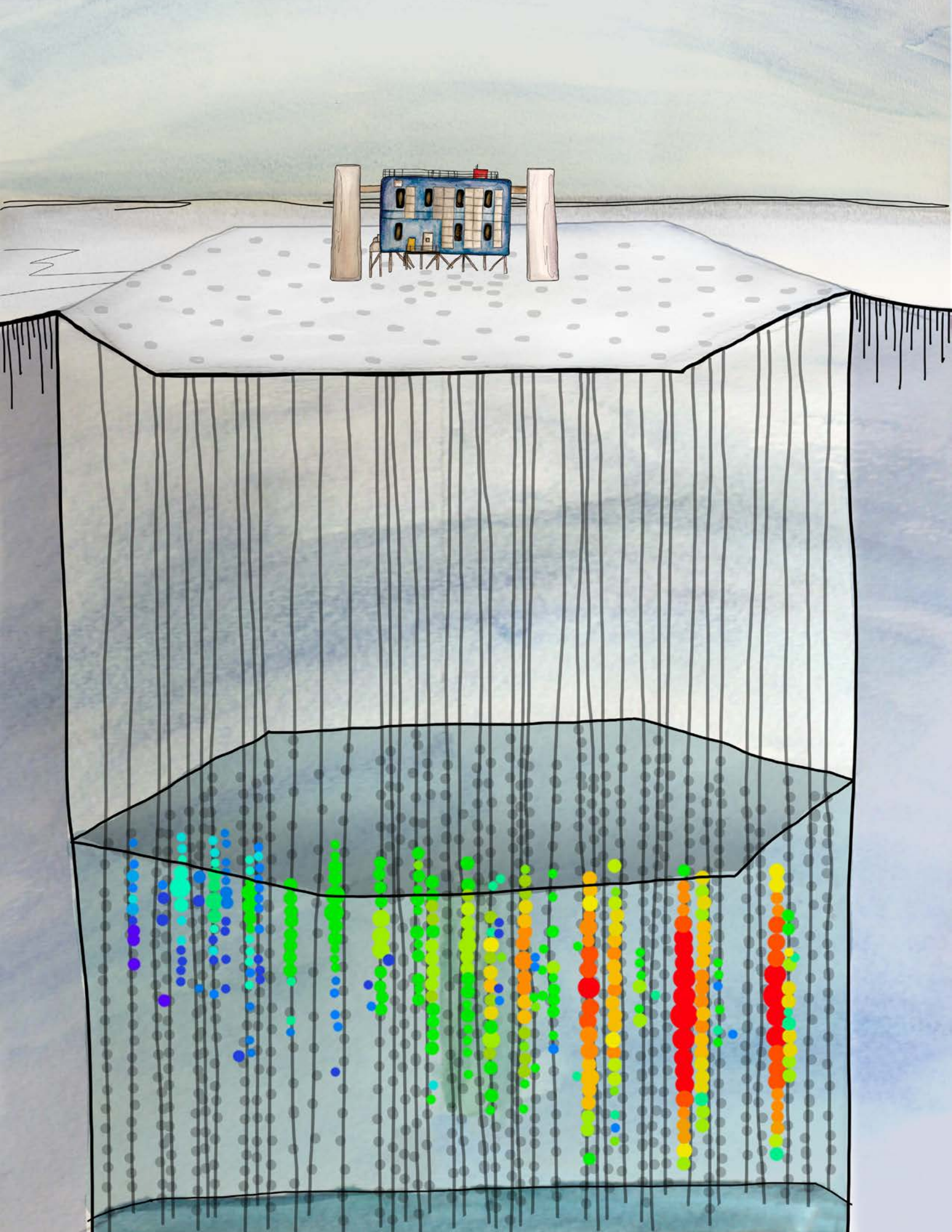


THE COMPLETE ADVENTURES OF **ROSIE & GIBBS** *the lost penguins*





ICECUBE

SOUTH POLE NEUTRINO OBSERVATORY

ILLUSTRATIONS BY:

Savannah Guthrie

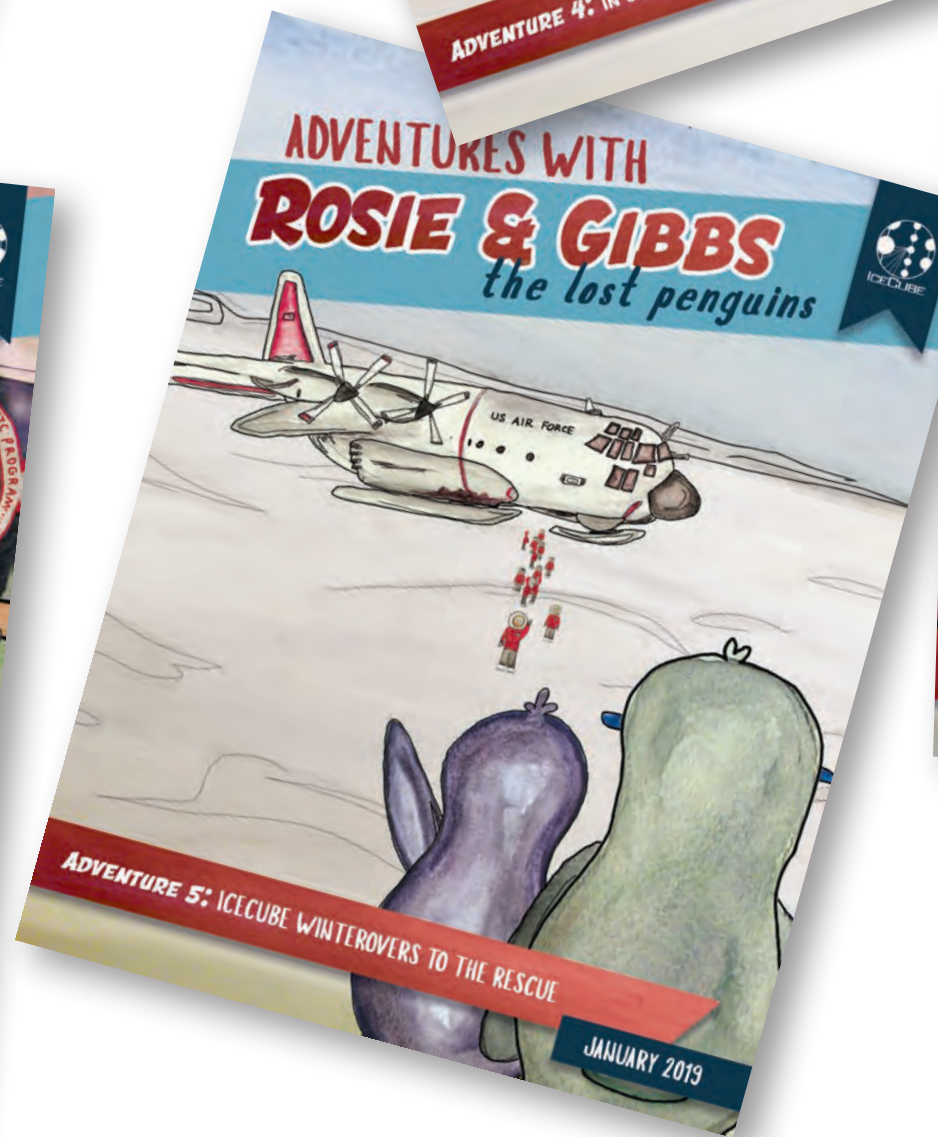
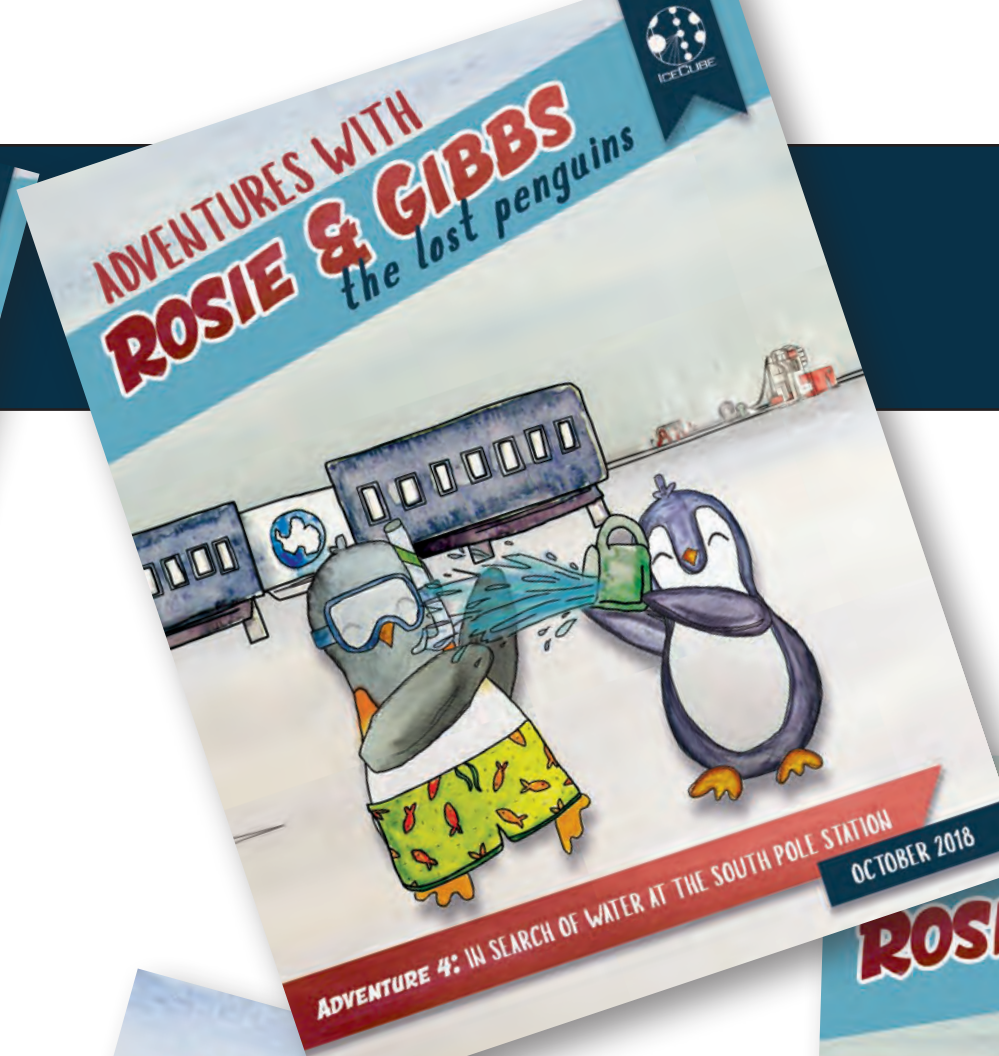
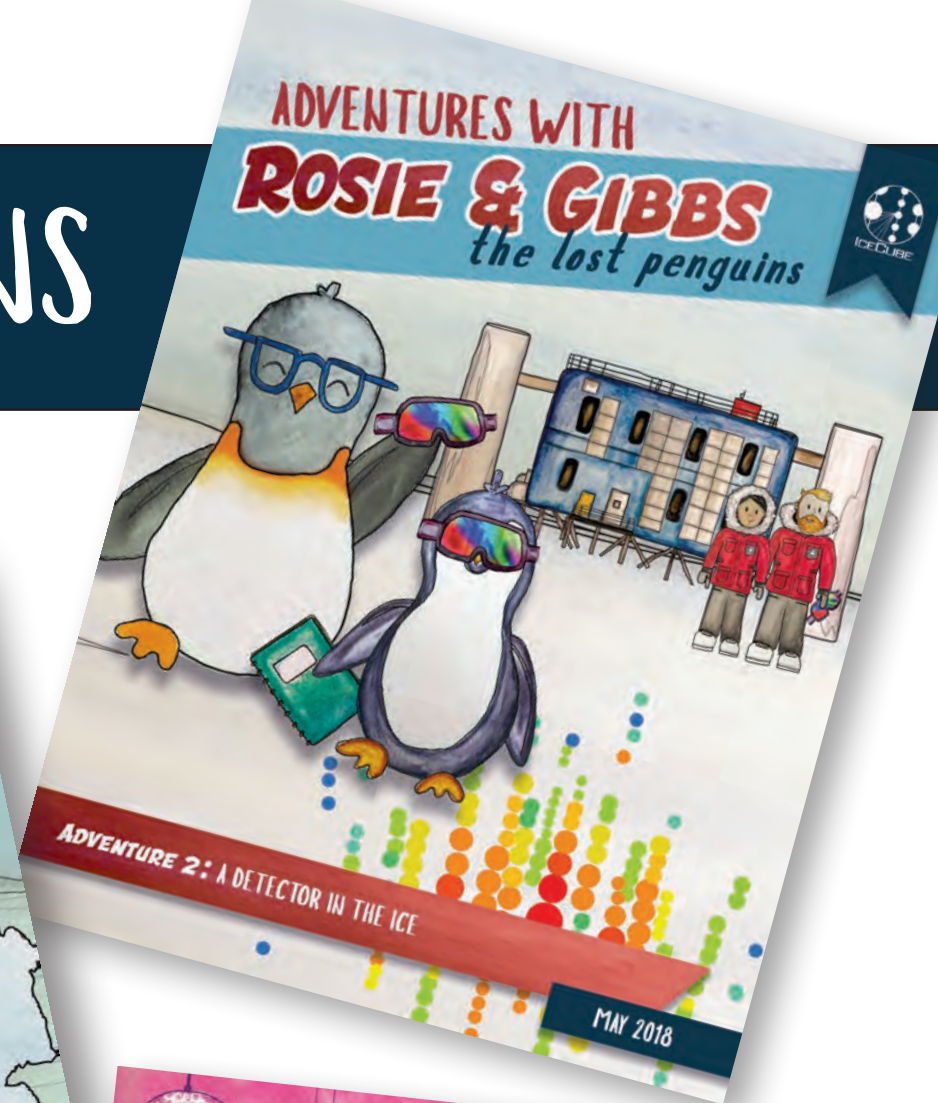
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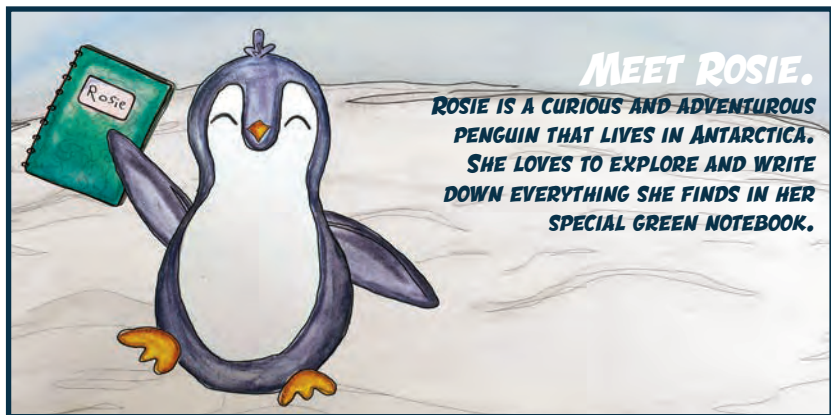
Silvia Bravo Gallart, Jean DeMerit
& Savannah Guthrie

ADVISORS:

John Kelley, Jim Madsen,
Jean Pennycook & Annie E. Schmidt

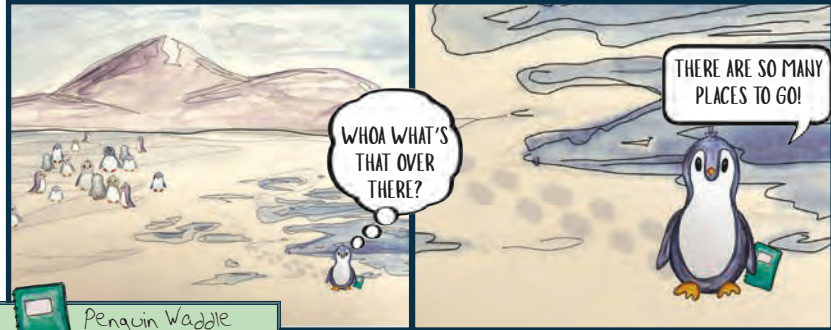
COVER DESIGNS





MEET ROSIE.
ROSIE IS A CURIOUS AND ADVENTUROUS PENGUIN THAT LIVES IN ANTARCTICA. SHE LOVES TO EXPLORE AND WRITE DOWN EVERYTHING SHE FINDS IN HER SPECIAL GREEN NOTEBOOK.

