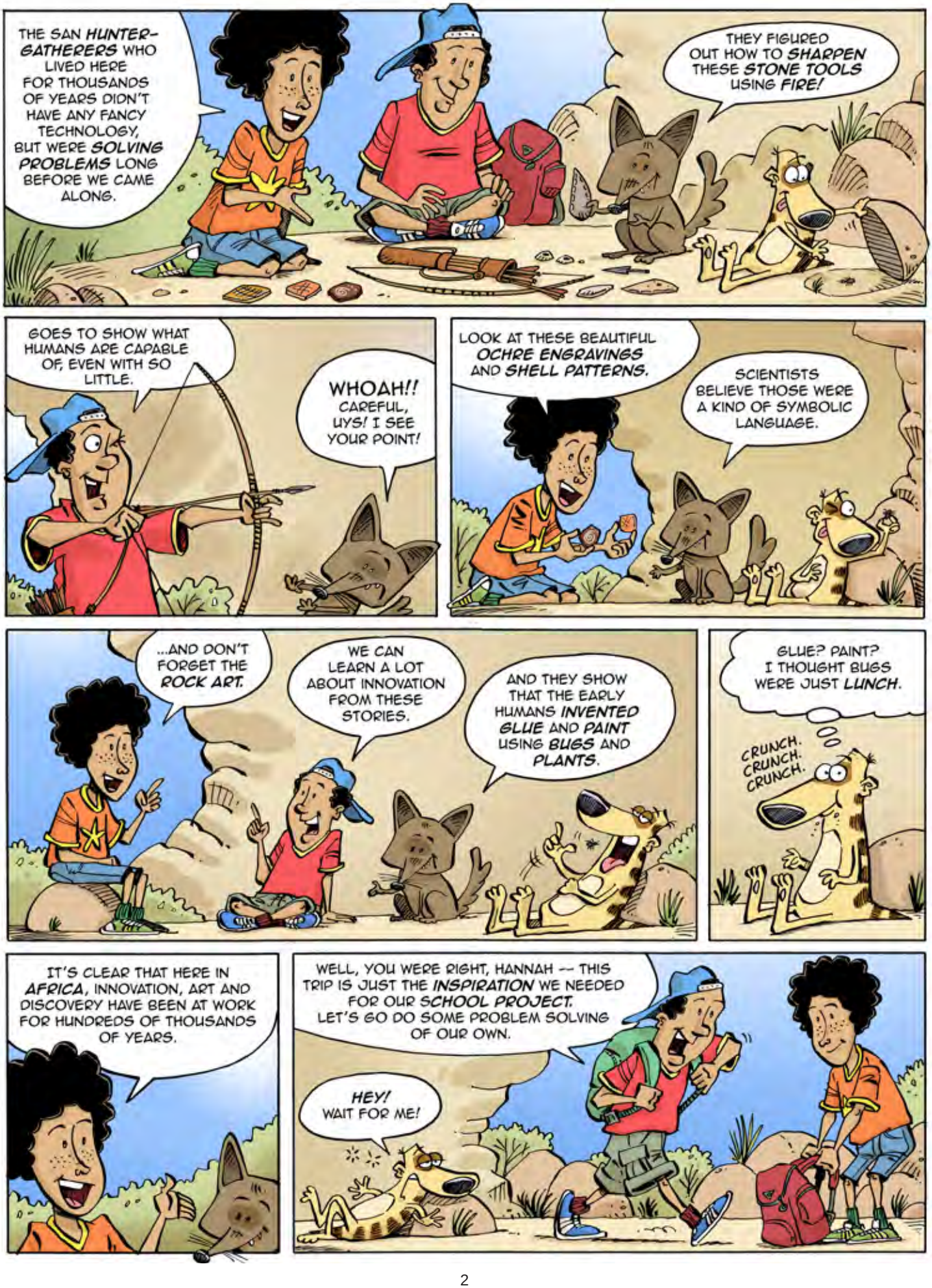
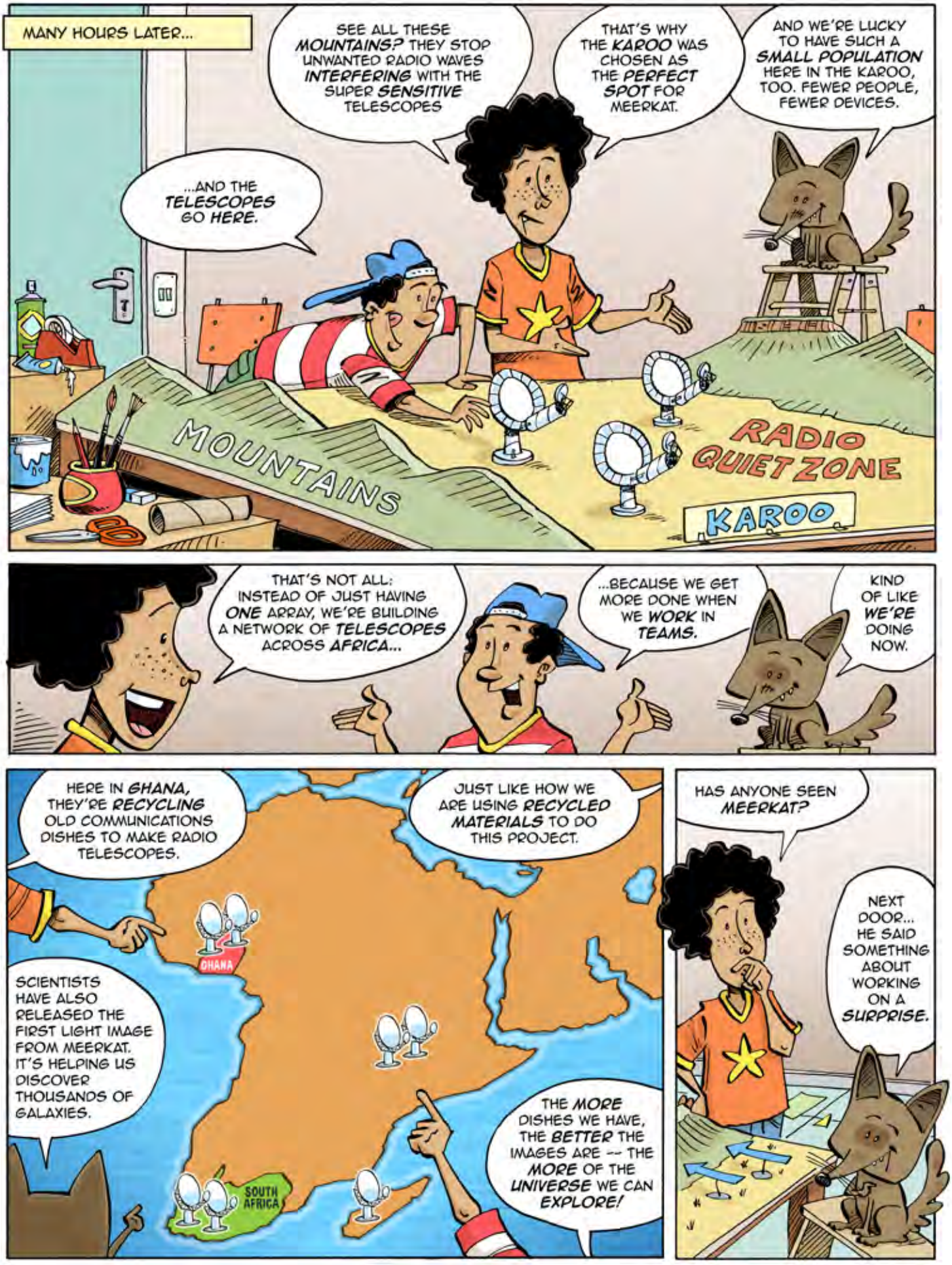
