

WHAT COULD YOU POSSIBLY BE
LOOKING AT IN THE MIDDLE OF THE
DAY?

I'M LOOKING AT OUR STAR, THE
SUN.

WOULD YOU LIKE TO TAKE A LOOK?
SURE.

THAT BIG RED BALL IS THE SUN,
AND IT LOOKS RED BECAUSE WE'RE
LOOKING AT IT IN A VERY SPECIAL
WAVELENGTH OF RED LIGHT, CALLED
HYDROGEN-ALPHA LIGHT.

THESE TELESCOPES WILL SEE ONLY
THAT TINY PORTION--

Lou Mayo: 400 YEARS AGO THIS
YEAR, GALILEO FIRST USED HIS
TINY TELESCOPE TO VIEW THE DARK
BLOTCHES ON THE SUN THAT WE NOW
KNOW ARE SUNSPOTS.

SINCE THEN, THE STUDY OF THE SUN
HAS BECOME ONE OF THE MOST
FASCINATING AND PRACTICAL FIELDS
IN ASTRONOMY.

EVEN THOUGH THE SUN IS
93 MILLION MILES AWAY, ITS
EFFECT ON EARTH IN OUR DAILY
LIVES GOES FAR BEYOND THE WARMTH
WE FEEL ON OUR FACE.

Troy Cline: WELCOME TO
SUN-EARTH DAY.

I'M YOUR HOST TROY CLINE.

THIS YEAR'S THEME IS OUR SUN,
YOURS TO DISCOVER.

HERE IN OUR STUDIO AT GODDARD
SPACE FLIGHT CENTER IN MARYLAND,
WE HAVE A PANEL OF SCIENTISTS
WHO ARE GOING TO TALK TO US
ABOUT THE WAYS NASA IS USING
SATELLITE TECHNOLOGY TO HELP THE
WORLD SEE THE SUN IN A WHOLE NEW
LIGHT.

WITH US TODAY ARE STEN ODENWALD,

TERRY KUCERA, NICKY FOX AND ERIC CHRISTIAN.

WE ALSO HAVE A DISTINGUISHED GROUP OF STUDENTS WITH US TODAY WHO ARE WORKING ON A SPECIAL NASA PROJECT.

HERE TO EXPLAIN MORE ABOUT THAT PROGRAM IS ASTRONOMER PAUL MORTFIELD.

HEY PAUL, WHAT'S HAPPENING OVER THERE?

Paul Mortfield: TROY, HERE WE ARE IN NASA'S SPACE ACTION CENTER.

WITH US IS A GROUP OF STUDENTS WHO CAN BE LOOKING AT THE SUN USING A VARIETY OF TELESCOPES ON THE GROUND AS WELL AS SATELLITES UP IN SPACE.

WHAT THEY'RE GOING TO WIND UP DOING IS FIGURING OUT HOW TO PREDICT IF THERE'S GOING TO BE ANY SOLAR STORMS OR ANY EXCITING SOLAR ACTIVITY.

ONE OF THE OTHER THINGS THEY'RE GOING TO DO IS PUT TOGETHER A SPACE WEATHER REPORT THAT WE'RE GOING TO SEE A LITTLE LATER ON IN THE SHOW.

NOW SPACE WEATHER IS REALLY IMPORTANT BECAUSE IT AFFECTS US IN A VARIETY OF DIFFERENT WAYS. IT AFFECTS US DOWN HERE ON EARTH BUT MORE IN PARTICULAR IT AFFECTS OUR ASTRONAUTS THAT ARE UP IN SPACE AND RIGHT NOW WE HAVE ASTRONAUTS UP ON THE SPACE STATION, AS WELL AS ON THE SPACE SHUTTLE.

SO WE'LL KEEP YOU POSTED THROUGHOUT THE SHOW.

Troy Cline: THANKS PAUL.

WE'LL KEEP CHECKING IN WITH YOU
AND THE STUDENTS
AS YOU MONITOR AND INTERPRET THE
DIFFERENT KINDS OF OBSERVATIONS
THAT OUR SATELLITES AND GROUND
BASED OBSERVATORIES ARE
PROVIDING.

THROUGHOUT THE WEBCAST, WE'LL
LEARN MORE ABOUT THE KINDS OF
MISSIONS THAT OBSERVE THE SUN
AND HOW THEY IMPACT THE SPACE
ENVIRONMENT.

WE'LL ALSO BE COUNTING DOWN THE
SUN-EARTH CONNECTION'S TOP FIVE
DISCOVERIES ABOUT THE SUN AND
ITS CONNECTION WITH OUR PLANET.
SO LET'S GET STARTED WITH NUMBER
FIVE.

Narrator: FROM A SPYGLASS TO
SATELLITES, OUR BACKYARD TO THE
VERY EDGE OF OUR SOLAR SYSTEM.
EVERY CULTURE ON EVERY CONTINENT
HAS OBSERVED THE SUN.

WE HAVE BEEN SEARCHING FOR THE
ANSWERS TO THE MYSTERIES OF TIME
AND THE SEASONS, THE WEB OF LIFE
ON EARTH, AND OUR PLACE IN THE
UNIVERSE.

OUR SUN HAS ALWAYS
BEEN MORE THAN A BALL OF HEAT
AND LIGHT.

OUR SUN THROUGH CURIOUS MINDS
AND INNOVATIVE TECHNOLOGY HAS
ALLOWED US TO EXPLORE HOW THE
NORTHERN LIGHTS DANCE AND HOW
OUR SOLAR SYSTEM MAY HAVE
FORMED.

THE SUN IS OURS TO DISCOVER.

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BEFORE SOPHISTICATED SATELLITES
BROUGHT US VIBRANT IMAGES IN
WAVELENGTHS BEYOND OUR SENSES,

PEOPLE SIMPLY LOOKED AT THE SUN.
ALTHOUGH HE WAS NOT ALONG IN HIS
PURSUIT, IN 1609,
GALILEO GALILEI PIONEERED THE
USE OF THE TELESCOPE IN ORDER TO
OBSERVE AND RECORD SUNSPOTS.
HIS DETAILED SKETCHES, PRODUCED
OVER THE SUMMER IN 1612,
REVEALED THAT SUN WAS NOT A
STATIC ORB IN THE SKY, BUT A
DYNAMIC FORCE. GALILEO'S SOLAR
DISCOVERIES SPARKED AN ACADEMIC
INTEREST IN THE SUN, LEADING
ASTRONOMERS AROUND THE WORLD TO
INVESTIGATE HOW THE SUN SHAPES
LIFE ON EARTH.

400 YEARS LATER, ASTRONOMERS
WITH INCREASINGLY COMPLEX
SATELLITE IMAGERS INVESTIGATE
THE ORIGINS AND EFFECTS OF THE
SUNSPOTS GALILEO FIRST OBSERVED.

Troy Cline: WE NOW KNOW THAT
SUNSPOTS ARE AREAS OF
CONCENTRATED MAGNETIC FIELDS,
ONE AREA THAT RESEARCHERS ARE
INVESTIGATING WITH THE HINODE
MISSION.

Sten Odenwald: HI, I'M
DR. STEN ODENWALD.

THE HINODE SATELLITE IS A
COLLABORATION OF OVER A DOZEN
COUNTRIES.

IT'S A TRULY INTERNATIONAL
MISSION AND THE GOAL OF THAT
MISSION IS TO EXAMINE THE SUN IN
GREAT DETAIL TO LEARN HOW ABOUT
HOW THE MAGNETIC FIELDS ON THE
SURFACE OF THE SUN IS
STRUCTURED.