SHE TENDS TO WANDER A BIT FAR FROM HOME... WAY TOO FAR!



WHOA WHAT'S THAT OVER THERE?

THERE ARE SO MANY PLACES TO GO!

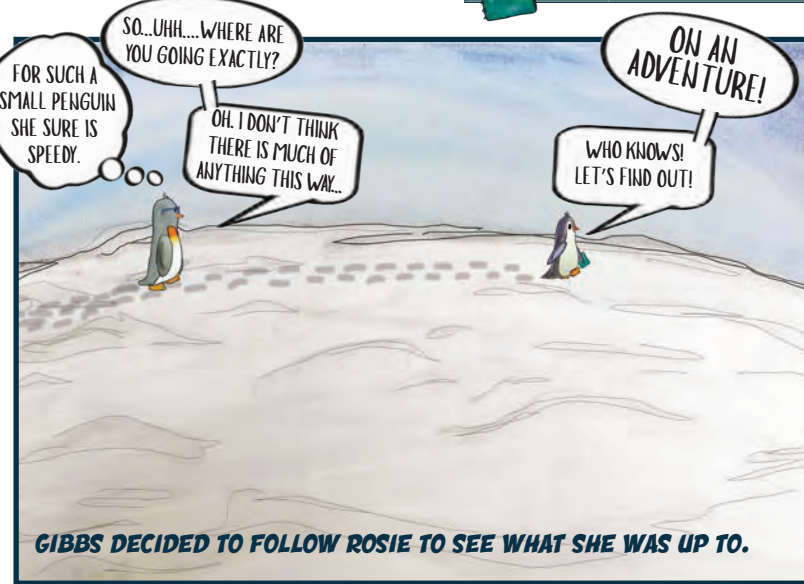
Penguin Waddle



I'VE NEVER SEEN A GENTOO PENGUIN AROUND HERE. WHERE IS SHE GOING?

THE PENGUINS HERE ARE SO TALL. IT'S CRAZY!

Emperor Penguin



FOR SUCH A SMALL PENGUIN SHE SURE IS SPEEDY.

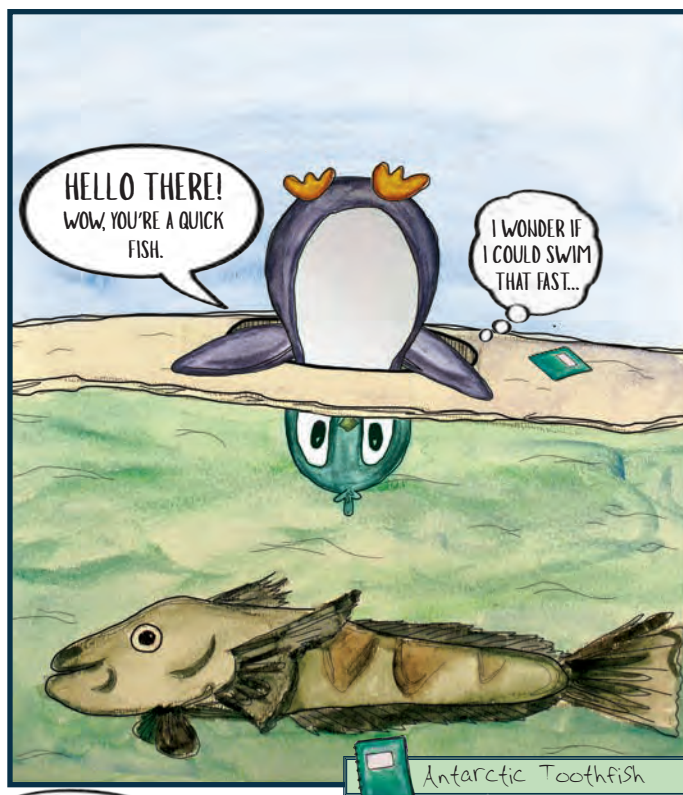
SO...UHH...WHERE ARE YOU GOING EXACTLY?

OH, I DON'T THINK THERE IS MUCH OF ANYTHING THIS WAY...

ON AN ADVENTURE!

WHO KNOWS! LET'S FIND OUT!

GIBBS DECIDED TO FOLLOW ROSIE TO SEE WHAT SHE WAS UP TO.



HELLO THERE! WOW, YOU'RE A QUICK FISH.

I WONDER IF I COULD SWIM THAT FAST...

Antarctic Toothfish

DAYS PASSED WITHOUT ANY SIGN OF FISH. THEY HAD NO CLUE WHERE THEY WERE, AND THEY NEEDED TO MOVE FAST...



MAN, I'M GETTING REALLY HUNGRY...

IT LOOKS LIKE THE REMAINS OF AN ANTARCTIC EXPEDITION.

WHAT COULD THAT BE?!



HOORAY! I SEE CANS OF FISH!

TUNA! SALMON! COD! WE'LL HAVE A FEAST!

ROPE, CRATES, BOTTLES... WAIT! WAIT! IT'S NOT JUNK, IT'S...IT'S...

I HAVE AN IDEA!

Antarctic Expeditions



I LIKE HOW SHE GETS EXCITED ABOUT EVERYTHING.

AH! WE CAN PUT THIS ROPE AROUND THIS BOX AND... OH! THIS POLE HERE!

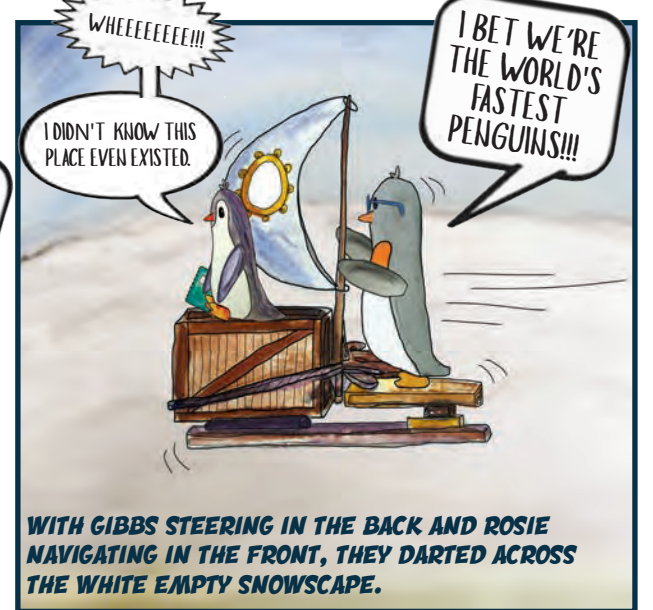


THAT'S WHAT I CALL AN ENGINEER!

BRILLIANT! THIS IS EVEN BETTER THAN FISH!

TA-DA! ALL ABOARD!

BETTER THAN FISH? NEVER THOUGHT I'D HEAR YOU SAY THAT...

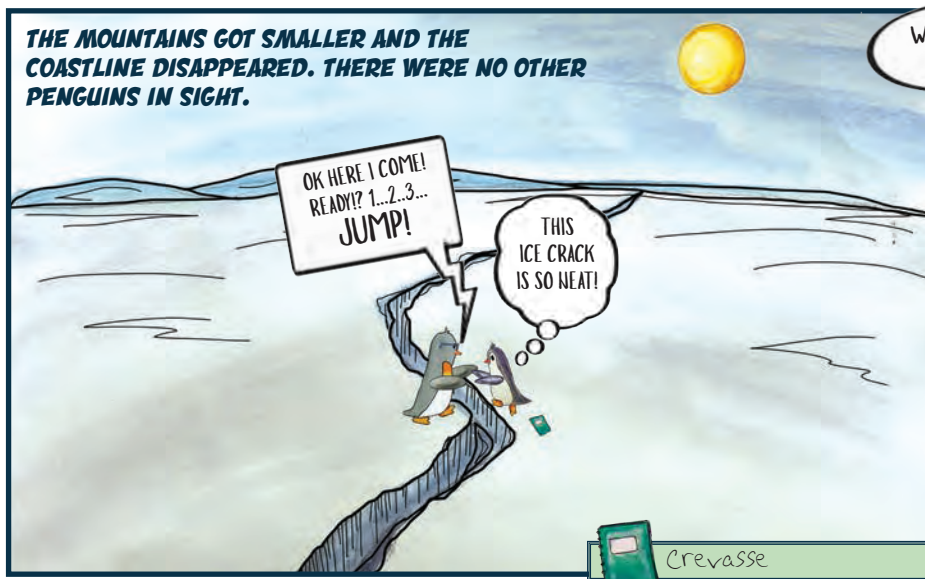


WHEEEEEEE!!!

I DIDN'T KNOW THIS PLACE EVEN EXISTED.

I BET WE'RE THE WORLD'S FASTEST PENGUINS!!!

WITH GIBBS STEERING IN THE BACK AND ROSIE NAVIGATING IN THE FRONT, THEY DARTED ACROSS THE WHITE EMPTY SNOWSCAPE.



OK HERE I COME! READY? 1...2...3... JUMP!

THIS ICE CRACK IS SO NEAT!

Crevasse

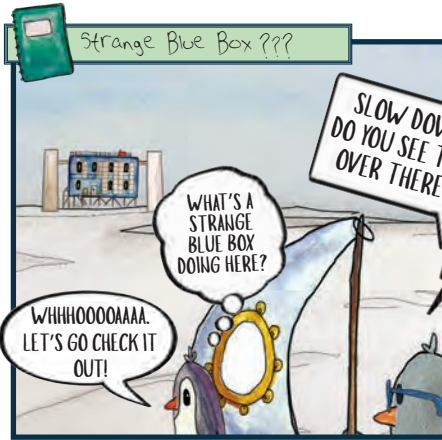


WE MAKE A PRETTY GOOD TEAM!

DON'T EVEN THINK ABOUT IT ROSIE...

YEAH! LOOK HOW DEEP THIS GOES! IT SURE WOULD BE FUN TO INVESTIGATE...

OH ALRIGHT.

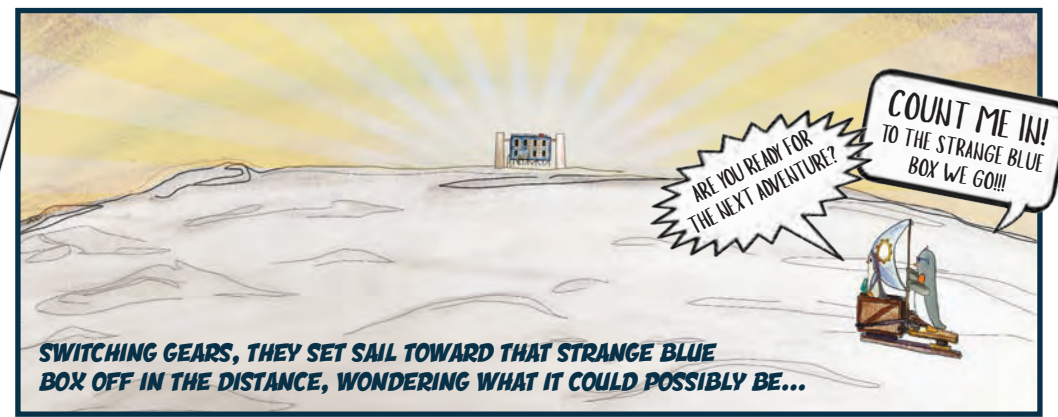


Strange Blue Box ???

WHHHOOOOAAA. LET'S GO CHECK IT OUT!

WHAT'S A STRANGE BLUE BOX DOING HERE?

SLOW DOWN! DO YOU SEE THAT OVER THERE?!