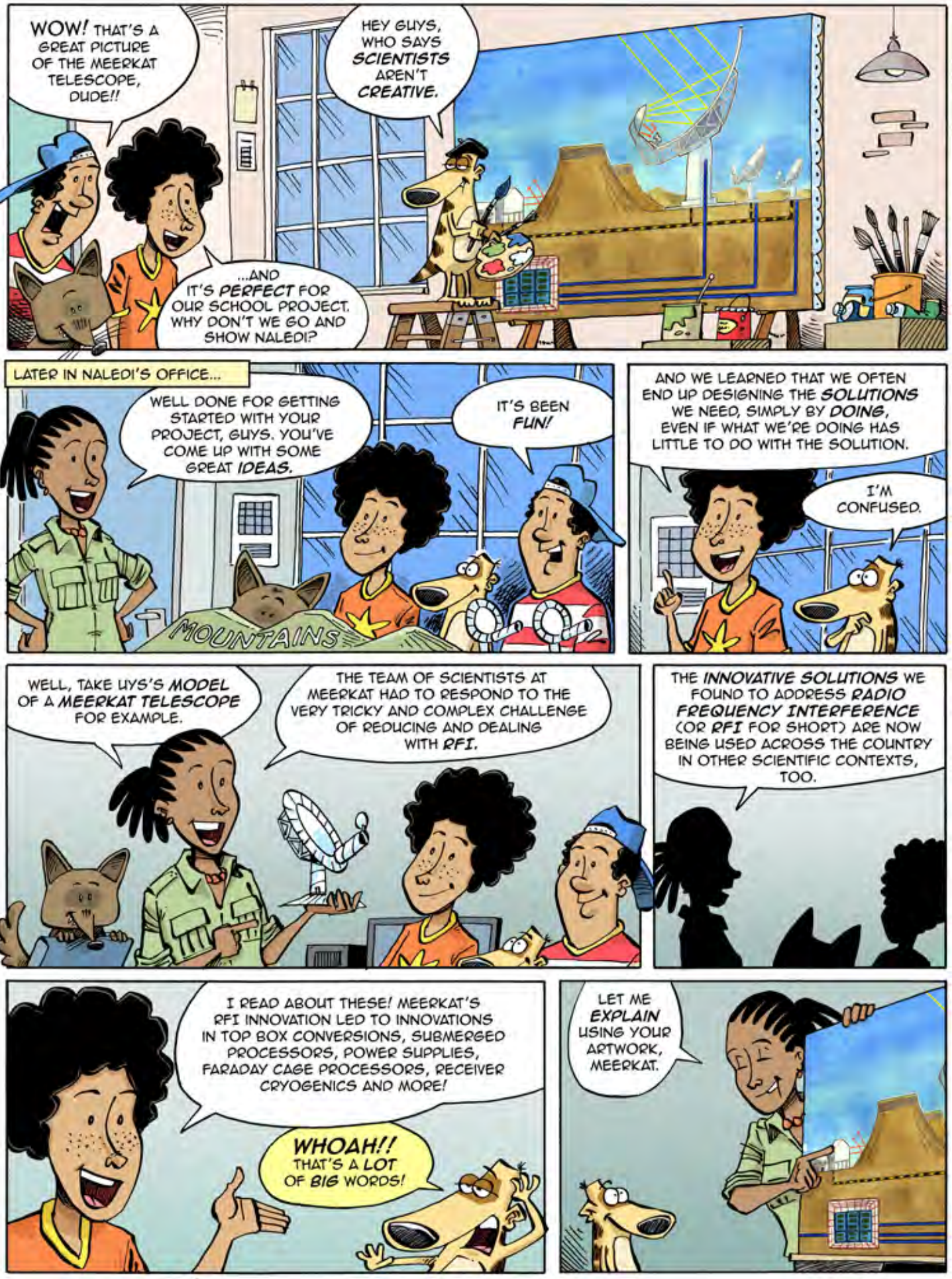