HOW IT IS AMPLIFIED, AND HOW IT
PRODUCES THINGS LIKE SUNSPOTS,
HEATING THE CORONA, AND ALSO

PRODUCING THE SOLAR WIND.
THE AMBIGUOUS THING IS THAT IT
SEEMS THAT THE SOLAR WIND, AND
THE CORONA IS NOT HEATED JUST BY
THESE REALLY BRILLIANT SUNSPOTS
THAT YOU SEE, BUT ALSO BY A
WHOLE BUNCH OF ALMOST LIKE
FRECKLES ALL ACROSS THE SUN.
THERE ARE THOUSANDS OF THESE
LITTLE THINGS THAT WE CAN JUST
BEGIN TO SEE WITH THE HINODE
SATELLITE.
AND IF YOU SEE THEM EDGE ON,
THEY LOOK LIKE GEYSERS COMING
OFF OF THE SURFACE OF THE SUN.
THESE GEYSERS ARE ACTUALLY
EJECTING VERY HOT MATERIAL UP
INTO THE CORONA OF THE SUN, AND
WE THINK THAT THAT'S ALSO
RELATED TO THE PRODUCTION OF THE
SOLAR WIND.
THESE DISCOVERIES ARE ONLY NOW
BEING MADE, AND THERE ARE MANY
MORE TO COME.
BUT THE WHOLE POINT IS TO
UNDERSTAND A LOT MORE ABOUT SOME
OF THE BIG MYSTERIES OF THE SUN
THAT ARE STILL PRETTY
OUTSTANDING SUCH AS WHY THE
CORONA OF THE SUN IS 2 MILLION
DEGREES HOT.
AND WHY WE EVEN HAVE SOMETHING
LIKE SOLAR WIND IN THE FIRST
PLACE.
WE'VE SUSPECTED FOR A LONG TIME
THAT THE MAGNETIC FIELDS ON THE
SURFACE OF THE SUN HAVE A LOT TO
DO WITH THIS, BECAUSE THEY
REPRESENT AN ENORMOUS AMOUNT OF
ENERGY THAT CAN BE TAPPED,
TRANSFORMED INTO HEATING
PARTICLES, PRODUCING MOTION, AND

IN MANY CASES, WE CAN OBSERVE
THIS NOW WITH THE HINODE
SATELLITE FROM LITERALLY TIME
LAPSE MOVIES LOOKING AT ACTIVE
REGIONS LIKE THIS ONE, WHERE WE
CAN ACTUALLY SEE THE HEATING OF
THE GASES, AND THE EJECTION OF
THE GASES IN PLUME.

AND WE THINK THAT THIS IS ALL
TIED TOGETHER TO GIVE US A MUCH
BETTER UNDERSTANDING OF THE
SOLAR WIND.

FOR INSTANCE, THE SURFACE OF THE
SUN IS FULL OF GRABULATION
REGIONS WHICH YOU SEE IN THIS
PICTURE.

KIND OF LOOKS LIKE MUSH BOILING
IN A POT AND IT'S THE SAME KIND
OF A PRINCIPLE.

THAT IS AN IMPORTANT ELEMENT IN
MAGNIFYING THE SUN'S SURFACE
MAGNETIC FIELD AND TRANSFORMING
IT INTO ENERGY THAT LEADS TO THE
CORONA, HEATING AND SOLAR WIND.

Troy Cline: RIGHT NOW WE HAVE
A QUESTION FROM JPL.

GOOD AFTERNOON, JPL.

GOOD AFTERNOON.

ARE YOU HEARING US LOUD AND
CLEAR IN JPL?

YES.

Troy Cline: HELLO.

IT'S ANDREA.

WHAT'S HAPPENING, GUYS?

Troy Cline: OKAY WHY DON'T
YOU GIVE US A QUESTION, ANDREA,
WE'D LOVE TO HEAR IT AND I
BELIEVE IT'S TO DR. STEN
ODENWALD.

OKAY, GO AHEAD.

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WHAT WOULD HAPPEN IF WE

DIDN'T HAVE A MAGNETOSPHERE?
WELL THE NEAT THING ABOUT THE
WORLD'S MAGNETOSPHERE IS THAT IT
SHIELDS US A LITTLE BIT FROM THE
SOLAR WIND BUT THE WAY THAT THE
MAGNETOSPHERE TWISTS AND TURNS
AROUND AROUND CHANGES IS ALSO
RESPONSIBLE FOR THOSE BEAUTIFUL
AURORA THAT WE SEE IN THE POLAR
REGIONS OF THE EARTH.

IF WE DIDN'T HAVE THE
MAGNETOSPHERE WE PROBABLY
WOULDN'T HAVE THOSE WONDERFUL
AURORAL CURTAINS THAT WE SEE IN
THESE GREAT, BEAUTIFUL
PHOTOGRAPHS.

INSTEAD THE SKY WOULD PROBABLY
JUST BE A KIND OF A GREENISH RED
GLOW WHENEVER THERE WAS A LARGE
SOLAR EVENT.

SO, THE EARTH'S MAGNETIC FIELD,
YOU KNOW, SHIELDS US FROM VERY
ENERGETIC PARTICLES, BUT IT ALSO
GIVES US THE LOVELY AURORA THAT
WE ENJOY IN PHOTOGRAPHS.

THANK YOU, DOCTOR ODENWALD.
NOW LET'S TAKE A LOOK AT
DISCOVERY NUMBER FOUR.

Narrator: THERE MUST BE
SOMETHING IN A SUNSPOT THAT
OPENS UP A WEALTH OF KNOWLEDGE
AND EVEN MORE QUESTIONS.

LIKE GALILEO BEFORE HIM, GERMAN
ASTRONOMER
SAMUEL HEINRICH SCHWABE BECAME
FASCINATED WITH SUNSPOTS.
FROM CAREFUL OBSERVATION OVER
17 YEARS, SCHWABE FOUND A
PERIODIC CYCLING OF THE AVERAGE
NUMBER OF SUNSPOTS.

IN THE MID-1800'S HE AND OTHER
ASTRONOMERS FOUND THAT THE SUN

HAS ABOUT AN 11-YEAR CYCLE BETWEEN THE TIMES WHEN WE CAN OBSERVE THE MOST AND THE LEAST SUNSPOTS.

DR. Holly Gilbert:

UNDERSTANDING THE 11-YEAR SOLAR CYCLE BECOMES VERY CRUCIAL WHEN UNDERSTANDING THE EFFECTS OF SPACE WEATHER HERE AT EARTH BECAUSE IT REALLY DICTATES HOW OFTEN SOLAR STORMS WILL OCCUR AND HOW STRONG THEY WILL BE.

Troy Cline: THE DISCOVERY OF THE SOLAR CYCLE HELPED US SEE HOW THE SUN VARIES OVER TIME AND HELPS US PREDICT PERIODS OF INTENSE SOLAR ACTIVITY AS WELL AS QUIETER PERIODS.

THESE NEXT TWO MISSIONS INVESTIGATE THE NATURE OF THE SOLAR ACTIVITY WITHIN THE SOLAR CYCLE, AS WELL AS HOW IT IMPACTS THE ENVIRONMENT OF SPACE.

Terry Kucera: HI I'M TERRY KUCERA AND I'M ON THE TEAM FOR BOTH THE STEREO AND SOHO MISSION.