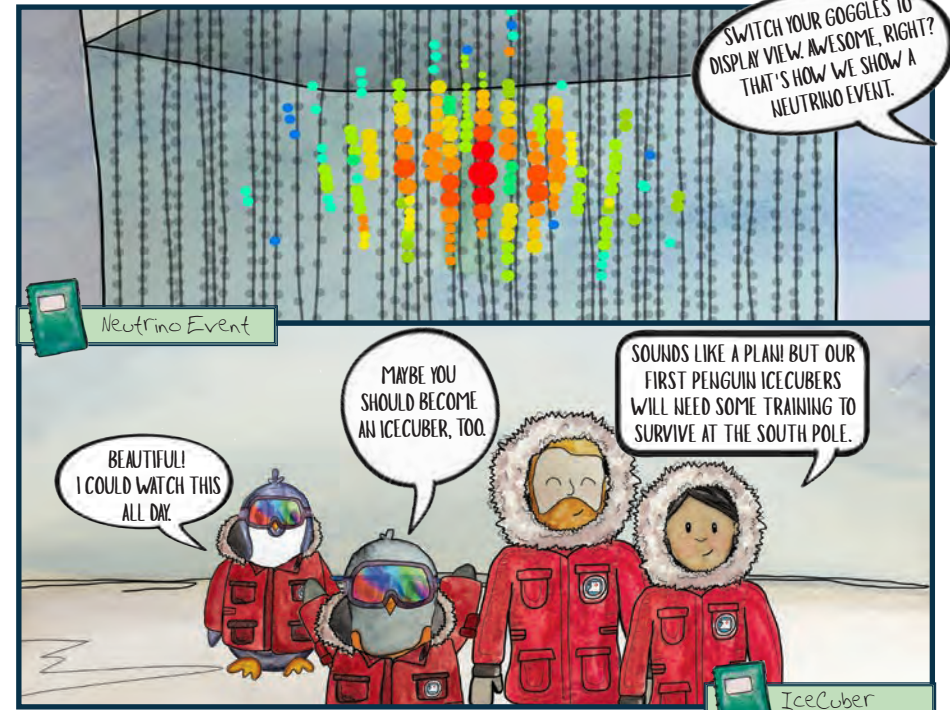
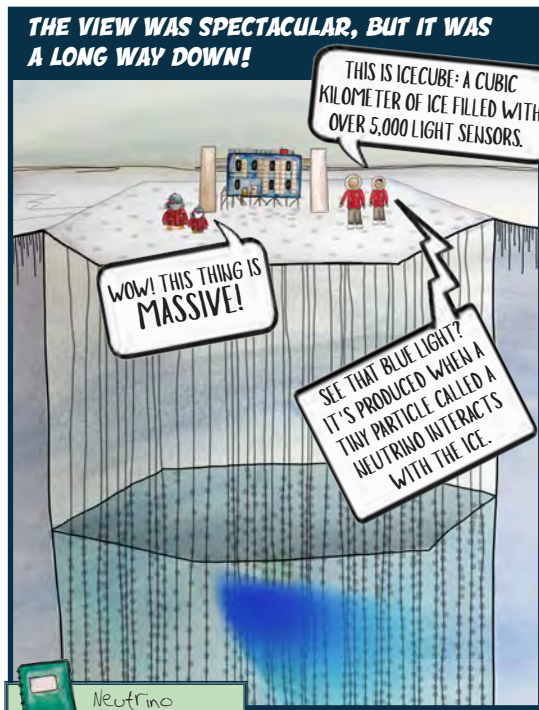
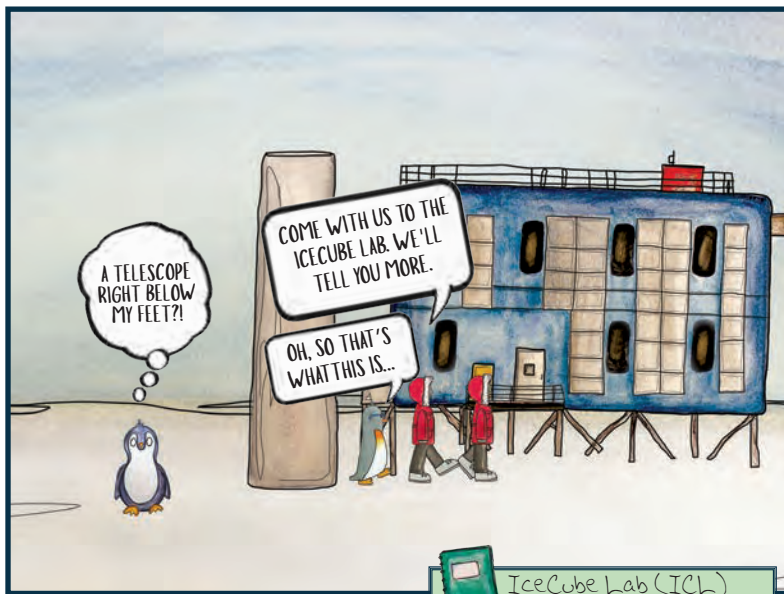
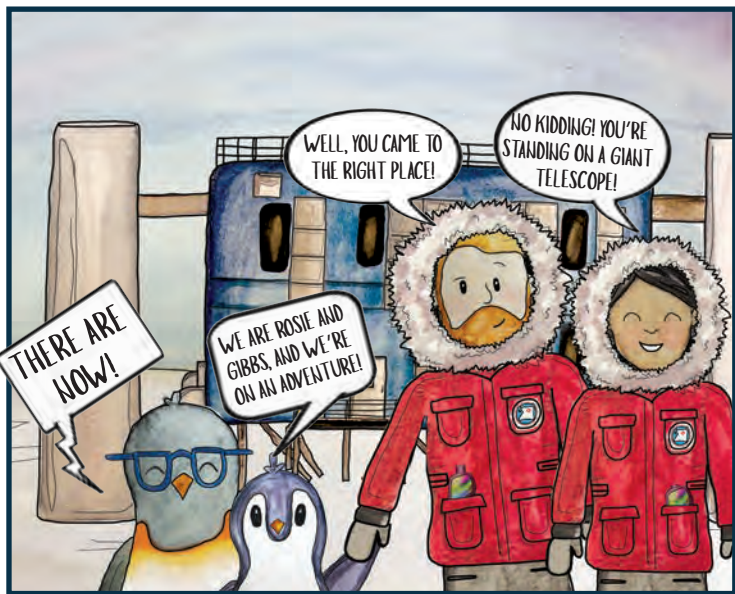
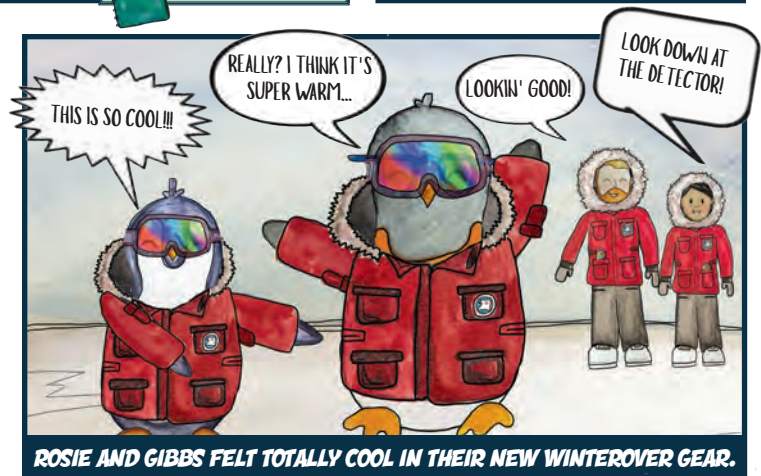
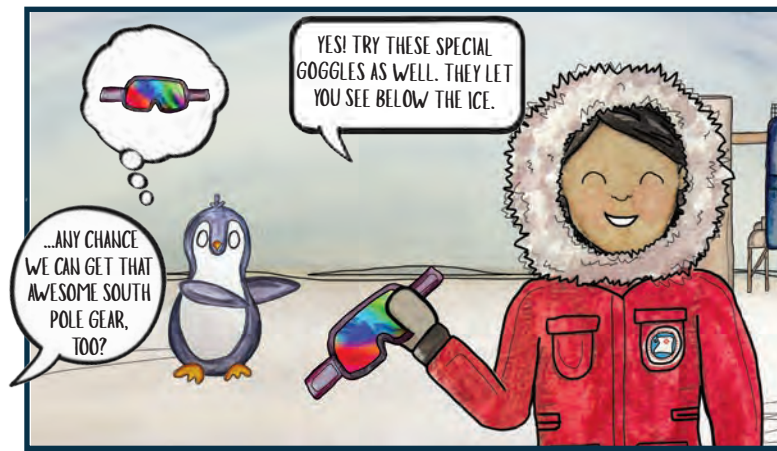
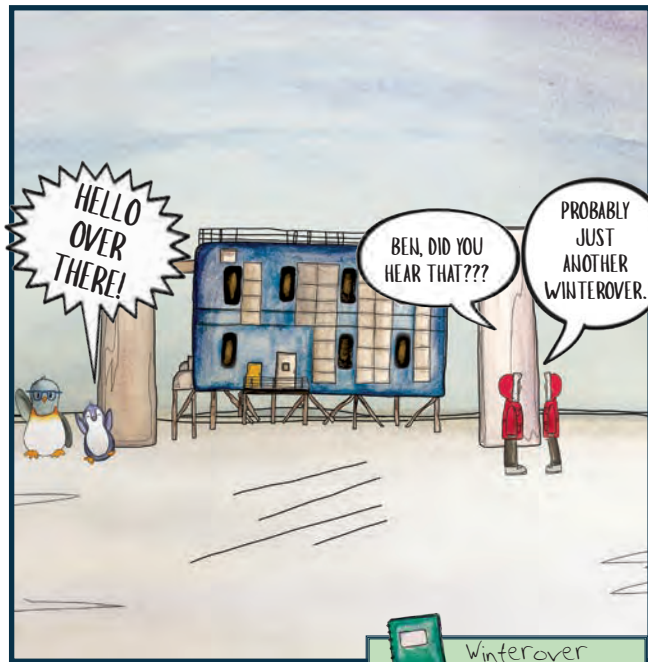
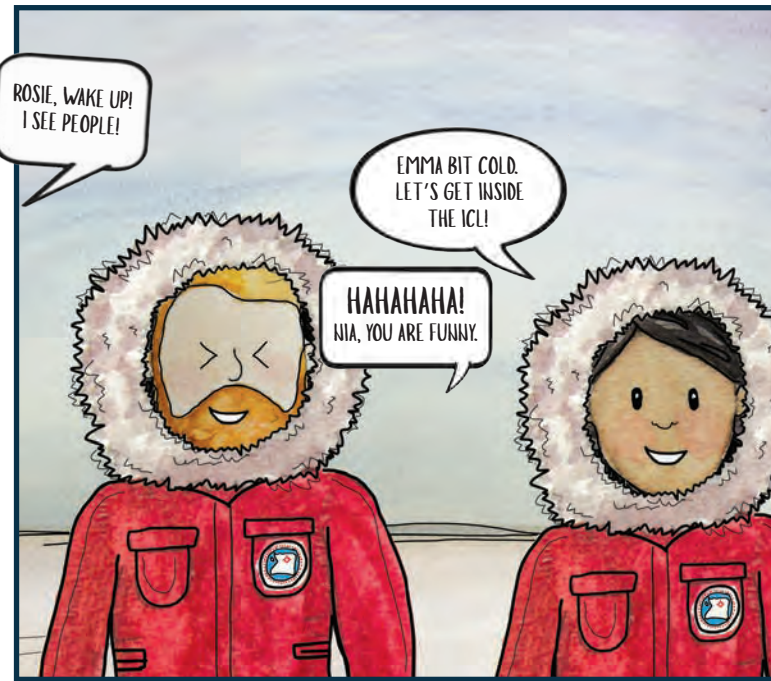


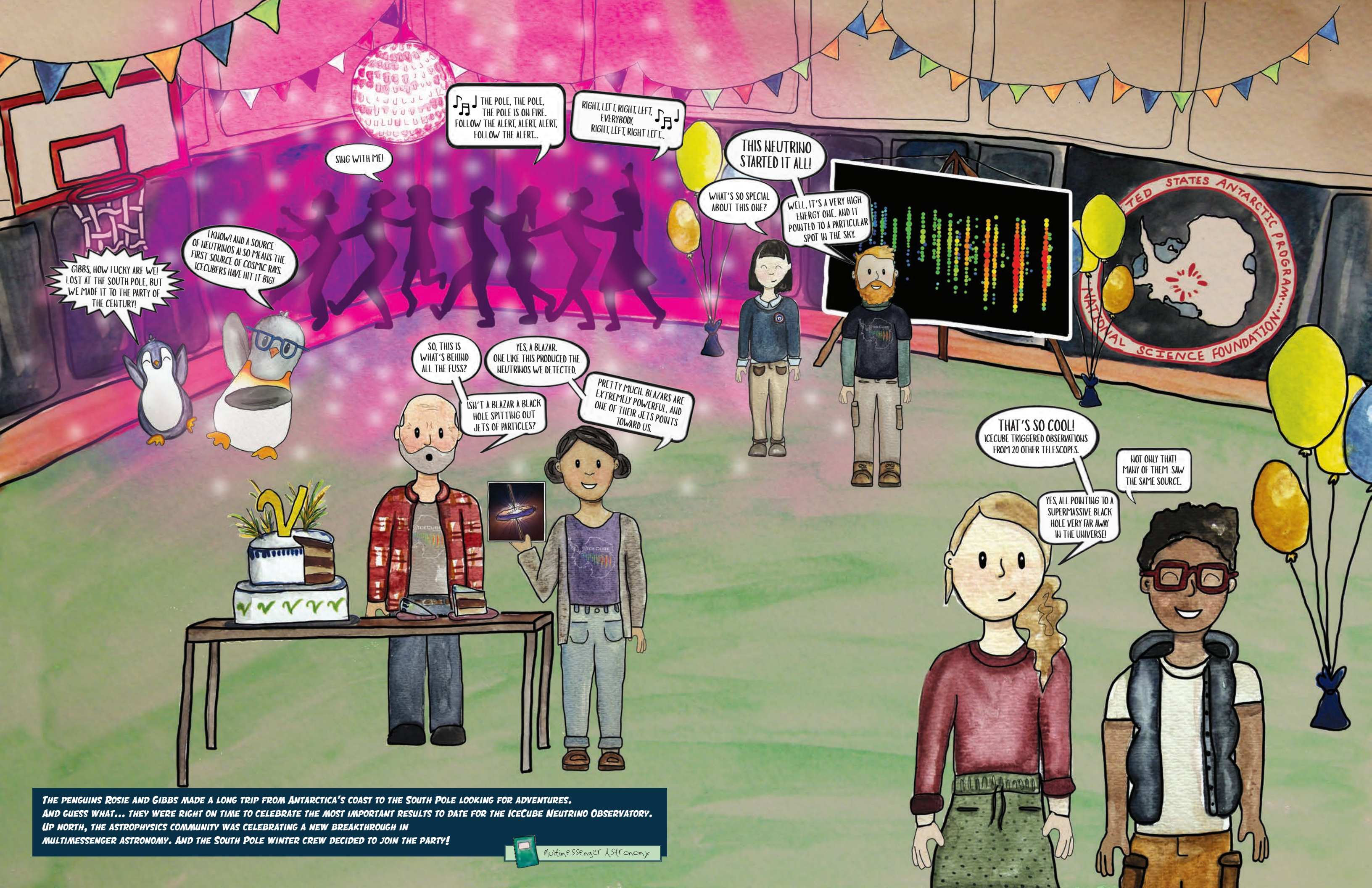
SWITCHING GEARS, THEY SET SAIL TOWARD THAT STRANGE BLUE BOX OFF IN THE DISTANCE, WONDERING WHAT IT COULD POSSIBLY BE...

ARE YOU READY FOR THE NEXT ADVENTURE?

COUNT ME IN! TO THE STRANGE BLUE BOX WE GO!!!

AFTER SO MUCH TRAVELING, ROSIE AND GIBBS FELL ASLEEP EXHAUSTED.





THE POLE, THE POLE,
THE POLE IS ON FIRE.
FOLLOW THE ALERT, ALERT, ALERT,
FOLLOW THE ALERT...

RIGHT, LEFT, RIGHT, LEFT,
EVERYBODY,
RIGHT, LEFT, RIGHT LEFT...

THIS NEUTRINO
STARTED IT ALL!

WHAT'S SO SPECIAL
ABOUT THIS ONE?

WELL, IT'S A VERY HIGH
ENERGY ONE. AND IT
POINTED TO A PARTICULAR
SPOT IN THE SKY.

I KNOW! AND A SOURCE
OF NEUTRINOS ALSO MEANS THE
FIRST SOURCE OF COSMIC RAYS.
ICECUBERS HAVE HIT IT BIG!

GIBBS, HOW LUCKY ARE WE!
LOST AT THE SOUTH POLE, BUT
WE MADE IT TO THE PARTY OF
THE CENTURY!

SING WITH ME!

SO, THIS IS
WHAT'S BEHIND
ALL THE FUSS?

YES, A BLAZAR.
ONE LIKE THIS PRODUCED THE
NEUTRINOS WE DETECTED.

PRETTY MUCH. BLAZARS ARE
EXTREMELY POWERFUL, AND
ONE OF THEIR JETS POINTS
TOWARD US.