SQUARE KILOMETRE ARRAY
SKA AFRICA
MISSION MEERKAT
No. 5
WOW! LOOK AT THAT VIEW!
FEELS GOOD TO GET A NEW PERSPECTIVE ON THINGS, DOESN'T IT?
I DON'T THINK MEERKAT AGREES.
PUFF! PUFF! WAIT FOR ME!
SORRY... HIKING JUST ISN'T A THING FOR US MEERKATS.
HERE IN AFRICA, WE CAN DO ANYTHING!
WELL DONE, TEAM... WE MADE IT!
WELCOME TO THE ROCK ART OF THE GREAT KAROO... I LIKE TO CALL IT THE BIRTHPLACE OF INNOVATION!


THE SAN HUNTER-GATHERERS WHO LIVED HERE FOR THOUSANDS OF YEARS DIDN'T HAVE ANY FANCY TECHNOLOGY, BUT WERE SOLVING PROBLEMS LONG BEFORE WE CAME ALONG.
THEY FIGURED OUT HOW TO SHARPEN THESE STONE TOOLS USING FIRE!
GOES TO SHOW WHAT HUMANS ARE CAPABLE OF, EVEN WITH SO LITTLE.
WHOAH!! CAREFUL, UYS! I SEE YOUR POINT!
LOOK AT THESE BEAUTIFUL OCHRE ENGRAVINGS AND SHELL PATTERNS.
SCIENTISTS BELIEVE THOSE WERE A KIND OF SYMBOLIC LANGUAGE.
...AND DON'T FORGET THE ROCK ART.
WE CAN LEARN A LOT ABOUT INNOVATION FROM THESE STORIES.
AND THEY SHOW THAT THE EARLY HUMANS INVENTED GLUE AND PAINT USING BUGS AND PLANTS.
GLUE? PAINT? I THOUGHT BUGS WERE JUST LUNCH.
CRUNCH. CRUNCH. CRUNCH.
IT'S CLEAR THAT HERE IN AFRICA, INNOVATION, ART AND DISCOVERY HAVE BEEN AT WORK FOR HUNDREDS OF THOUSANDS OF YEARS.
WELL, YOU WERE RIGHT, HANNAH -- THIS TRIP IS JUST THE INSPIRATION WE NEEDED FOR OUR SCHOOL PROJECT. LET'S GO DO SOME PROBLEM SOLVING OF OUR OWN.
HEY! WAIT FOR ME!