SOHO IS A JOINT EUROPEAN/U.S. MISSION THAT STUDIES ALL DIFFERENT ASPECTS OF ASTRONOMY. THE INTERIOR, THE SURFACE, THE ATMOSPHERE AND EVEN THE SOLAR WIND AS IT BLOWS OUT AWAY FROM THE SUN INTO THE SOLAR SYSTEM. IN THIS PICTURE WE'RE SHOWING A NUMBER OF DIFFERENT WAYS THAT WE OBSERVE THE SUN WITH OUR MANY DIFFERENT TELESCOPES.

IN THE LEFT WE SEE IMAGES OF THE SUN IN ULTRAVIOLET LIGHT. THE KIND OF LIGHT THAT HUMANS CAN'T SEE, BUT IF YOU PUT A

SPACECRAFT UP ABOVE THE EARTH'S ATMOSPHERE, YOU CAN SEE THIS KIND OF LIGHT THAT SHOWS THE SUN'S ATMOSPHERE AND ITS ACTIVITY REALLY WELL. SO IT'S VERY IMAGING. THEY'RE IMAGES BASED ONLY VISIBLE LIGHT THAT SHOW US THINGS ABOUT THE SUN'S MAGNETIC FIELD. WE ALREADY TALKED A BIT ABOUT THE MAGNETIC FIELD BUT THAT'S WHAT DRIVES ALL SOLAR ACTIVITY. HERE WE'RE SEEING THE SUN'S OUTER ATMOSPHERE AND SOMETHING WE CALL CORONAL MASS EJECTION. IT'S A GIANT MAGNETIC CLOUDS MOVE OUT INTO THE SOLAR SYSTEM AND CAN AFFECT US HERE ON EARTH AS WE WILL BE TALKING ABOUT LATER. ANOTHER MISSION THAT'S COMING UP, IN FACT THAT WAS LAUNCHED A COUPLE YEARS AGO IS CALLED STEREO. STEREO CONSISTS OF TWO SPACECRAFTS OBSERVING THE SUN FOR A 3-D VIEW OF SOLAR ACTIVITY AND ESPECIALLY CORONAL MASS EJECTION. WE'RE SEEING HOW ONE OF THE SPACECRAFTS IS LOOKING AT THE SUN BUT NOW YOU SHOULD GET OUT OUR 3-D GLASSES BECAUSE THIS IS A 3-D MOVIE OF THE SUN WITH YOUR LEFT AND RIGHT EYES COMING FROM THE TWO DIFFERENT SPACECRAFT. SO HERE YOU CAN SEE THE SUN AND ALL THOSE STRUCTURES IN THE SUN'S MAGNETIC FIELD. AND YOU HAVE OVER ON THE LEFT A SOLAR ACTIVE REGION LIKE THE

ONES STEN WAS SHOWING FROM
HINODE.

THIS IS WHERE THE SUN WAS
ESPECIALLY ACTIVE AND YOU CAN
SEE THE CHANGES AND THE
STRUCTURED MAGNETIC FIELD THAT
CAUSES ALL THESE THINGS TO
HAPPEN.

THANK YOU, DOCTOR KUCERA THAT
WAS INCREDIBLY INTERESTING.

I JUST WISH I HAD MY 3-D GLASSES
WITH ME RIGHT NOW.

HOW ABOUT LET'S TAKE A QUESTION
RIGHT NOW FROM ADLER
PLANETARIUM.

HOW ARE YOU TODAY?

JUST A MOMENT.

WE'RE FINDING ADLER.

HI ADLER, HOW ARE YOU?

AND ARE YOU ABLE TO HEAR US?

I SEE YOU WITH YOUR 3-D GLASSES.

I UNDERSTAND WE HAVE A QUESTION
FROM ADLER.

WE SURE, DO.

GO AHEAD.

OKAY, LET'S HEAR THE
QUESTION.

-- THE SUN TURNS INTO A RED
DWARF, THAT IS WHAT'S GOING TO
HAPPEN, RIGHT?

THE QUESTION HOW LONG UNTIL
THE SUN TURNS -- BUT FIRST IS
FOR IT TO TURN -- WE'RE
EXPECTING THE SUN TO TURN INTO
SOMETHING CALLED A RED GIANT IN
ABOUT 5 MILLION YEARS.

IT ABOUT EXPAND OUTWARDS INTO
THE SOLAR SYSTEM AND REACH ABOUT
THE ORBIT OF THE EARTH AND WE'LL
CERTAINLY BE IN TROUBLE THEN IF
WE'RE STILL HERE.

THEN EVENTUALLY, THOUGH, IT WILL

SORT OF SLOUGH OFF THAT OUTER
ATMOSPHERE AND WHAT WILL BE LEFT
WILL BE A REALLY SMALL STAR
CALLED A WHITE DWARF.

A VERY SMALL, RED STAR AND THAT
WILL SLOWLY COOL DOWN AND FADE
AWAY.

BUT THIS WILL ALL TAKE BILLIONS
OF YEARS, AND IT'S VERY FAR IN
THE FUTURE.

INCREDIBLE.

THAT MEANS WE HAVE QUITE A BIT
OF TIME BEFORE WE HAVE TO WORRY
ABOUT ANYTHING LIKE THIS HERE ON
EARTH.

SO TO FIND OUT MORE ABOUT SPACE
WEATHER AND WHAT'S HAPPENING
RIGHT NOW, LET'S CHECK IN WITH
OUR SPACE WEATHER ACTION CENTER.

PAUL, HOW'S IT GOING OVER THERE?

TROY, WELL, WE'RE HAVING A
LOT OF ACTIVITY OVER HERE AND
THEY'RE WORKING ON SOME OF THESE
EXPERIMENTS AND THESE
ACTIVITIES.

AND BY THE WAY, THESE ACTIVITIES
ARE AVAILABLE OFF THE WEBSITE,
SO YOU CAN DO THESE IN THE
CLASSROOM OR BASICALLY ANYWHERE
AND FIND OUT WHAT'S HAPPENING ON
THE SUN.

SO RIGHT NOW, WE'VE GOT ONE OF
OUR EXPERTS OVER HERE, SHIESHA
IS GOING TO TELL US A LITTLE BIT
ABOUT WHAT SHE'S LOOKING AT AND
TELL US WHERE THIS IMAGE IS
COMING FROM AND WHAT SHE'S
FOUND.

WELL, THIS IMAGE IS AN IMAGE
FROM THE SOHO SPACECRAFT, AND
THAT AIRCRAFT SHOWS WHERE BRIGHT
SPOTS ARE ON THE SUN, AND THE

ACTIVITY.

BUT THERE'S NO ACTIVITY RIGHT NOW.

THAT'S REALLY GREAT.

AND WE ALSO HAVE JORDAN IS GOING TO SHOW US ANOTHER IMAGE FROM SOMEWHERE ELSE, AND TELL US A LITTLE BIT ABOUT THAT, AS WELL.

SO JORDAN?

YES, THIS IS A PICTURE OF THE AURORA THAT IS IN FRONT OF OUR EARTH RIGHT NOW.

BUT, WE CAN'T SEE IT RIGHT NOW. BUT IF YOU GO QUITE A BIT NORTH YOU MIGHT BE ABLE TO SEE SOMETHING.

SO NOTHING THAT SEEMS TO BE AFFECTING US RIGHT AT THIS MOMENT.

SO WE'LL STILL KEEP YOU POSTED ON WHAT'S GOING ON, TROY.