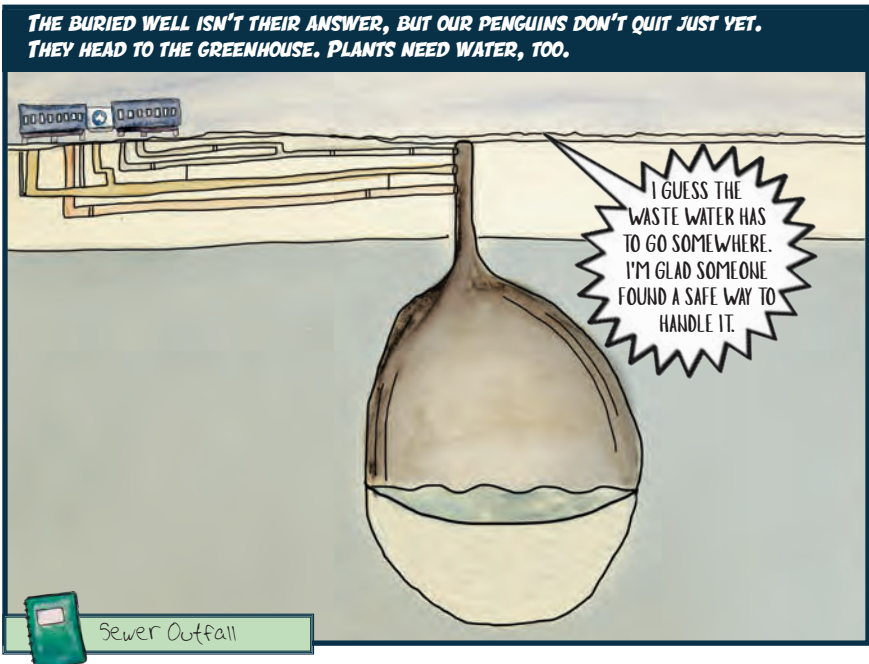
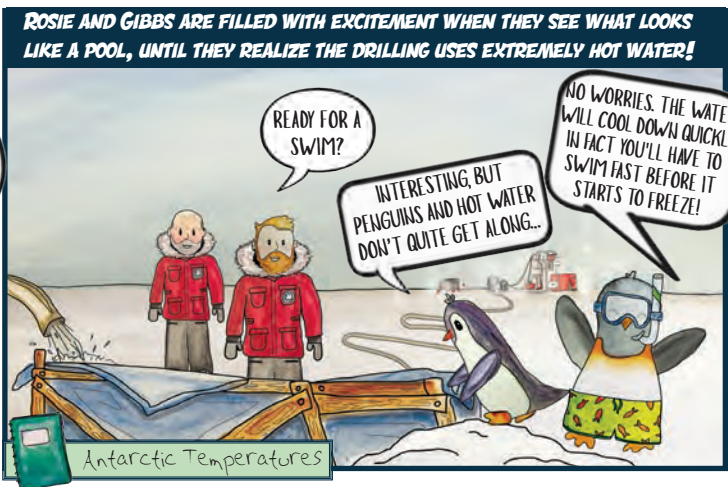
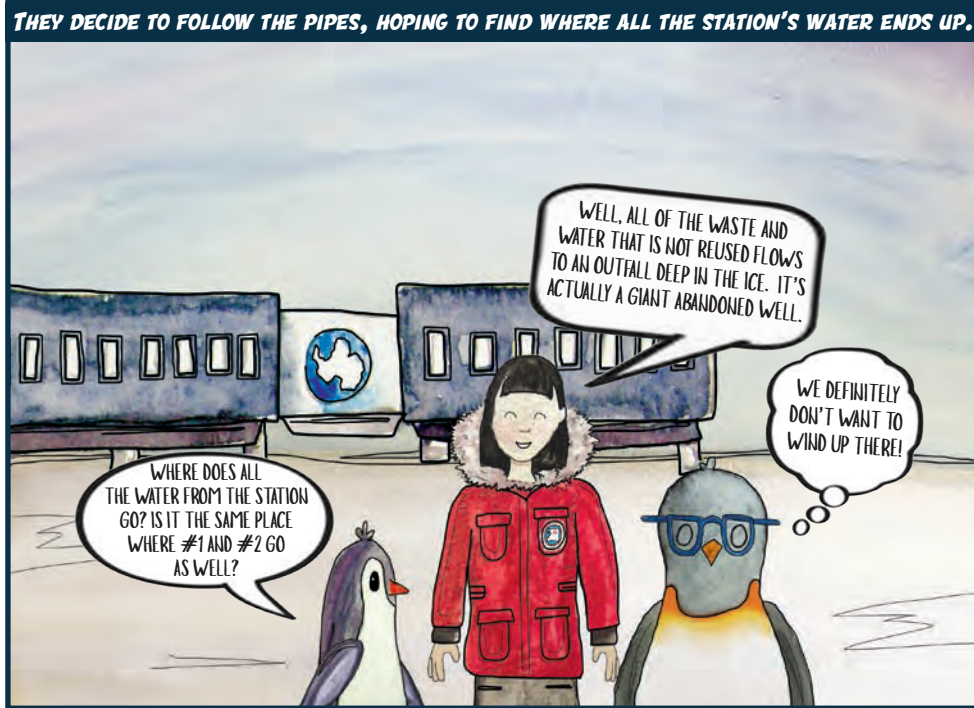
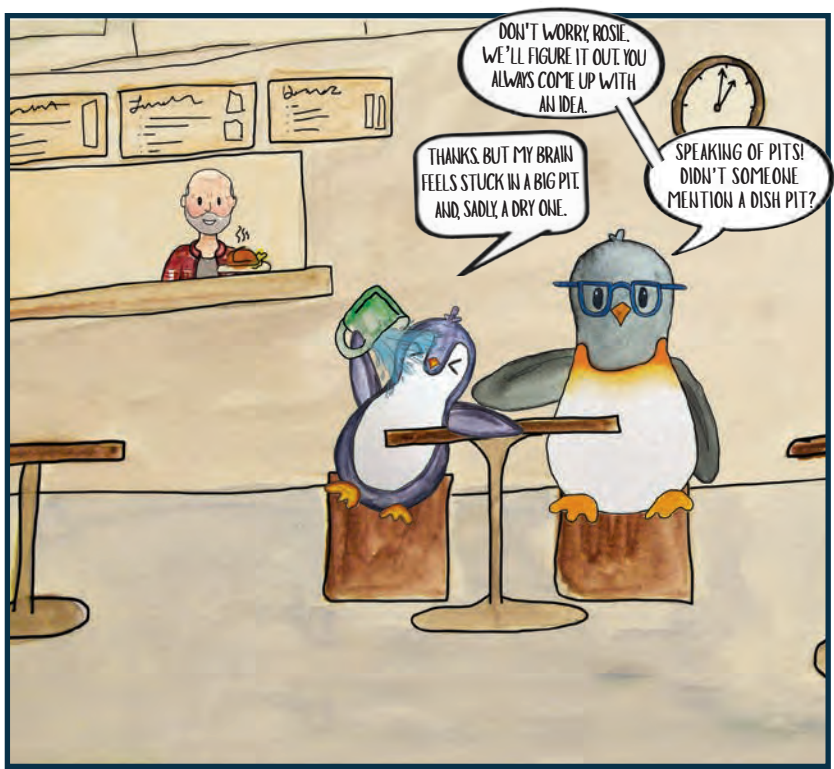
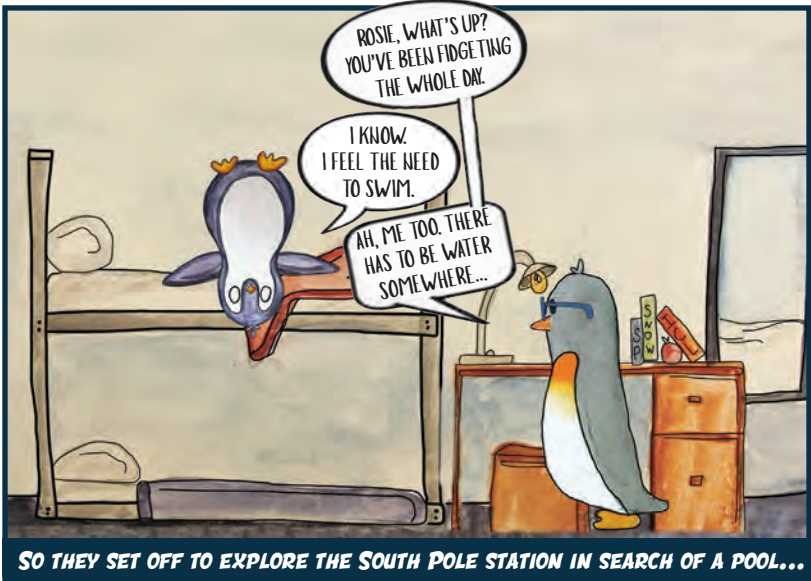
ISN'T A BLAZAR A BLACK
HOLE SPITTING OUT
JETS OF PARTICLES?

THAT'S SO COOL!
ICECUBE TRIGGERED OBSERVATIONS
FROM 20 OTHER TELESCOPES.

NOT ONLY THAT!
MANY OF THEM SAW
THE SAME SOURCE.

YES, ALL POINTING TO A
SUPERMASSIVE BLACK
HOLE VERY FAR AWAY
IN THE UNIVERSE!

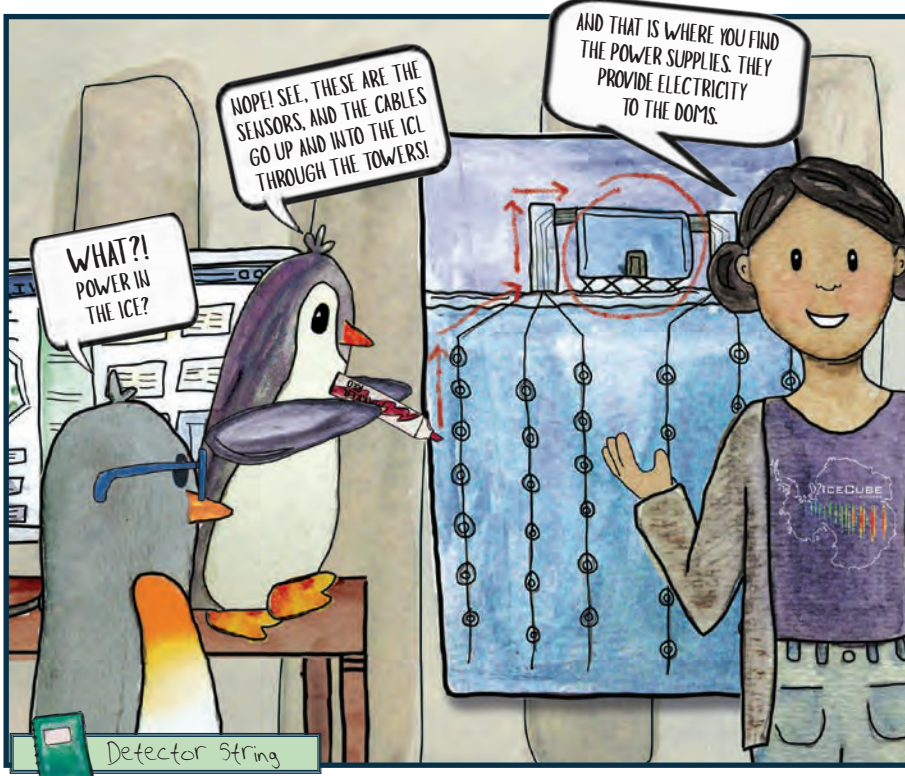
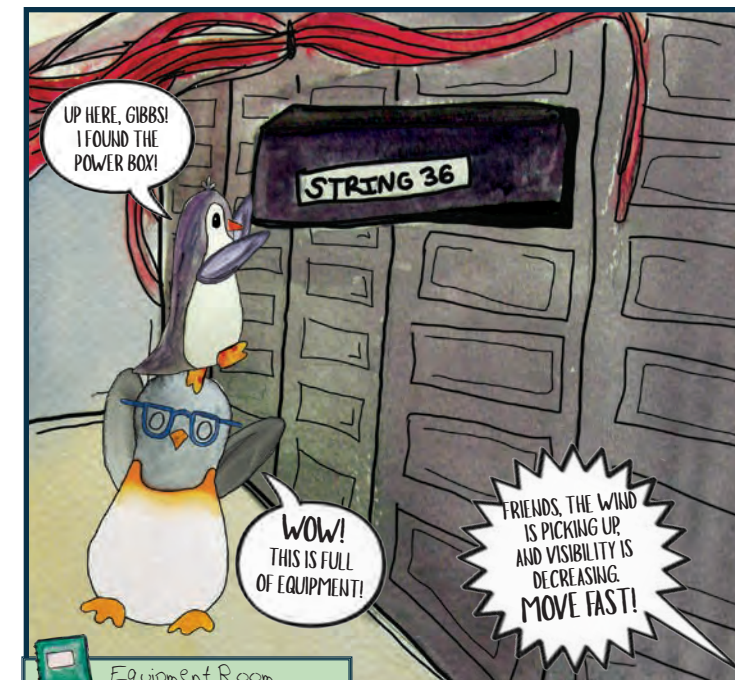
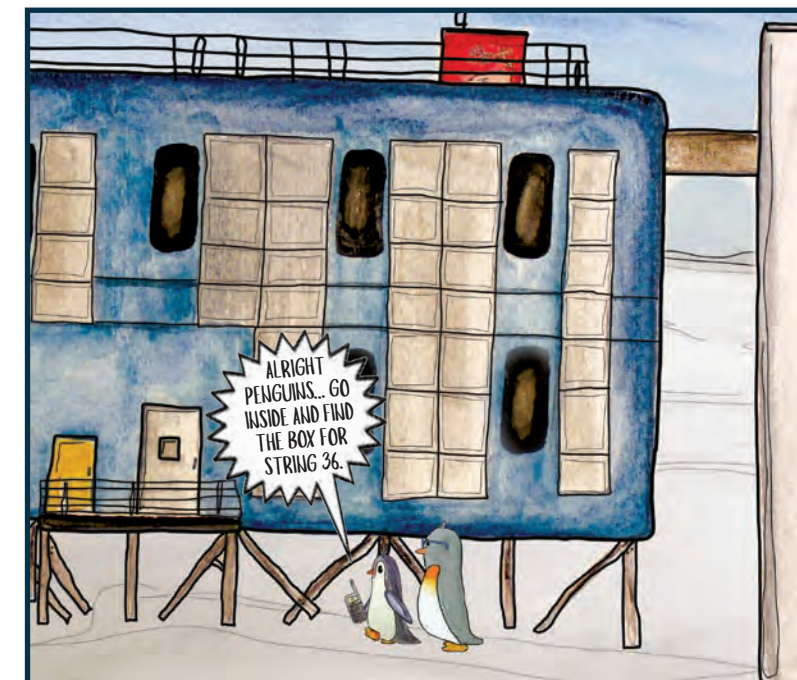
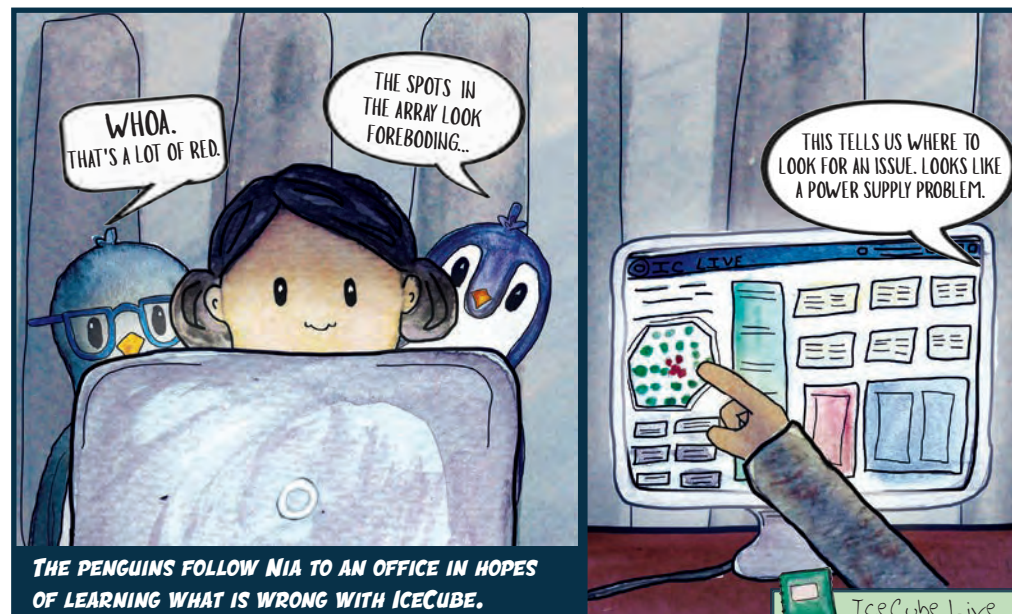
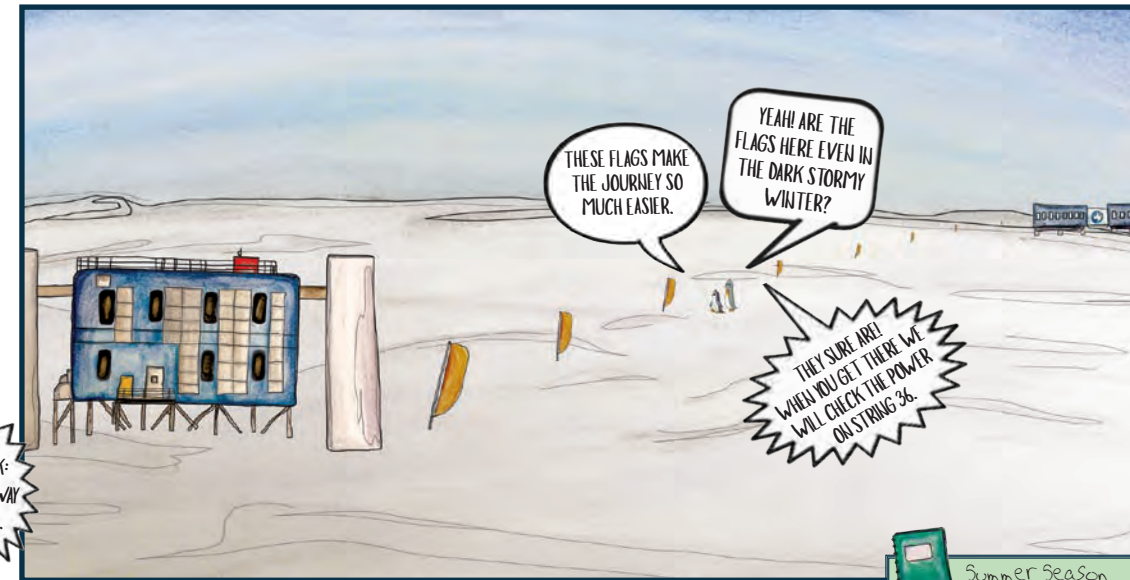
THE PENGUINS ROSIE AND GIBBS MADE A LONG TRIP FROM ANTARCTICA'S COAST TO THE SOUTH POLE LOOKING FOR ADVENTURES. AND GUESS WHAT... THEY WERE RIGHT ON TIME TO CELEBRATE THE MOST IMPORTANT RESULTS TO DATE FOR THE ICECUBE NEUTRINO OBSERVATORY. UP NORTH, THE ASTROPHYSICS COMMUNITY WAS CELEBRATING A NEW BREAKTHROUGH IN MULTIMESSENGER ASTRONOMY. AND THE SOUTH POLE WINTER CREW DECIDED TO JOIN THE PARTY!