OKAY! WHO'S READY TO GET CREATIVE?
WE'VE BEEN ASKED TO TELL OUR CLASS ABOUT RADIO ASTRONOMY IN AFRICA, AND WE'RE GOING TO DO IT USING ART – JUST LIKE THE SAN DID.
THIS INNOVATING THING IS NOT EASY... I'VE BEEN THINKING ALL DAY ALREADY.
CRASH!
WELL, THIS IS OFF TO A GREAT START!
HEY, SOMETIMES THE BEST DISCOVERIES HAPPEN BY ACCIDENT.
HEY, WILL YOU TWO KEEP IT DOWN!! I CAN'T HEAR MYSELF THINK!
SPEAKING OF KEEPING QUIET, DID YOU KNOW THAT THE KAROO WAS CHOSEN AS THE PERFECT SITE FOR THE MEERKAT RADIO TELESCOPE BECAUSE IT'S A RADIO QUIET ZONE?
WHAT'S A RADIO QUIET ZONE? A PLACE WHERE YOU HAVE TO TURN THE TUNES DOWN?
YOU CAN'T STOP THE MUSIC!!
RADIO QUIET ZONES ARE ACTUALLY PLACES WHERE RADIO TELESCOPES CAN GET THE BEST SIGNAL WITHOUT ANY RADIO FREQUENCY INTERFERENCE, LIKE MOBILE DEVICES, GETTING IN THE WAY.
NO CELL PHONE SIGNAL!
HEY, THAT GIVES ME AN IDEA! I KNOW WHAT WE CAN DO!


MANY HOURS LATER...
SEE ALL THESE MOUNTAINS? THEY STOP UNWANTED RADIO WAVES INTERFERING WITH THE SUPER SENSITIVE TELESCOPES
THAT'S WHY THE KAROO WAS CHOSEN AS THE PERFECT SPOT FOR MEERKAT.
AND WE'RE LUCKY TO HAVE SUCH A SMALL POPULATION HERE IN THE KAROO, TOO. FEWER PEOPLE, FEWER DEVICES.
...AND THE TELESCOPES GO HERE.
MOUNTAINS
RADIO QUIET ZONE
KAROO
THAT'S NOT ALL: INSTEAD OF JUST HAVING ONE ARRAY, WE'RE BUILDING A NETWORK OF TELESCOPES ACROSS AFRICA...
...BECAUSE WE GET MORE DONE WHEN WE WORK IN TEAMS.
KIND OF LIKE WE'RE DOING NOW.
HERE IN GHANA, THEY'RE RECYCLING OLD COMMUNICATIONS DISHES TO MAKE RADIO TELESCOPES.
JUST LIKE HOW WE ARE USING RECYCLED MATERIALS TO DO THIS PROJECT.
GHANA
SCIENTISTS HAVE ALSO RELEASED THE FIRST LIGHT IMAGE FROM MEERKAT. IT'S HELPING US DISCOVER THOUSANDS OF GALAXIES.
SOUTH AFRICA
THE MORE DISHES WE HAVE, THE BETTER THE IMAGES ARE -- THE MORE OF THE UNIVERSE WE CAN EXPLORE!
HAS ANYONE SEEN MEERKAT?
NEXT DOOR... HE SAID SOMETHING ABOUT WORKING ON A SURPRISE.