THANK YOU VERY MUCH, PAUL.

THAT'S JUST INCREDIBLE NEWS FOR RIGHT NOW.

I BELIEVE WE ARE READY TO SEE DISCOVERY NUMBER THREE.

Narrator: WE OFTEN

UNDERESTIMATE HOW BEAUTIFUL A SCIENTIFIC DISCOVERY CAN BE.

WHEN THE THEMIS SATELLITE FLEET LAUNCHED IN 2007, THE MISSION SET OUT TO INVESTIGATE WHAT TRIGGERS SUBSTORMS.

SUBSTORMS ARE ATMOSPHERIC EVENTS VISIBLE IN THE NORTHERN HEMISPHERE AS A SUDDEN BRIGHTENING OF THE NORTHERN LIGHTS, OR AURORA BOREALIS.

ONE SUCH SUBSTORM IN MARCH 2008 PRODUCED LIGHTNING-FAST AURORA WITH THE ENERGY OF A MODERATE EARTHQUAKE.

NASA SCIENTISTS FOUND THE ANSWER TO THIS MYSTERIOUS BEHAVIOR AND MASSIVE ENERGY IN GIANT MAGNETIC ROPES.

THESE CAN BE AS WIDE AS THE EARTH ITSELF, SERVE AS CONDUITS FOR SOLAR WIND PARTICLES, WHICH COLLIDE WITH THE EARTH'S MAGNETIC FIELD, AND CHARGE THE SPECTACULAR SUBSTORMS AND AURORAS.

THESE ROPES ARE EVIDENCE OF A DIRECT CONNECTION BETWEEN THE SUN AND THE EARTH'S UPPER ATMOSPHERE.

IT IS WHEN THESE ROPES FORM AND UNRAVEL THAT THE HIGHLY ENERGETIC SOLAR WIND IGNITES THE EARTH'S MAGNETIC FIELD AND LIGHTS UP THE NORTHERN SKY, PROVIDING A CELESTIAL DANCE THAT HAS CAPTIVATED OBSERVERS SINCE ANCIENT TIMES.

THE CONNECTION BETWEEN MAGNETISM ON THE EARTH IS REALLY QUITE AMAZING.

TERRY KUCERA SPOKE ABOUT CORONAL MASS EJECTIONS.

WHEN ONE OF THOSE COMES TO VISIT IT CREATES A DISTURBANCE IN THE EARTH'S MAGNETIC FIELD AND LEADS TO A DOMINO OF EVENTS THAT EVENTUALLY LEAD TO THE AURORA.

THE THEMIS SATELLITE IS A SERIES OF FIVE SATELLITES THAT WERE DESIGNED TO LINE UP BASICALLY ALONG EARTH'S MAGNETIC TAIL, AND EXAMINE THE EVENTS THAT LEAD TO THE FORMATION OF WHAT ARE CALLED SUBSTORMS, WHICH ARE ERUPTIONS OF ACTIVITY IN THE AURORA.

THE CURIOUS THING ABOUT IT IS

THAT IT TURNED OUT THAT FOR A LONG TIME WE DIDN'T QUITE KNOW WHAT EVENTS HAPPENED FIRST. AND SO IT REQUIRED A SATELLITE SYSTEM LIKE THEMIS, LOCATED AT DIFFERENT PLACES ALONG EARTH'S MAGNETIC FIELD, TO ACTUALLY SORT OUT WHAT EVENT HAPPENS FIRST, WHAT EVENT HAPPENS SECOND, AND SO FORTH.

WE DISCOVERED THROUGH THE TIMING INFORMATION THAT THE FIRST THING THAT HAPPENS IS A RECONNECTION EVENT WAY OUT IN THE TAIL, AND THEN THIS LEADS TO AN ACCELERATION OF EVENTS CLOSER AND CLOSER TO THE EARTH, WHICH THEN FINALLY LEADS TO THE SUBSTORM EVENT IN THE POLAR REGION.

THANK YOU, DOCTOR.

AT THIS POINT I WOULD LOVE TO BE ABLE TO TALK TO DR. NICKY FOX.

NICKY, HOW ARE YOU TODAY?

HI, VERY WELL, THANK YOU.

AS STEN SAID, AURORAS ARE EXTREMELY BEAUTIFUL PHENOMENON THAT OCCUR MOSTLY IN THE HIGH POLAR REGIONS AS WE JUST HEARD FROM OUR SPACE ACTION CENTER. WE NEED TO GO FAIRLY FAR NORTH TO SEE THEM.

AND THEY'RE SPECTACULAR INDICATORS THAT SPACE WEATHER IS HAPPENING JUST ABOVE YOUR VERY HEADS.

BUT THERE ARE MORE EFFECTS THAN THE AURORA THAT TAKE PLACE IN OUR MAGNETOSPHERE.

THE PROCESSES THAT DRIVE THE AURORA ALSO CAUSE EFFECT IN THE VAN ALLEN RADIATION BELT.

WHICH ARE TWO DOUGHNUT SHAPED
REGIONS THAT ENCIRCLE THE EARTH.
AND THESE BELTS GROW
DRAMATICALLY, BOTH IN SIZE AND
IN ENERGY, AND DURING THESE BIG
STORMS, AND THIS HAS DIRECT
EFFECTS FOR SATELLITES IN ORBIT
AS WELL AS ACTION IN SPACE.
BUT FORTUNATELY FOR US, THE
JOHNS HOPKINS UNIVERSITY OF
APPLIED PHYSICS LAB IS CURRENTLY
BUILDING THE RADIATION BELT
STORM PROBE COMMISSION FOR NASA.
IT'S TWO IDENTICAL SPACECRAFT IN
ORBIT AND THEY'RE GOING TO STUDY
THE RADIATION BELTS AND
HOPEFULLY GIVE US ENOUGH
UNDERSTANDING THAT WE CAN
ACTUALLY PREDICT WHAT'S GOING TO
HAPPEN.
BECAUSE THIS IS A VERY CRITICAL
REGION OF SPACE AURA AND IT
DRIVES MAJOR CHANGES NOT ONLY
THERE, BUT ALSO IN THE EARTH'S
ATMOSPHERE.
THE HIGHEST UNFINISHED LAYER OF
THE EARTH'S ATMOSPHERE IS CALLED
THE IONOSPHERE.
THIS IS HOME TO A VERY LOT OF
IMPORTANT PROCESSES THAT ARE
HAPPENING IN OUR ATMOSPHERE.
BACK IN 2001, NASA AND THE JOHNS
HOPKINS APPLIED PHYSICS LAB
BUILT AND LAUNCHED THE TIME
SATELLITE.
AND THAT IS TELLING US JUST HOW
OUR UPPER ATMOSPHERE RESPONDS
TO IMPACTS FROM SOLAR CHANGES.
WE SEE HEATING AND COOLING
CYCLES.
WE SEE CURRENTS THAT ARE FLOWING
THAT CAUSE DISRUPTIONS TO POWER

GRIDS, AND TO PIPELINES.

AND THE REASON THAT WE ARE INTERESTED IN IS ABOUT 40 TO 110 KILOMETERS ABOVE THE EARTH. NOW THIS IS WELL ABOVE WHERE COMMERCIAL AIRCRAFT FLY, SO WE DON'T NEED TO WORRY PERSONALLY. BUT IT IS A KEY REGION FOR US TO BE ABLE TO FIND OUT EFFECTS TO ASTRONAUTS AND TO SATELLITES.