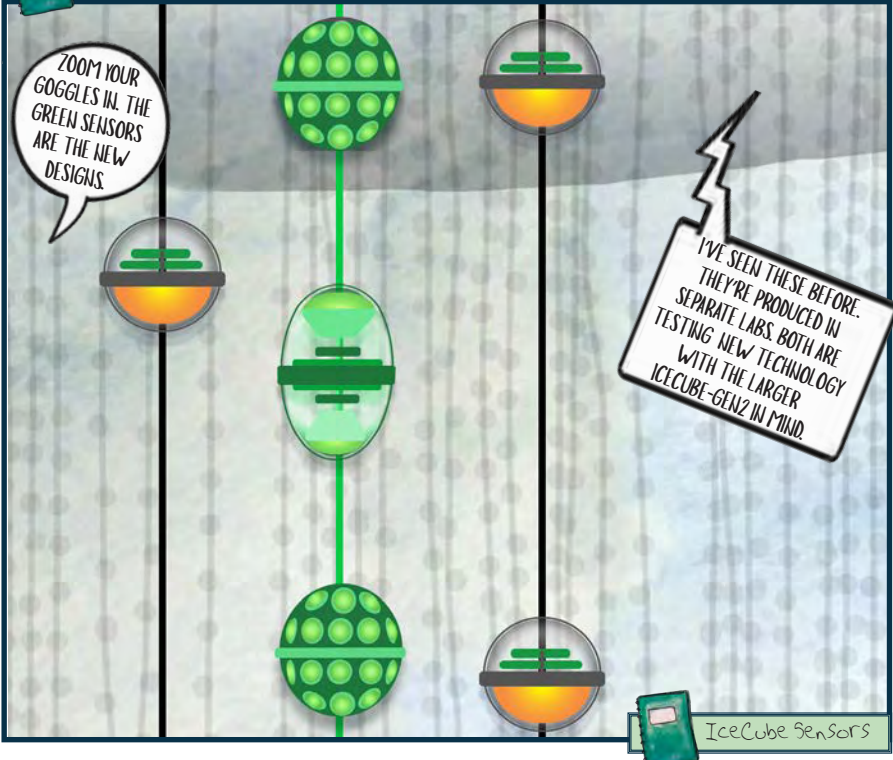
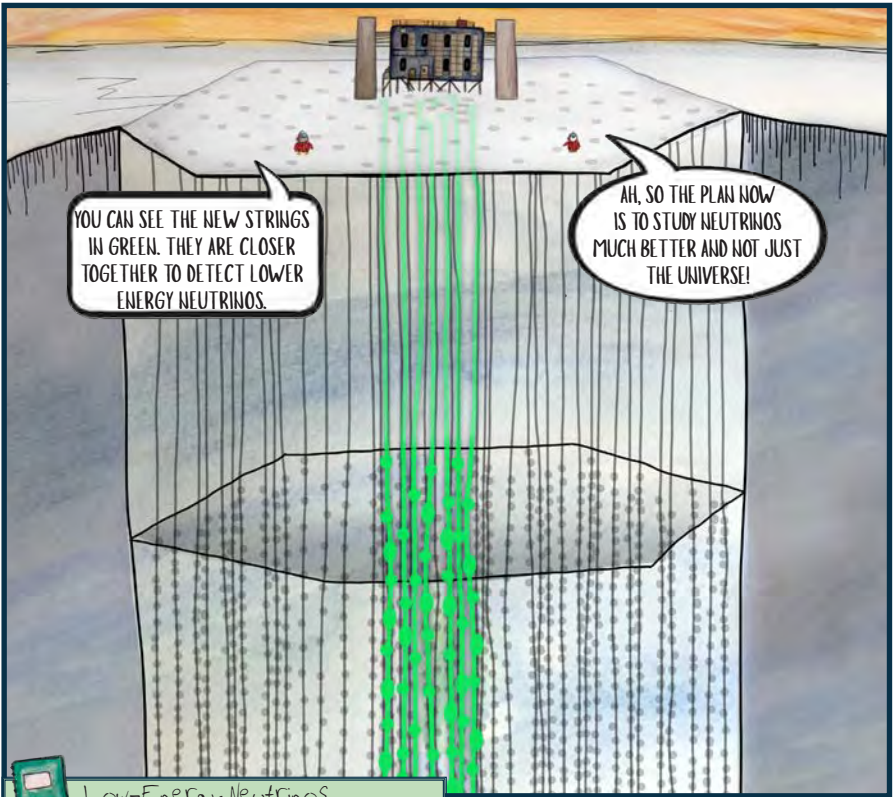
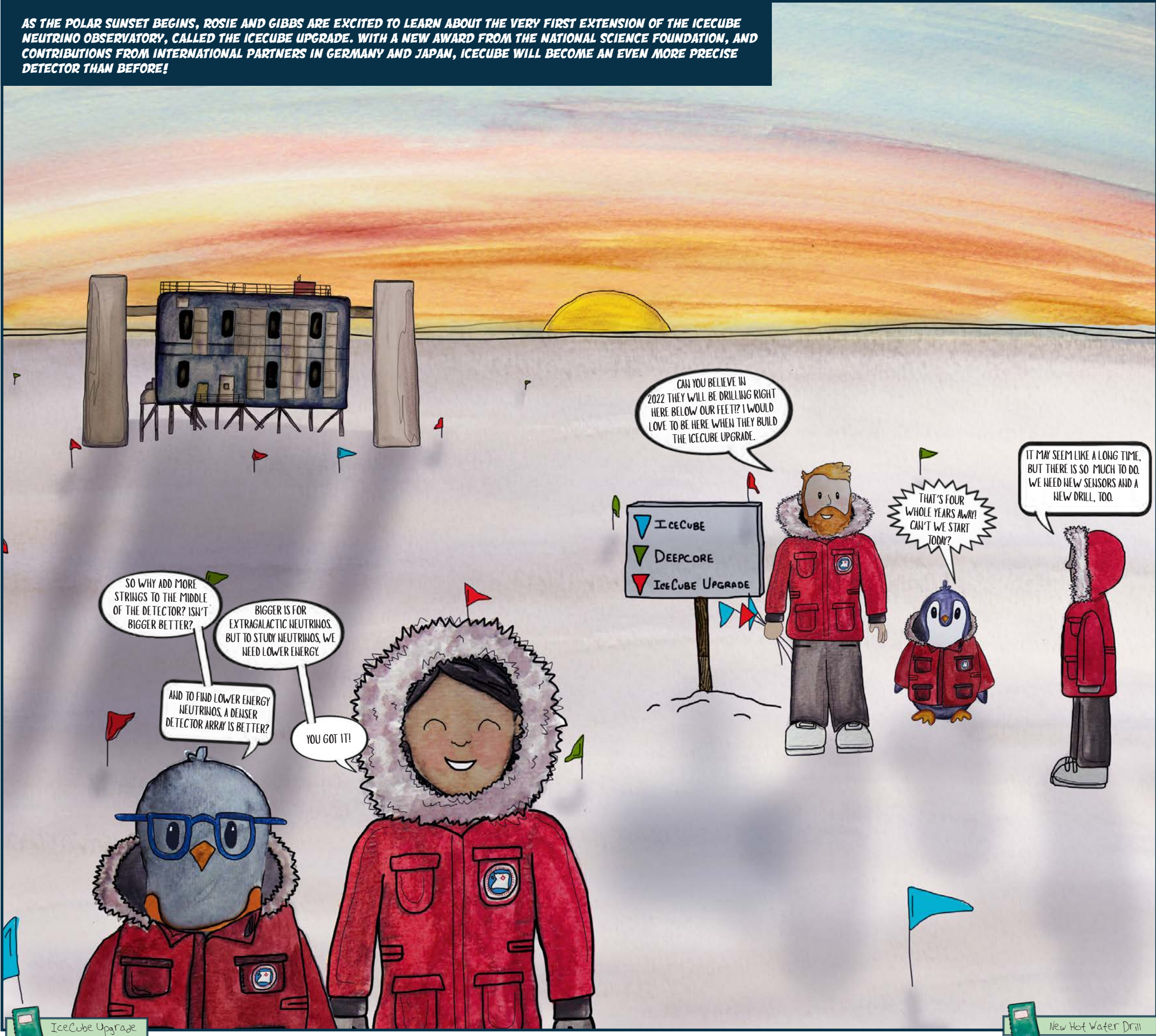
NOVEMBER STARTS THE SUMMER SEASON AT THE SOUTH POLE. MANY PEOPLE ARRIVE, INCLUDING NEW ICECUBE WINTEROVERS, WHO BEGIN THEIR YEARLONG JOB OF TAKING CARE OF ICECUBE.



WINTEROVERS HAVE TO BE READY FOR ANY AND ALL PROBLEMS THAT MIGHT COME THEIR WAY.