WOW! THAT'S A GREAT PICTURE OF THE MEERKAT TELESCOPE, DUDE!!
HEY GUYS, WHO SAYS SCIENTISTS AREN'T CREATIVE.
...AND IT'S PERFECT FOR OUR SCHOOL PROJECT. WHY DON'T WE GO AND SHOW NALEDI?
LATER IN NALEDI'S OFFICE...
WELL DONE FOR GETTING STARTED WITH YOUR PROJECT, GUYS. YOU'VE COME UP WITH SOME GREAT IDEAS.
IT'S BEEN FUN!
MOUNTAINS
AND WE LEARNED THAT WE OFTEN END UP DESIGNING THE SOLUTIONS WE NEED, SIMPLY BY DOING, EVEN IF WHAT WE'RE DOING HAS LITTLE TO DO WITH THE SOLUTION.
I'M CONFUSED.
WELL, TAKE UYS'S MODEL OF A MEERKAT TELESCOPE FOR EXAMPLE.
THE TEAM OF SCIENTISTS AT MEERKAT HAD TO RESPOND TO THE VERY TRICKY AND COMPLEX CHALLENGE OF REDUCING AND DEALING WITH RFI.
THE INNOVATIVE SOLUTIONS WE FOUND TO ADDRESS RADIO FREQUENCY INTERFERENCE (OR RFI FOR SHORT) ARE NOW BEING USED ACROSS THE COUNTRY IN OTHER SCIENTIFIC CONTEXTS, TOO.
I READ ABOUT THESE! MEERKAT'S RFI INNOVATION LED TO INNOVATIONS IN TOP BOX CONVERSIONS, SUBMERGED PROCESSORS, POWER SUPPLIES, FARADAY CAGE PROCESSORS, RECEIVER CRYOGENICS AND MORE!
WHOAH!! THAT'S A LOT OF BIG WORDS!
LET ME EXPLAIN USING YOUR ARTWORK, MEERKAT.

1 THE MEERKAT TELESCOPES ARE POWERED FROM THE KAROO ARRAY PROCESSING BUILDING VIA ELECTRICITY CABLES THAT ARE BURIED DEEP UNDERGROUND TO PREVENT RADIO FREQUENCY INTERFERENCE (RFI).

2 THE RADIO WAVES THAT THE TELESCOPES RECEIVE MAY HAVE TRAVELLED BILLIONS OF YEARS TO REACH EARTH: WHEN THEY ARRIVE THEY CAN BE 1 000 000 000 000 000 000 TIMES WEAKER THAN AN ORDINARY CELL PHONE SIGNAL. THIS MEANS EVEN THE SLIGHTEST DISTURBANCE CAN INTERFERE WITH THEM.

3 THE SUBREFLECTOR IS OFFSET FROM THE MAIN REFLECTOR SO THAT THERE ARE NO STRUTS TO BLOCK THE RADIO WAVES FROM SPACE. THIS IS CALLED AN OFFSET GREGORIAN DESIGN – AND IT ALSO HELPS BLOCK RFI.

RADIO WAVES FROM OUTER SPACE

4 CRYOGENIC RECEIVERS ADD VERY LITTLE NOISE TO THE SIGNALS RECEIVED FROM SPACE. A HELIUM PROCESSOR FOR CRYOGENIC COOLING OF THE TELESCOPE'S PROCESSING UNIT ALSO PREVENTS INTERFERENCE.

5 THE SIGNALS ARE CONVERTED RIGHT ON THE ANTENNAE INTO A DIGITAL SIGNAL THAT IS SENT TO THE ARRAY PROCESSOR BUILDING VIA UNDERGROUND FIBRE-OPTIC DATA LINES.

6 THE ARRAY PROCESSOR BUILDING (ARP) IS SUBMERGED IN A BUNKER 5 METRES UNDERGROUND IN ORDER TO STOP RADIO WAVES FROM THE EQUIPMENT INTERFERING WITH THE TELESCOPES.

MOUNTAINS

HELP SHIELD THE MEERKAT RADIO TELESCOPES FROM RADIO FREQUENCY INTERFERENCE (RFI)

KAROO ARRAY PROCESSING BUILDING

POWER LINES

DATA

DATA

DATA

7 A FARADAY CAGE USUALLY KEEPS RADIO WAVES OUT: THE ARRAY PROCESSOR BUILDING IS SURROUNDED BY A FARADAY CAGE TO KEEP ALL RADIO WAVES INSIDE THE BUNKER, SO THAT THEY CANNOT CAUSE INTERFERENCE.

8 AFTER PROCESSING, THE DATA IS SENT BY FIBRE-OPTIC LINE TO CAPE TOWN.

DATA TO CAPE TOWN

DATA

DATA

Mission MeerKAT is produced on behalf of the Square Kilometre Array Project in South Africa. Visit www.ska.ac.za to find out more or to download other comics in the Mission MeerKAT series.