THANK YOU DR. FOX.

IT'S HARD TO BELIEVE WE CAN TAKE SOME DUZLEING IMAGERY OF OUR VERY ONLY PLANET.

RIGHT NOW WE HAVE A CHANCE TO TAKE A QUESTION FROM GODDARD SPACE FLIGHT CENTER.

HI, GODDARD, HOW ARE YOU TODAYth WE'RE GREAT, THANK YOU.

I UNDERSTAND YOU HAVE A QUESTION.

WE'D REALLY LIKE TO HEAR IT.

HI, MY NAME IS STEPHANIE.

HOW DO WE PROTECT OURSELVES FROM THE SUN?

STEPHANIE'S QUESTION WAS HOW DO WE PROTECT OURSELVES FROM THE SUN?

THERE'S LOTS OF WAYS THAT WE PROTECT OURSELVES.

BUT WE'RE VERY LUCKY THAT WE HAVE OUR OWN PROTECTION THAT'S ALREADY OUT THERE, OUR MAGNETOSPHERE DOES A WONDERFUL JOB OF PROTECTING US.

IT SHIELDS US FROM ALL THE VERY HIGH ENERGY PARTICLES.

IT'S GOT SOME COMING DOWN TO THE SURFACE AND IT LOOKS AFTER US VERY WELL.

BUT THE BIGGEST WAY WE CAN ACTUALLY PROTECT OURSELVES IS TO

BE ABLE TO PREDICT THESE THINGS
ARE HAPPENING.
SO NASA HAS THIS WONDERFUL FLEET
OF SPACECRAFT IN KEY REGIONS, SO
WE'RE ABLE TO SEE THINGS
HAPPENING ON THE SUN, TRACK THEM
AS THEY COME TOWARDS THE EARTH
AND PREDICT WHAT THEY'LL BE
DOING TO OUR ATMOSPHERE.
AND IF NECESSARY, THEN WE CAN
TAKE PRECAUTIONS TO STOP THE
REALLY HARMFUL EFFECTS HAPPENING
TO US.

THANK YOU.

IT'S JUST INCREDIBLE HOW TIME IS
FLYING RIGHT NOW.

WE ARE ALREADY PREPARED FOR
DISCOVERY NUMBER TWO.

Narrator: SOMETIMES A GREAT
DISCOVERY IS A NEW PERSPECTIVE
ON THE UNIVERSE WE THOUGHT WE
KNEW.

AS THE VOYAGER SPACECRAFTS NEAR
THE EDGE OF SUN'S REACH,
SCIENTISTS ARE GETTING A NEW
LOOK AT THE EXPANSE AND SHAPE OF
THE SOLAR SYSTEM.

OVER 30 YEARS AGO, VOYAGER 1 AND
2 SET OUT FOR JUPITER, SATURN,
AND BEYOND.

NOW AS THE TWIN SPACECRAFTS
EXPLORE THE OUTER REACHES SOME
9 BILLION MILES AWAY FROM EARTH,
THEY HAVE CROSSED THE
HELIOSPHERE, THE BUBBLE OF
SUPERSONIC SOLAR WIND.

HOWEVER, WHEN VOYAGER 2 CROSSED
THIS BOUNDARY MUCH CLOSER TO THE
SUN THAN EXPECTED, WE RECEIVED A
PICTURE OF A SQUASHED
HELIOSPHERE RATHER THAN A ROUND
BUBBLE.

THE SQUASHED HELIOSPHERE HELPS SCIENTISTS BUILD UP A PICTURE OF HOW THE SUN INTERACTS WITH THE SPACE OUTSIDE OF OUR SOLAR SYSTEM.

THE RECENTLY LAUNCHED IBEX, OR INTERSTELLAR BOUNDARY EXPLORER, WILL FURTHER THE STUDY OF HOW THE SOLAR WIND INTERACTS WITH THE COLD GAS BETWEEN STARS.

Troy Cline: THE VOYAGER SPACECRAFTS HAVE BEEN ABLE TO OBSERVE THE OUTER REACHES OF OUR SUN, ALLOWING US TO LEARN ABOUT THE SUN'S INFLUENCE FAR BEYOND OUR OWN PLANET.

RIGHT NOW WE HAVE DR. ERIC CHRISTIAN.

THANK YOU, TROY.

DID YOU KNOW THAT THE SUN HAS AN ATMOSPHERE?

THE SOLAR WIND AND A STREAM OF PARTICLES FLOAT OUT IN ALL DIRECTIONS FROM THE SUN AT A MILLION MILES PER HOUR.

THIS SOLAR WIND BLOWS WAY PAST ALL THE PLANETS.

AND IT BLOWS A BUBBLE IN INTERSTELLAR SPACE.

WE ALL THIS BUBBLE THE HELIOSPHERE AND IT'S THE ATMOSPHERE OF THE SUN.

SEE THE PICTURE, THERE'S ACTUALLY TWO PARTS TO THIS BUBBLE.

THERE'S AN INNER, ROUND PART, AND THEN THERE'S A PART THAT HAS A LONG TAIL.

THE BOUNDARY BETWEEN THESE TWO LAYERS IS THE SOLAR WIND TERMINATION SHOT.

AND THAT'S WHAT THE TWO VOYAGER

SPACECRAFTS, AND THEY'RE THE FARTHEST THINGS FROM EARTH, BOTH OF THEM DETERMINED SOLAR WIND DETERMINATION SHOCK.

WHAT IS SOLAR WIND TERMINATION SHOCK?

YOU CAN DO ANALOGY RIGHT IN YOUR VERY SINK.

IF YOU TAKE A STREAM OF WATER AND BOUNCE IT OFF A PLATE, WHAT YOU GET IS AN INNER REGION WHERE THE WATER IS MOVING VERY FAST AND VERY STRAIGHT.

AND THEN YOU'LL SEE A JUMP IN THE DEPTH OF THE WATER, AND THEN IT WILL START TO FLOW DOWN THE SINK.

THAT JUMP IS A SHOCK.

THAT'S WHERE THE WATER OR THE SOLAR WIND MOVING VERY FAST AND VERY STRAIGHT TO MORE TURBULENT, PILES UP, GETS DENSER, AND SO GREAT ANALOGY.

YOU CAN DO AN EXPERIMENT RIGHT IN OUR VERY SINK.

NOW, VOYAGER 1 AND VOYAGER 2 MORE THAN 30 YEARS AGO HAVE BOTH -- ARE NOW EXPLORING THE OUTSIDE OF THE SOLAR SYSTEM.

THIS REGION BETWEEN THE TERMINATION SHOCK AND THE EDGE.

WE'RE HOPING THEY CONTINUE WORKING FOR ANOTHER 10 OR 15 YEARS, BECAUSE THEY WILL PROBABLY BREAK OUTSIDE OF THE HELIOSPHERE AND BE MAN KIND'S FIRST INTERSTELLAR PROBE.

THE VOYAGERS GIVE US GREAT DATA. BUT THERE ARE ONLY TWO POINTS IN THIS ENORMOUS STRUCTURE THAT THE SOLAR WIND HAS MADE, THIS BUBBLE.

AND THEY'RE 10 BILLION MILES
AWAY FROM EARTH.
THEY'RE ALSO 10 BILLION MILES
AWAY FROM EACH OTHER.
SO HOW DO WE KNOW THE ENTIRE
STRUCTURE?