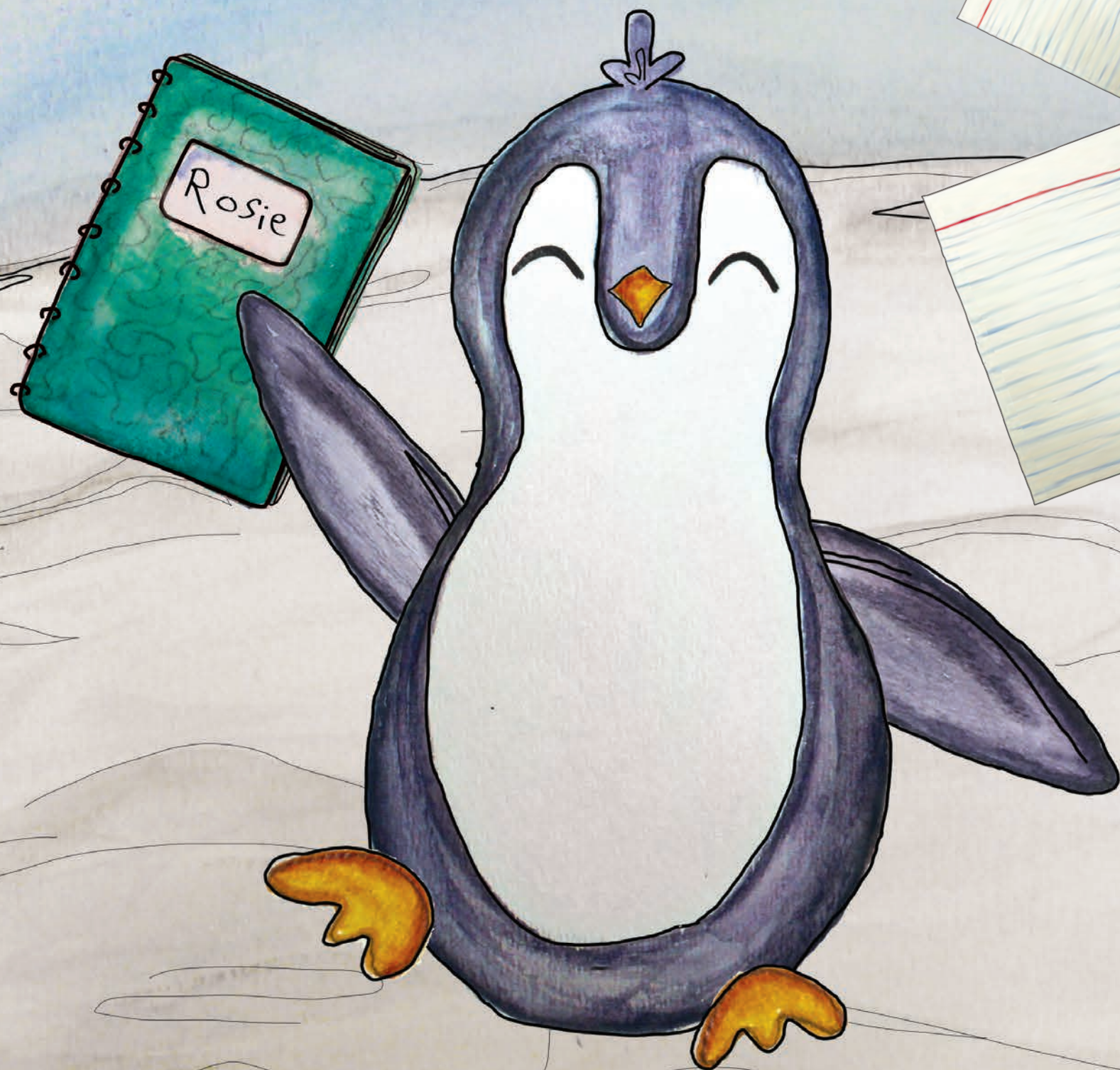
AS THE POLAR SUNSET BEGINS, ROSIE AND GIBBS ARE EXCITED TO LEARN ABOUT THE VERY FIRST EXTENSION OF THE ICECUBE NEUTRINO OBSERVATORY, CALLED THE ICECUBE UPGRADE. WITH A NEW AWARD FROM THE NATIONAL SCIENCE FOUNDATION, AND CONTRIBUTIONS FROM INTERNATIONAL PARTNERS IN GERMANY AND JAPAN, ICECUBE WILL BECOME AN EVEN MORE PRECISE DETECTOR THAN BEFORE!





THE SUN HAS SET AND THE AURORAS ARE OUT, LIGHTING THE WAY FOR ROSIE AND GIBBS AS THEY TRAVEL HOME. AFTER AN AWESOME SEASON AT THE ICECUBE NEUTRINO OBSERVATORY, THEY DECIDED IT'S TIME TO GO BACK TO THE OCEAN AND THEIR FAMILIES. THEY CAN'T WAIT TO TELL ALL THE OTHER PENGUINS ABOUT ICECUBERS, NEUTRINOS, AND THE INCREDIBLE DETECTOR DEEP IN THE ICE AT THE SOUTH POLE.

Rosie's Discoveries



Adventure 1 - March 2018

Antarctic toothfish:

A species of cod icefish that swims in extremely cold water. They can grow up to the size of a small human. And they are very delicious.

Emperor penguin:

The tallest penguin! They are known for their bright yellow and orange markings near their face. Male emperors will sit on their eggs in the freezing cold for two whole months. That's so neat!

Gentoo penguin:

That's me! We love to eat krill and fish. We are lighter in color when we are younger. I thought by now I would already have the cool white marks that older penguins have by their eyes, but I guess I will have to wait longer.

Penguin waddle or colony:

A group of penguins on land is called a waddle. In the water it is a raft of penguins. Other words include a rookery, a huddle, and a colony.

Crevasse:

A large crack that forms from stresses in the ice. Crevasses can be really deep and are sometimes hidden under the snow.

Antarctic expeditions:

In 1911, two expeditions were racing to be the first people to the South Pole. One was led by Roald Amundsen and the other by Robert Falcon Scott. Roald beat Robert by only a few weeks. I wonder if we are the first penguins to be in this part of Antarctica.

Strange blue box: ???

Adventure 2 - May 2018

Winterover

Winterovers are the few people who spend the long, dark winter at the South Pole. From February to October, which is wintertime in Antarctica, planes can't land at the Pole and the winterovers are totally isolated.

IceCube Lab (ICL)

The ICL is the only IceCube structure visible, since the detector is buried in the ice. It hosts racks of computers that collect lots of data all the time.

Detector

The IceCube detector consists of a grid of light sensors, called DOMs, attached to 86 cables, or strings, spread out over a cubic kilometer of ice. So, "Ice" + "Cube" is actually an appropriate name for this detector.

Neutrino

Neutrinos are tiny particles that travel through the universe. They are like light except that they sail through everything, even the entire Earth! Neutrinos are also called ghost particles because they are very hard to catch.

Neutrino Event

Scientists create colorful displays to show what happens as a result of a neutrino interacting with the ice in or around IceCube. A red DOM indicates the first light that was seen, while green and blue represent light seen later. The size of the bubble tells us how much energy was detected.

IceCuber

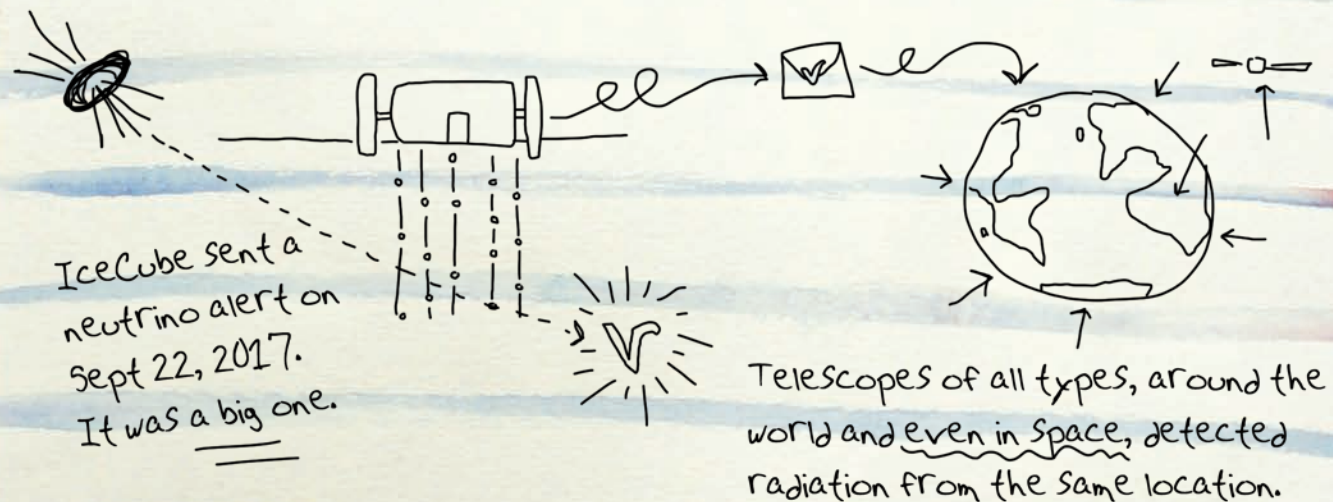
If you work at IceCube, whether or not you are a scientist, you are an IceCuber. I'm excited to be the first penguin on the team!

Adventure 3 - July 2018

A multimessenger astronomy discovery (or is it a neutrino discovery?)

This was such a fun day that I am not sure where to start!

Here is what happened. We have found that a supermassive black hole is the origin of some neutrinos detected by IceCube. It took them about 4 billion years to travel from their source to the South Pole. It's mind blowing!



It turns out that we knew this source! It's a blazar, or a black hole spitting out high-energy jets of particles along its axis. We had never seen neutrinos from a specific source before. Was this first neutrino the only one? No, IceCubers found over a dozen more neutrinos from using that alert as a pointer. And here we are! Learning more about the discovery with IceCube's winterovers!

Is this neutrino astronomy? Or is this multimessenger astronomy? I'd say it's both! And it may happen again soon! I need to talk to Gibbs. I'm not going back home to Antarctica's coast until the next exciting neutrino shows up.

Adventure 4 - October 2018

Sewer outfall

All of the waste water at the pole, including water from the showers, toilets, and kitchen, flows in pipes to giant, old, dry wells in the ice. There the waste is frozen.

Hydroponic farming

The garden at the South Pole has no soil; instead, they set the plant's roots into mineral-enriched water, which allows the plants to grow. Volunteers from the station help grow things like greens or tomatoes that cannot be frozen and shipped to the Pole like other foods.

IceCube drill

IceCubers used a hot-water drill to make deep holes in the dark ice to build the IceCube detector. After the holes were melted, the DOMs were strung all the way down to the bottom of the water-filled holes.

Antarctic temperatures

It turns out that Antarctica is not only the coldest place on earth but also the driest. No wonder we had a hard time finding water. Temperatures can range anywhere from -83°C to -12°C . Wow!

Water at the South Pole station

First, I was surprised not to find water at the station, but it makes sense now. After all, we're living in a desert, in a frozen desert! Even in summer, everything is frozen. Melting ice and keeping it liquid is not an easy thing! I've learned that they use the heat provided by the electric power generator plant to melt the ice for the water used at the station. The water is actually too pure for the people to drink so they add minerals to it! How cool is that!

Adventure 5 - January 2019

Hercules aircraft

The Hercules planes, or "HerCs" as they're called, come and go bringing people and supplies to the Pole between November and February. It is so neat how they can land and take off from the ice! It is always an exciting day when one lands. I want to learn how to park one at the fuel pit.

IceCube Live

There is a ton of information coming from the IceCube detector every minute. IceCube Live is the program that collects and displays all that information. It is a big help to winterovers at the Pole and IceCubers all over the world to see what is happening under the ice.

Detector string

Power and information is carried from the ICH to the in-ice sensors by strings. The strings are in a hexagonal grid and hold 60 sensors each. They go as deep as 2450 m into the ice!

Summer season

Summer at the Pole is one loooooong day, lasting 6 months. There is only one sunrise and sunset a year! When the sun is up, IceCubers are hard at work while the weather is manageable. When the sun sets, winter comes and the conditions are too harsh for anyone to travel, or be outside for very long.

Equipment room

The ICH is full of equipment. For each string, there is a computer box that contains the power supply and lots of other technical parts needed for the detector to run. I was happy we found the box we were looking for before the weather got bad.

Adventure 6 - April 2019

IceCube Upgrade

This IceCube extension will deploy 7 new strings in the middle of the current array and will have a total of 760 new sensors. Strings will go even deeper than before, down to 2600 meters. And the plan is to drill the 7 holes in one season. There's a second extension of IceCube planned, called IceCube-Gen 2. This one is to build a 10-times-larger detector and to look for very high energy neutrinos from outer space. I'm amazed, but if there's a team that can build it, it's the IceCubers.

New hot water drill

The drill is the most critical piece of equipment for this new project. It will use near boiling water to efficiently make holes in which to put the new sensors.

Low-energy neutrinos

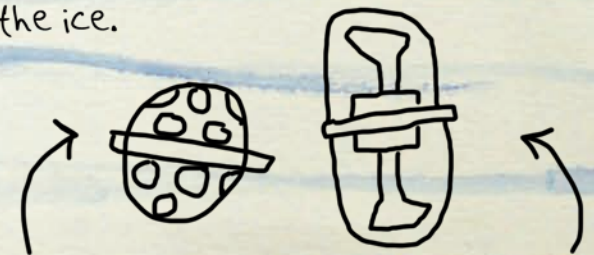
What IceCube calls low-energy neutrinos are in fact high-energy for other detectors. These are neutrinos created in Earth's atmosphere that can be used to study the properties of neutrinos themselves.

IceCube sensors

These are all light sensors that can detect the blue light produced by neutrino and other particle interactions in the ice.



This is the one used in the current IceCube.



These two will be used for the first time in the IceCube Upgrade. They will be produced in Germany and Japan.

ROSIE AND GIBBS

in real life!