WELL LAST YEAR WE LAUNCHED A
MISSION CALLED THE INTERSTELLAR
BOUNDARY EXPLORER OR IBEX.
IT'S A SMALL SPACECRAFT THAT
FROM EARTH'S ORBIT TAKES A
PICTURE OF THE OUTSKIRTS OF OUR
SOLAR SYSTEM.

AND IT DOESN'T TAKE THE PICTURE
WITH LIGHT LIKE YOU'RE USED TO.
IT ACTUALLY TAKES THE PICTURE
WITH PARTICLES.

VERY SPECIAL PARTICLES CALLED
ENERGETIC NEUTRAL ATOMS.
AND IT COLLECTS THE ENERGETIC
NEUTRAL ATOMS THAT ARE FORMED IN
THE OUTSKIRTS OF THE SOLAR
SYSTEM AND MAKES A PICTURE THAT
SHOWS US THE ENTIRE STRUCTURE.
IN ABOUT SIX MONTHS WE'LL HAVE A
PICTURE OF THE ENTIRE STRUCTURE
OF THE SOLAR SYSTEM.

WHAT EXCITING INFORMATION
THAT IS.

THANK YOU, SO MUCH.
NOW WE ACTUALLY HAVE TIME FOR A
QUESTION FROM THE ADLER
PLANETARIUM.

HOW ARE YOU TODAY?
MY NAME'S SHEA AND MY
QUESTION IS HOW DOES A SOLAR
STORM AFFECT US ON EARTH.

THAT WAS HOW DOES A SOLAR
STORM AFFECT US ON EARTH?

WELL, THERE ARE MANY AFFECTS
OF A SOLAR STORM CAN HAVE AND
THE EARTH.

AS WELL AS THE PRETTY ONES, YOU GET THE GREAT AURORAS TO COME FURTHER SOUTH WHEN WE HAVE A SOLAR STORM.

IT CAN ACTUALLY AFFECT THE POWER SYSTEM.

THERE ARE POWER OUTAGES THAT HAVE BEEN CAUSED BY SOLAR STORMS.

IT CAN AFFECT OIL PIPELINES, CAUSE VOLTAGES AND ALL SORTS OF DAMAGE TO THEM.

IT CAN AFFECT ASTRONAUTS UP IN SPACE.

AND IT CAN AFFECT SATELLITES.

SO REALLY HAVE TO PAY ATTENTION TO SPACE WEATHER BECAUSE THERE'S A LOT OF EFFECTS THESE STORMS CAN CAUSE.

THANK YOU, DR. CHRISTIAN.

NOW, WE ACTUALLY HAVE TIME TO TAKE A AT ALSO COVERRY NUMBER ONE.

Narrator: IT'S HARD TO IMAGINE WEATHER BEING MORE THAN RAIN ON OUR WEEKEND OR ICE ON OUR ROAD, BUT SPACE WEATHER CAN AFFECT THE GLOBE, ESPECIALLY IN THE WAY WE COMMUNICATE AND POWER OUR WORLD.

SPACE WEATHER IS THE ENVIRONMENTAL CONDITIONS OUTSIDE OF OUR PLANET ORIGINATING FROM THE MASSIVELY ENERGETIC OUTPUT OF THE SUN.

DR. David Sibeck: THE SOLAR WIND IS PRIMARILY COMPRISED OF PROTONS AND ELECTRONS. THEY'RE STREAMING OUTWARD FROM THE SUN AT SPEEDS UP TO A MILLION MILES AN HOUR, AND THEY'RE CONSTANTLY BOMBARDING

THE EARTH'S MAGNETIC FIELD.

Narrator: SATELLITES HAVE BEEN LAUNCHED TO STUDY SOLAR WIND, SOLAR FLARES, CORONAL MASS EJECTIONS, AND OTHER BEHAVIORS OF THE SUN. THESE PHENOMENA IMPACT OUR ATMOSPHERE, SOMETIMES WITH DEVASTATING FORCE. SO SPACE WEATHER INCLUDES POWER OUTAGES IN HIGH-LATITUDE POWER GRIDS.

IT INCLUDES DISRUPTIONS OF SPACECRAFT.

IT INCLUDES RADIATION THAT CAN HARM ASTRONAUTS IN SPACE.

Narrator: WITH ANY WEATHER, PREDICTION IS THE GOAL.

THESE MISSIONS WILL ALL ADD TO THE UNDERSTANDING OF WHAT IT MEANS TO TRULY LIVE WITH A STAR.

Troy Cline: SPACE WEATHER IS ABOUT LOOKING TO THE FUTURE, AND NASA IS STAYING AHEAD OF THE CURVE WITH A NEW MISSION CALLED SDO.

WE HAVE ALL GONE THROUGH THIS TRANSITION OF CONVERTING OVER TO HIGH DEFINITION TV.

WELL, THE SOLAR DYNAMICS OBSERVATORY IS NASA'S ANSWER TO A HIGH DEFINITION VIEW OF THE SOLAR SURFACE.

THE MAIN THING THAT WE'RE TRYING TO UNDERSTAND ABOUT THE SUN IS WHY DOES IT HAVE MAGNETIC FIELDS?

IF THE MAGNETIC FIELDS THAT SEEM TO POWER ALL OF THE INTERESTING THINGS AND PROBLEMS THAT WE HAVE WAY OUT HERE ON EARTH.

AND SO, WHAT SDO IS DESIGNED TO

DO IS TO GIVE US MORE INSIGHT AS TO HOW THESE MAGNETIC FIELDS ARE GENERATING.

AMAZINGLY ENOUGH WE CAN PROBE INSIDE THE INTERIOR OF THE SUN USING SATELLITES LIKE SDO AND ACTUALLY STUDY THE INTERIOR OF THE SUN, AND THE LAYERS WHICH WE THINK ARE ACTUALLY PRODUCING THE MAGNETIC FIELDS.

WE CAN USE THAT SAME KIND OF APPROACH NOT ONLY TO STUDY THE ACTIVE REGIONS ON THE FRONT OF THE SUN, WHICH YOU SEE IN THE ILLUSTRATIONS HERE, BUT WE CAN ALSO EXAMINE THE DARK SIDE OF THE SUN WHICH IS CURRENTLY NOT OBSERVABLE BY THE EARTH FROM WHERE WE'RE LOCATED.

SO SDO IS GOING TO ALLOW US TO MORE ACCURATELY SEE THE OTHER SIDE OF THE SUN, AND TO EXAMINE THOSE ACTIVE REGION AS THEY ROTATE AROUND TO THE FRONT SIDE AND BECOME A PROBLEM FOR US AS PART OF SPACE WEATHER.

THE HIGH RESOLUTION CAPABILITY OF SDO AND IN PARTICULAR THE FACT THAT IT LOOKS IN EIGHT DIFFERENT WAVE LENGTH BANDS AT THE SAME TIME, AND GIVE US LITERALLY REALTIME MOVIES OF THE CHANGES OF THE EARTH'S -- OF THE SUN'S MAGNETIC FIELD, IS GOING TO PROVIDE AN ENORMOUS AMOUNT OF INFORMATION THAT WE DON'T CURRENTLY HAVE ABOUT HOW THESE MAGNETIC FIELDS ARE GENERATED, HOW THEY INTERACT WITH EACH OTHER, AND HOW THEY RELEASE ENERGY.

THANK YOU, DR. ODENWALD.

NOW LET'S TAKE ANOTHER QUESTION
FROM JPL.

JPL, YOU'RE WITH US.

THERE YOU ARE.

HI.

WHAT'S YOUR QUESTION?

MY NAME IS JOSEPH BURGESS AND
MY QUESTION IS HOW THE
NORTHERN -- HOW DOES THE SUN
CAST THE NORTHERN LIGHTS IN
ALASKA?

WELL, THE SUN ACTUALLY
DOESN'T CAUSE THE NORTHERN
LIGHTS.

THAT'S ONE OF THOSE MYSTERIES
THAT PEOPLE OFTEN GET CONFUSED
AT.

IT'S VERY EASY TO THINK THAT THE
SUN DOES SOMETHING AND THE
NORTHERN LIGHTS IMMEDIATELY
FORM.

BUT IT'S ACTUALLY A VERY COMPLEX
SERIES OF PROCESSES.

IT'S ACTUALLY THE ENERGY FROM
THE SUN THAT COMES ALONG, IT
INTERACTS WITH OUR OWN MAGNETIC
FIELD UNDER CERTAIN CONDITIONS
AND IT ALLOWS ALL OF THE ENERGY
TO COME IN IT.

IT TURNS UP OUR MAGNETICS
ATMOSPHERE, OUR MAGNETOSPHERE.

IT LITERALLY MOVES MAGNETIC
SLOTS FROM ONE SIDE OF THE EARTH
TO THE OTHER AND NATURE CAN
NEVER HAVE AN IMBALANCE.

ONE THOSE SCALES ARE TIPPED IT'S
GOT TO BE SOMETHING TO BRING
THEM BACK INTO BALANCE.

SO THE WAY IT DOES THAT IS IT
RELEASES TITANIC AMOUNTS OF
ENERGY INTO OUR EARTH'S
ATMOSPHERE BY THIS PROCESS

CALLED RECONNECTION, THAT STEN SPOKE ABOUT A FEW MINUTES AGO, AND THIS ALLOWS VERY ENERGETIC OXYGEN -- SORRY, VERY ENERGETIC ELECTRONS AND PROTONS TO COME STREAMING DOWN OUR EARTH'S MAGNETIC FIELD LINE.

IT INTERACTS WITH OUR EARTH'S OWN ATMOSPHERE, WITH THE OXYGEN AND THE NITROGEN IN THE AIR THAT YOU BREATHE EVERY DAY, AND IT HITS THEM.

IT LITERALLY HITS THE ATOMS IN OUR ATMOSPHERE, AND IT CAUSES THEM TO GLOW.

IT ENERGIZES THEM.

THEY GET SO MUCH ENERGY, THEY HAVE TO GET RID OF THE ENERGY. AND THEY DO THAT BY GLOWING.

IT'S RATHER LIKE GETTING A 2-YEAR-OLD TOO MUCH SUGAR.

THEY HAVE TO RUN AROUND A LOT AND THEN THEY GO RIGHT BACK TO HOW THEY WERE BEFORE AND FALL ASLEEP.

SO THAT'S WHAT HAPPENS TO OUR ATMOSPHERE.

IT GETS ENERGIZED, IT GLOWS AND IT GOES RIGHT BACK TO HOW IT WAS BEFORE.

THANK YOU, DR. FOX.

WHAT INCREDIBLE INFORMATION THAT IS.

I ALSO WOULD LIKE TO REMIND EVERYBODY THAT ON THE SUN-EARTH DAY WEBSITE YOU'LL BE ABLE TO GO AND FIND SOMETHING CALLED THE SPACE WEATHER MEDIA VIEWER. AND ON THAT TOOL YOU'LL BE ABLE TO SEE ALL SORTS OF INFORMATION JUST LIKE THESE PANELISTS ARE TALKING ABOUT TODAY.

WE HAVE TIME TO TAKE ANOTHER
QUESTION FROM JPL.

MY QUESTION IS -- THE STARS,
THE MOON AND OTHER OBJECTS --
DARK?

YES, COULD YOU REPEAT THE
QUESTION FOR US?

OTHER OBJECTS, WHY -- DARK
SHOULDN'T THE SPACE BE MORE --
WELL, THAT'S A REALLY GREAT
QUESTION.

WHY IS SPACE DARK?

AND THE REASON WHY IS BECAUSE
LIGHT ISN'T VISIBLE AS IT
TRAVELS.

IT'S ONLY VISIBLE WHEN IT
BOUNCES OFF SOMETHING.

AND SO, YOU SEE ME BECAUSE THE
LIGHT'S BOUNCING OFF.

BUT YOU DON'T SEE A PATH OF
LIGHT COMING FROM THE LIGHT TO
ME.

ONLY YOU SEE IT, SOMETHING
THAT'S GLOWING LIKE THE SUN, OR
YOU SEE IT WHEN IT BOUNCES OFF
AN OBJECT LIKE A PLANET OR A
MOON AND COMES AT US.

BUT YOU ACTUALLY DON'T SEE IT
TRAVELING.

GOOD QUESTION.

OH, THANK YOU VERY MUCH.

I ALSO BELIEVE WE HAVE GODDARD
SPACE FLIGHT CENTER, WHO IS
AVAILABLE AND WOULD LIKE TO ASK
A FEW QUESTIONS, AS WELL.

GODDARD, ARE YOU THERE WITH US?
IN JUST A FEW MOMENTS -- THERE
THEY ARE.

HELLO, GODDARD.

AND COULD YOU GIVE US YOUR
QUESTION?

HELLO, MY NAME IS CHRISTIAN.

DOES THE SUN AFFECT OUR WEATHER?

DOES THE SUN AFFECT OUR WEATHER?

WELL, IT DOES.

I MEAN IT AFFECTS OUR WEATHER IN THAT, YOU KNOW, WHEN IT'S A SUNNY DAY, THERE'S NO CLOUDS, WE GET LOTS OF SUNSHINE.

BUT IT DOESN'T REALLY HAVE A GLOBAL EFFECT ON OUR WEATHER ITSELF.

IT CERTAINLY HAS AN EFFECT ON LARGE-SCALE CLIMATE CHANGES.

IF YOU GO BACK A FEW HUNDRED YEARS, THERE WAS A MINIMUM PERIOD WHERE THERE WERE NO SUN SPOTS VISIBLE ON THE SUN AND WE HAD A MINI ICE AGE.

PEOPLE SKATED ON THE THAMES IN LONDON.

AND I CAN TELL YOU COMING FROM LONDON, THAT DOESN'T HAPPEN VERY OFTEN.

SO IT DOES HAVE LARGE-SCALE CHANGES.

BUT, IT CERTAINLY WOULDN'T BE IF YOU SAW A BIG SOLAR STORM TODAY THAT YOU'D HAVE A SUNNY DAY OR A RAINY DAY TOMORROW.

IT'S MUCH MORE OF A LARGE-SCALE EFFECT THAN AN INSTANTANEOUS ONE.

THANK YOU VERY MUCH.

AS A MATTER OF FACT, WE HAVE TIME FOR ONE MORE QUESTION FROM GODDARD.

AND GODDARD, COULD YOU SPEAK YOUR QUESTION LOUDLY FOR US?

MY NAME IS JUSTIN AND MY QUESTION IS, WHAT EFFECTS DO SOLAR WINDS HAVE ON SATELLITES?

YEAH, THE SOLAR WINDS CAN

HAVE A LOT OF DIFFERENT EFFECTS
ON SATELLITES.

THE PARTICLES I MENTIONED THAT
ARE GOING AT ALMOST THE SPEED OF
LIGHT CAN HIT THE SATELLITE, CAN
HURT THE SATELLITE'S
ELECTRONICS.