EMPEROR AND GENTOO PENGUINS

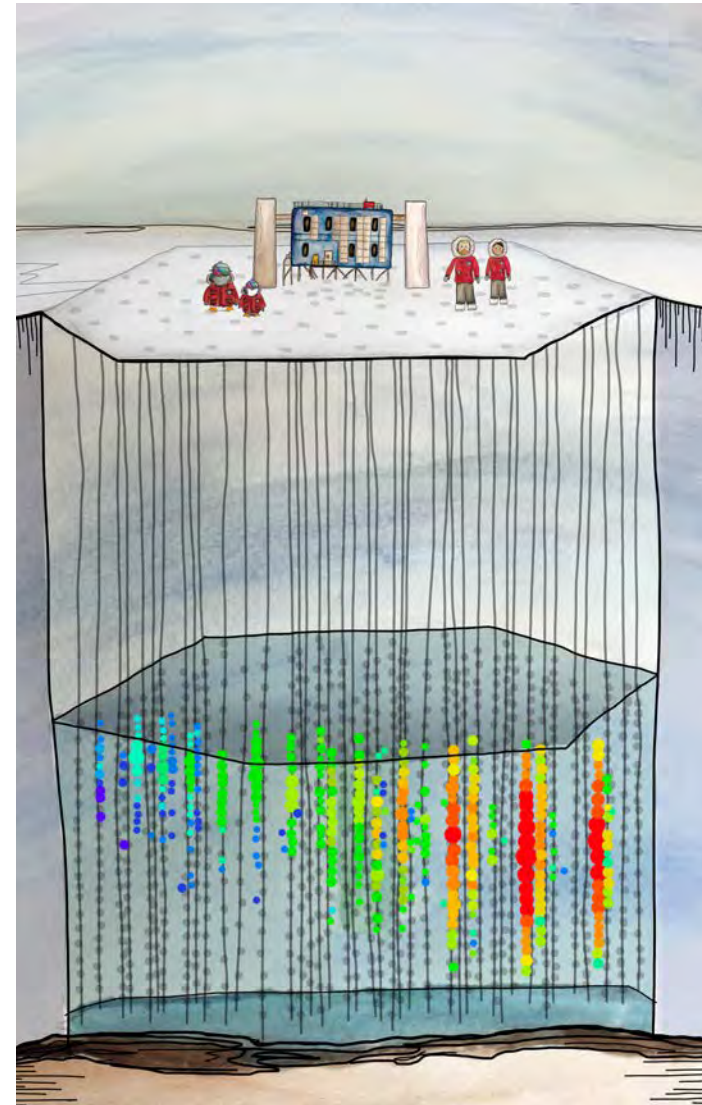


Emperor Penguins // Glenn Grant, National Science Foundation

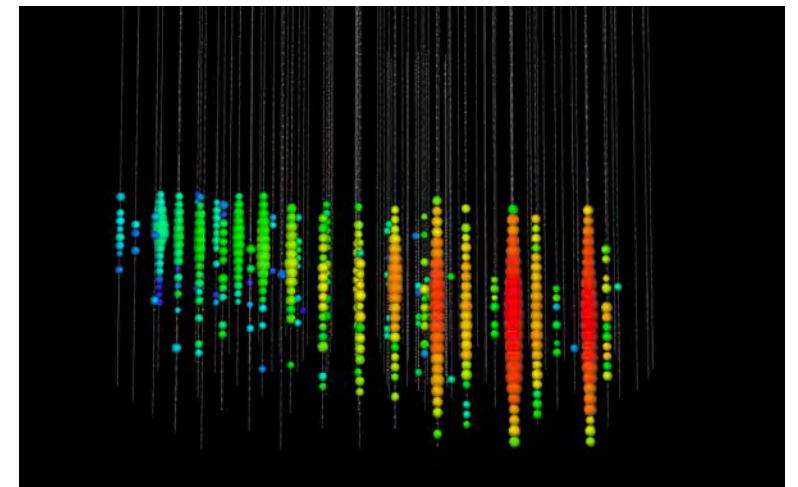


Gentoo Penguins // Melissa Rider, National Science Foundation

ICECUBE LAB AND ICECUBE EVENT



ICL // Martin Wolf, IceCube/NSF



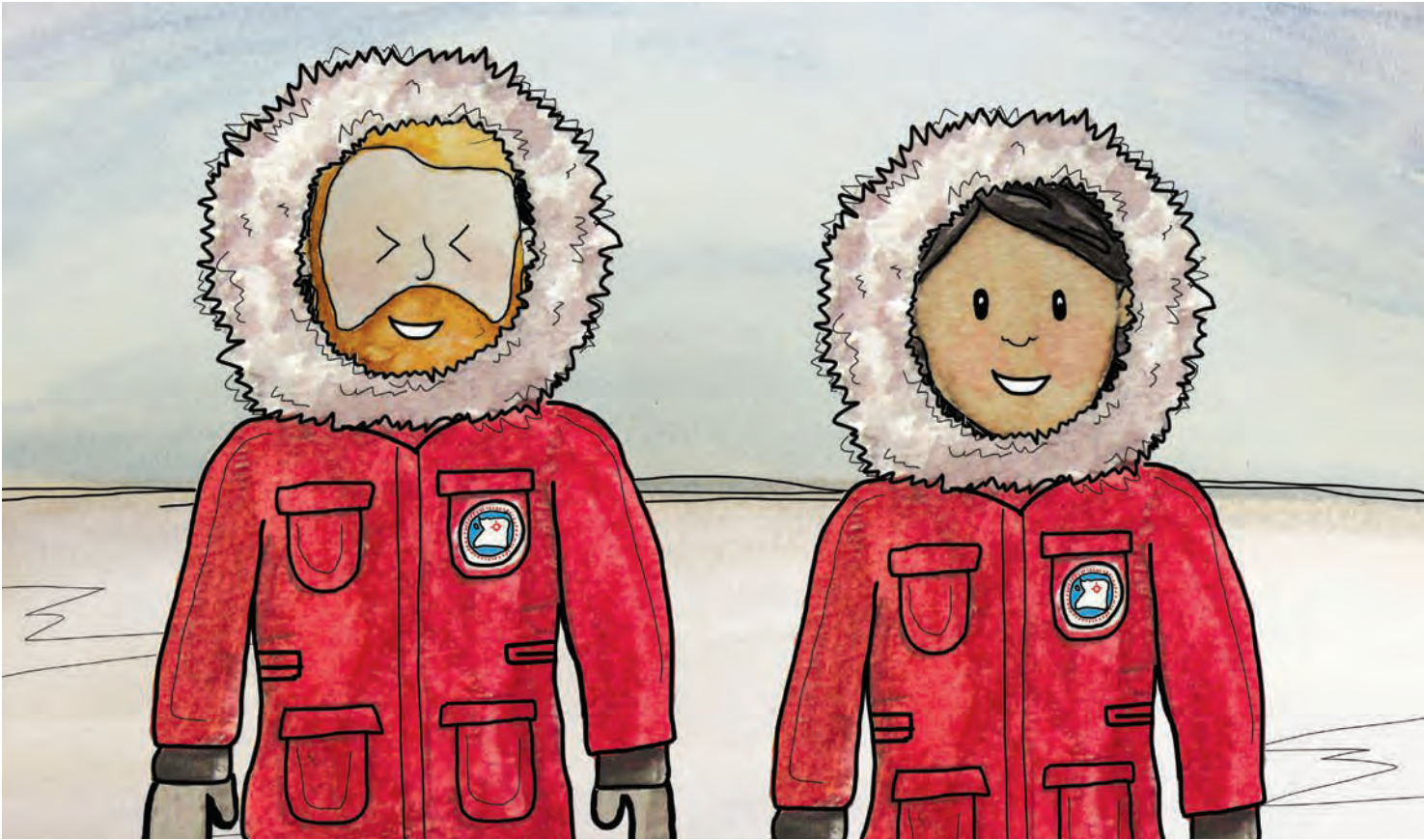
IceCube Event // IceCube Collaboration

HERCULES AIRCRAFT

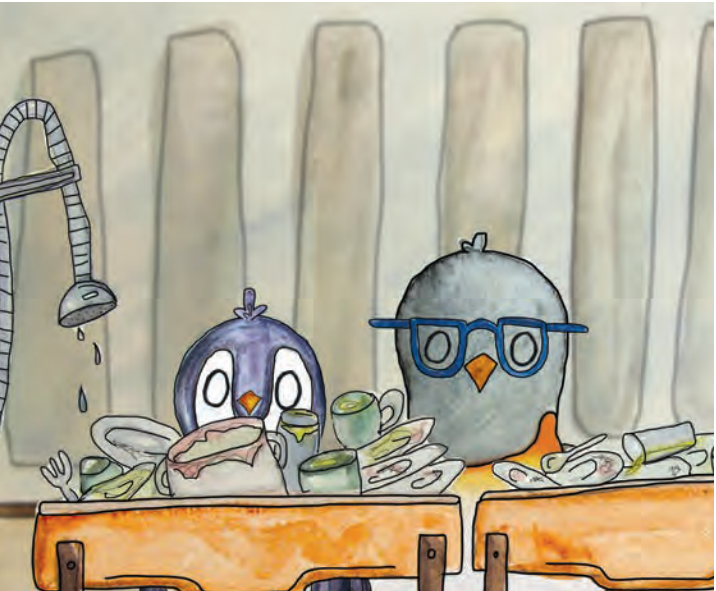


Hercules // Gonzalo Merino, IceCube/NSF

ICECUBE WINTEROVERS

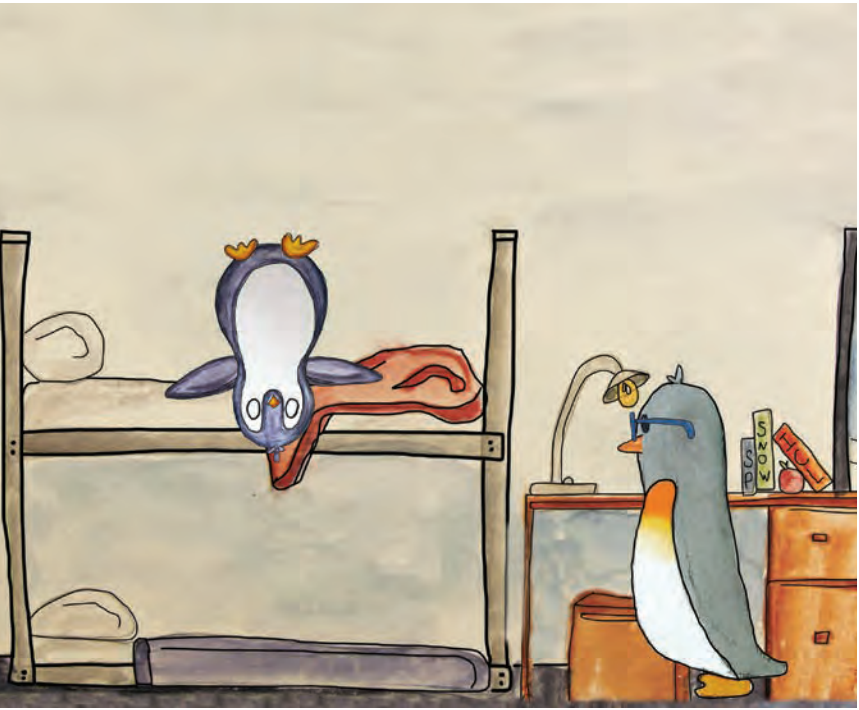


SOUTH POLE STATION DISH PIT



2017 Winterovers // David Riebel, NOAA/NSF

SOUTH POLE STATION SLEEPING QUARTERS

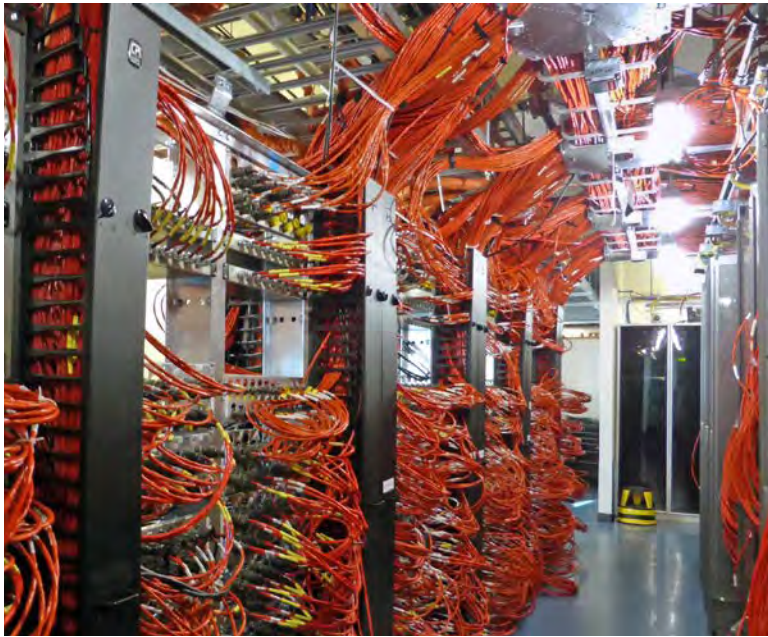


Sleeping Quarters // IceCube/NSF



2018 Winterovers // Johannes Werthebach, IceCube/NSF

ICECUBE EQUIPMENT ROOM



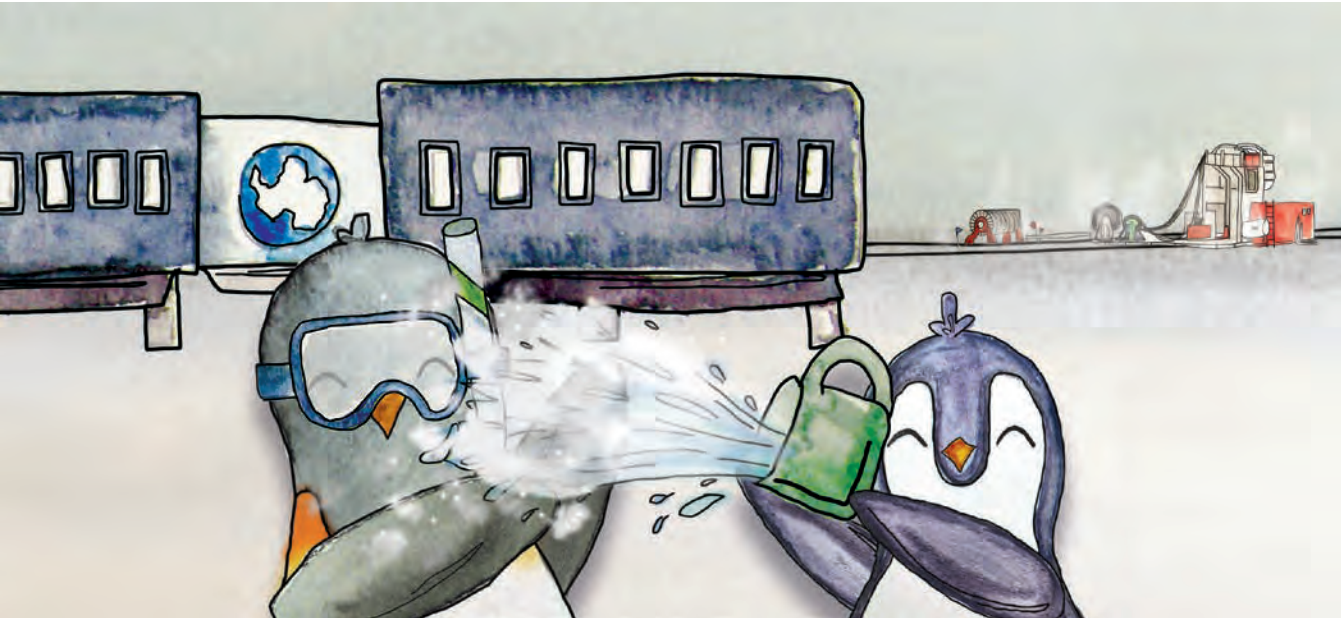
Inside ICL // Delia Tosi, IceCube/NSF

SOUTH POLE STATION GREENHOUSE

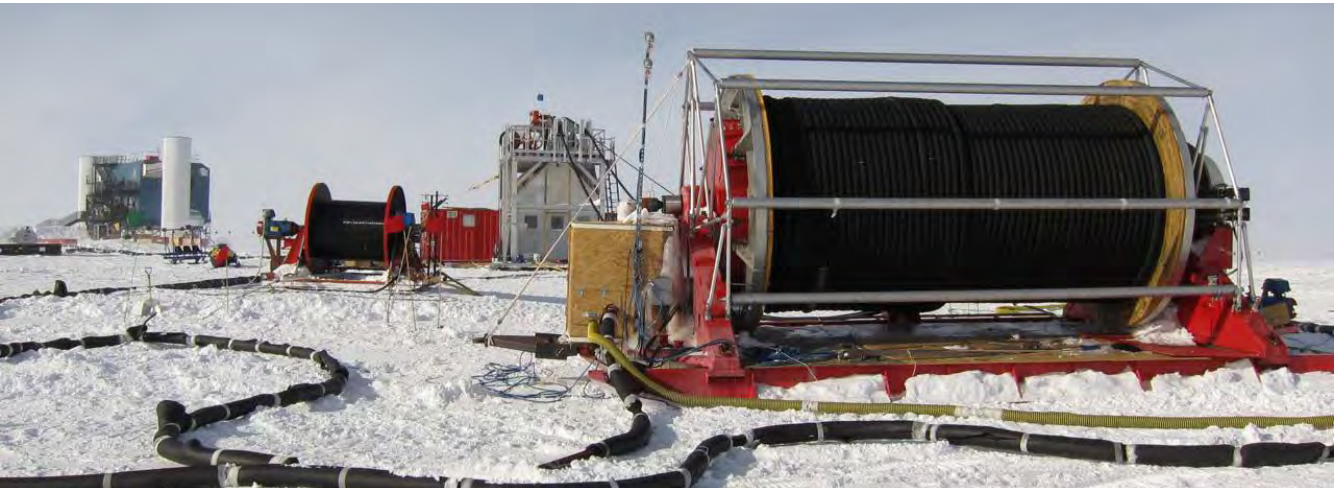


Greenhouse // Darryn Schneider, National Science Foundation

AMUNDSEN-SCOTT SOUTH POLE STATION AND ICECUBE DRILL



South Pole Station // National Science Foundation



ICL and IceCube Drill // Jim Haugen, IceCube/NSF

DID YOU KNOW?

THERE ARE NO PENGUINS AT THE SOUTH POLE.

You heard it right! There are no penguins at the South Pole. Rosie and Gibbs were the first! The South Pole is a dry desert. There is no open water or other resources needed for penguins to survive. Penguins enjoy the coastal climate of Antarctica. The only reason humans can survive at the Pole is because of the resources made available by the National Science Foundation's Amundsen-Scott South Pole Station. IceCubers have been supported by NSF from the beginning to make IceCube possible.

ROSIE AND GIBBS GOT THEIR NAMES FROM VERY SPECIAL PEOPLE.

Rosie is named after a British explorer and polar adventurer born in the 1960s named Rosie Stancer. Among her many adventures, she is well-known for getting first place in the McVities All Women's Penguin Polar Relay in 1997 and skiing solo in the Snickers South Pole Solo 2004 expedition. Amazing!

Gibbs is named after the one and only George Washington Gibbs Jr. Not only was he a sailor in the US Navy, but he was the very first African American to set foot on Antarctica. There is a location on the Antarctic Peninsula named after his feat, Gibbs Point. Gibbs served on the United States Antarctic Service Expedition in 1939 and later went on to get a degree in Education.

THIS COMIC SERIES IS HAND-PAINTED WITH WATERCOLORS.

After the Rosie & Gibbs team developed an initial story idea, each detail was brought to life first with watercolor paintings. The images were then digitized and manipulated to create the comic you see today. Characters such as the penguins and winterovers were painted in pieces and then layered together. This allowed the same paintings to be used again and again by the artist to keep the comic visually consistent.

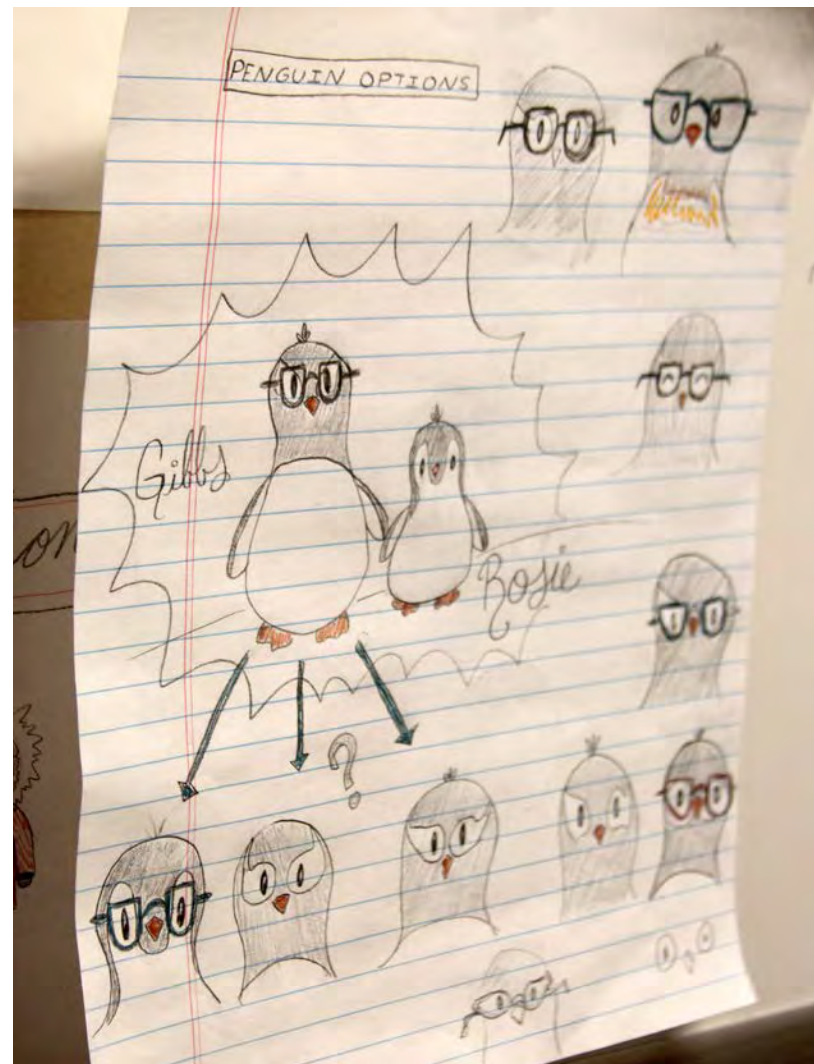
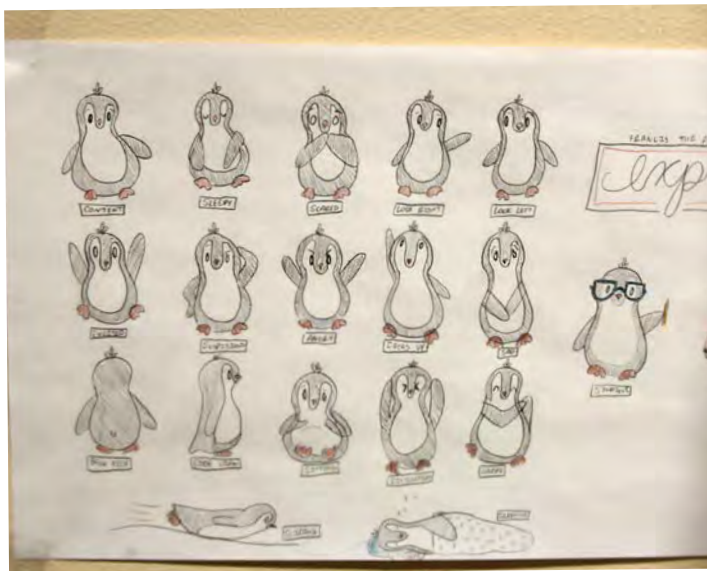
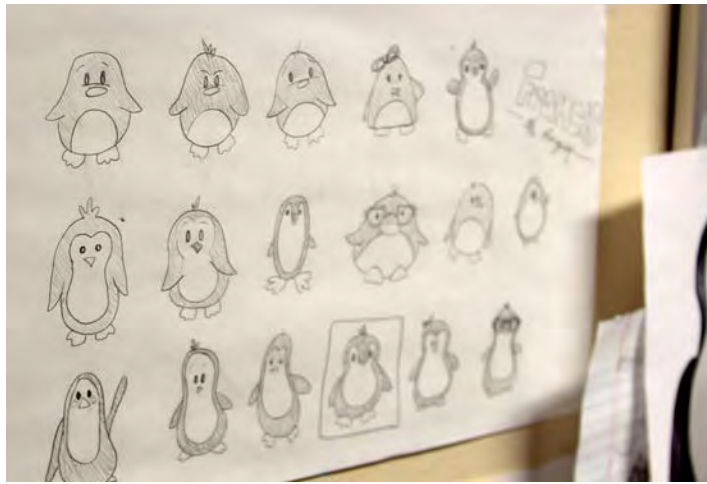
THE SCIENCE IS REAL.

We may have talking penguins and crazy goggles that let you see below the ice, but besides these few fictional aspects of our comic, all the science is real. The IceCube Neutrino Observatory is busy everyday detecting neutrinos. For more information on the science presented in these comics, you can visit our website at icecube.wisc.edu.

ROSIE AND GIBBS COULD BE YOU.

We chose two penguins, one an energetic female and another named after an African American, because we believe that everyone fits in at IceCube and at the South Pole station. Whether your passion is for STEM or ART, we hope that you are pursuing it, just like Rosie and Gibbs.





THE MAKING OF ROSIE AND GIBBS



STEP 1: Brainstorm characters

STEP 2: Design final characters

STEP 3: Write a story

STEP 4: Storyboard and sketch



STEP 5: Draw and paint

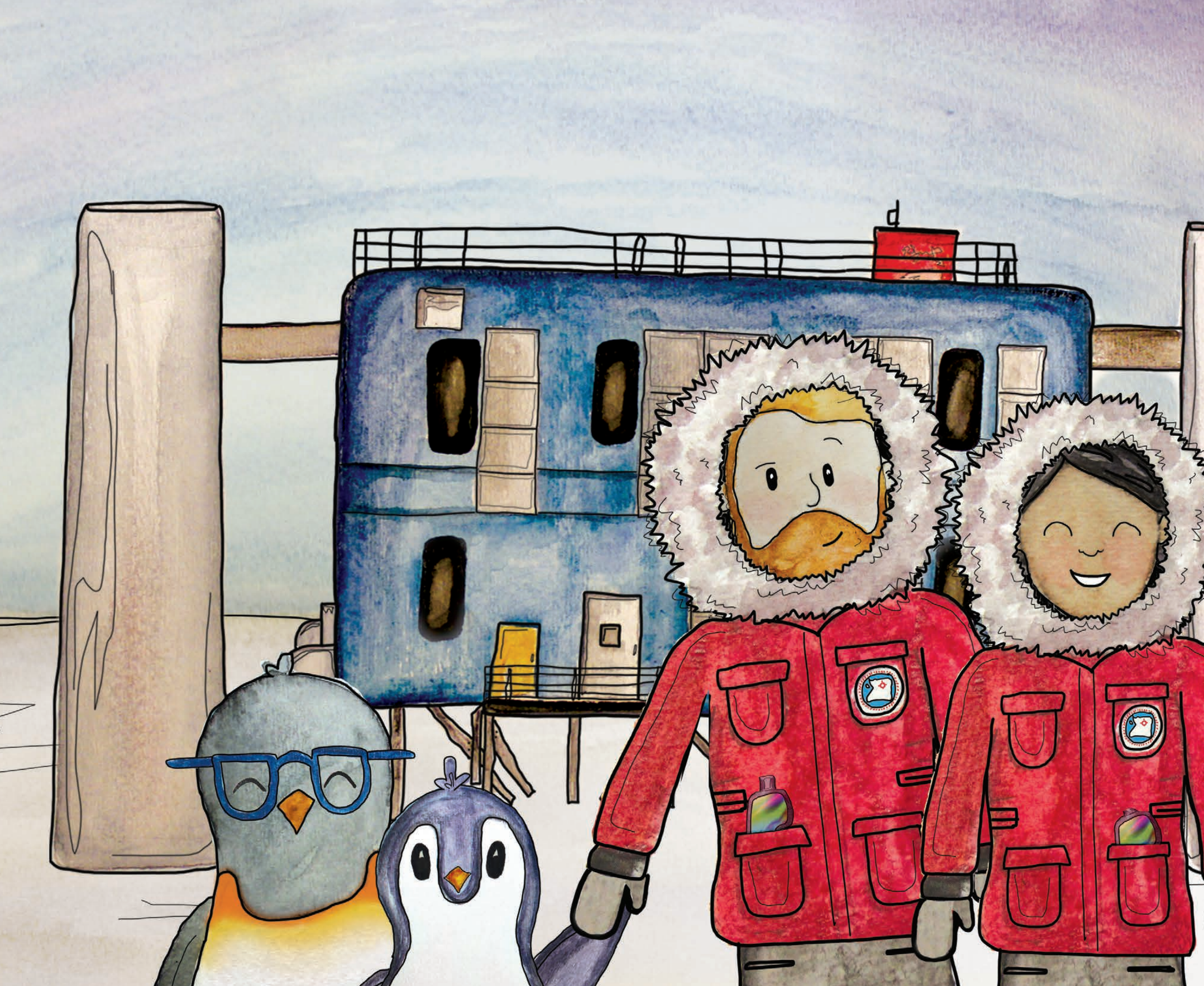
STEP 6: Digitize artwork

STEP 7: Add final text

STEP 8: Proofread (x4!)

STEP 9: Export, print, and share





PRINTABLE
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COMIC
PROJECT
SHEETS

Available on the
next page!

ADVENTURES WITH... **ROSIE &**



WHAT IS THE
STRANGE BLUE
BOX?



ILLUSTRATOR:



ILLUSTRATOR:

MEET OUR TEAM



Savannah Guthrie
Illustrator and Story Writer

Savannah is a graphic designer and artist. She began her work for IceCube at the headquarters in Madison, WI, in 2017. She has loved learning all about neutrinos and the South Pole as she develops her designs. Helping bring Rosie and Gibbs to life has been her favorite project so far, since it blends art and science together!



Silvia Bravo Gallart
Story Writer

Silvia's love for science has been growing for many years. She still has plenty to learn and many things to do on her bucket list, but her time with IceCube has brought adventures, exciting people, and Rosie and Gibbs to her life. She talks a lot and likes to engage everyone with science. Guess what's been a favorite topic since 2013, when she joined the IceCube communications and outreach team...neutrinos!!!



Jean DeMerit
Story Writer

Jean is a technical editor who reads and reviews a broad range of documents related to IceCube, from academic articles to web pages...and now comics! Though she views herself as more analytical than creative, the two sides of language have always held a special fascination for her. She has had a lot of fun working on Rosie & Gibbs with Savannah and Silvia.

ADVISORS



John Kelley

John Kelley is a physicist at the University of Wisconsin-Madison. As detector operations manager of IceCube, he works with a team of scientists, engineers, and software developers to keep the experiment running smoothly and support the IceCube winterovers.



James Madsen

Jim Madsen is an associate director of the IceCube Neutrino Observatory, where he leads the education and outreach team. He is also a professor in the Physics Department at the University of Wisconsin-River Falls. He has deployed five times to Antarctica and provides opportunities to engage audiences with IceCube astrophysics research.



Jean Pennycook

Jean has spent 18 austral seasons working in Antarctica, 14 of which have been spent living in a tent at the Cape Royds Adelie penguin colony on Ross Island. She has shared with thousands of students around the world. Her passion is to connect scientific research, the wonder of Antarctica, and penguins to the K-12 community.



Annie E. Schmidt

Annie is outdoor-loving Antarctica program leader. She currently manages the Adelie penguin ecology research for Point Blue Conservation Science. Some of her favorite months of the year are spent at the field site on Ross Island, Cape Crozier, one of the largest Adelie penguin colonies in the world.

THANK YOU FOR JOINING US!





ICECUBE



The IceCube Neutrino Observatory is funded primarily by the National Science Foundation and is operated by a team headquartered at the University of Wisconsin–Madison.

IceCube construction and operations were also funded by significant contributions from the National Fund for Scientific Research (FNRS & FWO) in Belgium; the Federal Ministry of Education and Research (BMBF) and the German Research Foundation (DFG) in Germany; the Knut and Alice Wallenberg Foundation, the Swedish Polar Research Secretariat, and the Swedish Research Council in Sweden; and the Department of Energy and the Wisconsin Alumni Research Foundation in the U.S.

The IceCube Collaboration, made up of more than 300 people from 50 institutions in 12 countries, is responsible for the scientific program. Many of the collaborators also contributed to the design and the construction of the detector.

icecube.wisc.edu