SO WE CAN USE ALL COMMUNICATIONS
WITH SPACECRAFT AND THAT'S
HAPPENED A NUMBER OF TIMES.
ESPECIALLY HERE AT NASA.

WE DON'T LIKE THAT VERY WELL.
IT CAN ALSO AFFECT OUR ABILITY
TO COMMUNICATE WITH A SPACECRAFT
WITHOUT AFFECTING IT DIRECTLY.
BUT IT AFFECTS ATHE EARTH'S
UPPER ATMOSPHERE AND ANY SIGNALS
GOING TO AND FROM THE
SPACECRAFT.

AND IT CAN EVEN CHANGE THE
SPACECRAFT'S ORBIT.

SOMETIMES SOLAR FLARES WILL
FLUFF UP THE EARTH'S ATMOSPHERE.
AND SPACECRAFT CLOSE TO THE TOP
OF THE ATMOSPHERE WILL ACTUALLY
SHIFT DOWNWARDS A LITTLE BIT AND
IT'S HARD TO KEEP TRACK OF THEM.

THANK YOU FOR THAT INCREDIBLE
ANSWER.

NOW THROUGHOUT THE
WEBCAST, WE'VE HAD OUR STUDENT
SPACE WEATHER FORECASTERS
ANALYZING THE DATA FROM BOTH
SATELLITE AND GROUND BASED
OBSERVATORIES.

SO LET'S CHECK IN RIGHT NOW WITH
PAUL MORTFIELD AND THE STUDENT
SPACE WEATHER FORECASTING TEAM.

WELL, TROY, YES WE'VE BEEN
WORKING AWAY HERE, ACTUALLY THE
STUDENTS HAVE.

I'VE JUST BEEN SITTING AROUND

HERE AND THEY'VE BEEN GOING THROUGH ALL THE DATA COMING OFF THE SUN AND OFF THE SPACECRAFT, AND PUTTING IT IN SOME SORT OF REPORT TOGETHER THAT YOU CAN SEE VERY SOON.

DON'T FORGET A LOT OF THESE ACTIVITIES ARE ALL AVAILABLE ON THE WEBSITE SO YOU IN YOUR CLASSROOM CAN GO AHEAD AND DO THIS YOURSELF.

NOW ALL YOU NEED, REALLY, IS SOME SORT OF VIDEO CAMERA AND WEB CAM AND YOU, TO, CAN PUT YOUR OWN SPACE WEATHER REPORT TOGETHER.

THE OTHER THING ABOUT IT AGAIN IS SPACE WEATHER IS VERY IMPORTANT TO US.

WE HAVE ASTRONAUTS SITTING UP ON THE INTERNATIONAL SPACE STATION RIGHT NOW AND WE HAVE THE SPACE SHUTTLE DISCOVERY IS UP THERE WITH THE ENTIRE CREW AND THEY'RE GOING TO BE UP THERE SPACEWALKING.

I'VE GOT A COUPLE STUDENTS HERE WHO DID A SPACE WEATHER REPORT AND THEY'RE GOING TO INTRODUCE IT FOR US.

HERE'S OUR SPACE WEATHER REPORT.

Narrator: YOUR NUMBER ONE SPACE WEATHER REPORTING TEAM IN THE TRIVALLEY REGION WITH SHANNAN AND LYNDISAY.

THIS IS THE SPACE WEATHER ACTION CENTER.

HELLO, THIS IS YOUR SPACE WEATHER TEAM BRINGING YOU YOUR SPACE WEATHER FROM GODDARD SPACE FLIGHT CENTER.

THE SUNSPOT REGIONS EXIST
TODAY THAT COULD BE A SOURCE OF
SOLAR STORMS.

TODAY, WE DETECT AN AREA ON
THE SUN THAT COULD BE A SUNSPOT.
WE'RE WAITING ON VER FEKZ FROM
THE MDI INSTRUMENT ABOARD THE
SOHO SATELLITE.

HAVE SIGNALS BEEN RECORDED
TODAY INDICATING THAT A SOLAR
STORM MIGHT BE HEADED TOWARDS
EARTH?

THOSE CONCERNED THAT A SOLAR
STORM IS NOT IN PROGRESS TODAY,
WHEW.

HAS THERE BEEN A MEASURABLE
DISTURBANCE IN THE EARTH'S
MAGNETIC FIELD?

NO.

CURRENT LEVELS ARE LOW.

HAVE AURORAS BEEN SEEN IN THE
LAST 24 HOURS DUE TO A SOLAR
STORM?

THE SATELLITE INDICATED MINOR
ACTIVITY IN THE HIGHER
LATITUDES.

THE GOOD NEWS IS THAT OUR
COMMUNICATIONS SYSTEMS SATELLITE
CAPABILITIES ENDS TODAY.

WE WILL CONTINUE TO WATCH THIS
DATA TO FIND WHEN WE MIGHT BE
ABLE TO SEE AN AURA.

THIS IS YOUR SPACE WEATHER
TEAM SAYING --

HAVE A SUNNY DAY.

THANK YOU SO MUCH FOR THAT
REPORT.

AS IT TURNS OUT RIGHT NOW, THERE
JUST DOESN'T SEEM TO BE A WHOLE
LOT OF SPACE WEATHER HAPPENING
RIGHT NOW.

BUT YOU NEED TO STAY TUNED WITH

OUR SPACE WEATHER ACTION TEAMS AROUND THE COUNTRY, BECAUSE IN SCHOOLS AND LOCATIONS ACROSS THE UNITED STATES AND AROUND THE WORLD, STUDENTS ARE GOING TO THE SUN-EARTH DAY WEBSITE AND LOOKING AT THE SPACE WEATHER ACTION CENTER PROGRAM.

AND IT'S IN THAT PROGRAM THAT TEACHERS CAN FIND AN INCREDIBLE INSTRUCTIONAL GUIDE, A FLIP CHART THAT WALKS YOU THROUGH EVERY STEP NEEDED TO INTRODUCE YOU, YOUR CLASS, YOUR STUDENTS, EVEN MUSEUM PARTICIPANTS TO SPACE WEATHER.

AS A MATTER OF FACT AT THE END OF THAT PROGRAM WE ALSO GIVE YOU INSTRUCTIONS HOW TO MAKE YOUR VERY OWN SPACE WEATHER REPORT THAT CAN BE DONE IN MULTIPLE WAYS.

OFTEN OUR STUDENTS LIKE TO USE A GREEN SCREEN AND THEY CAN PUT THAT UP IN THEIR CLASSROOM WITH A GREEN SCREEN OF VERY INEXPENSIVE DOWNLOADED PROGRAMS, AND A WEB CAMERA AND THAT'S IT. YOU HAVE AN INSTANT TELEVISION STUDIO.

NOW, AT THIS POINT, WE'VE HAD A LOT OF INFORMATION COMING IN TO US TODAY FROM OUR PANELISTS, FROM OUR STUDENT REPORTERS, AND FROM ALL THE VIDEOS THAT YOU'VE BEEN WATCHING.

AND I'M SURE MANY OF YOU HAVE MANY, MANY MORE QUESTIONS YOU WOULD LIKE TO ASK.

AS A MATTER OF FACT, STARTING THOSE TYPES OF QUESTIONS IN YOUR HEAD, THAT'S THE KEY TO

DISCOVERY.

SO IN ORDER TO FIND SOME MORE INFORMATION, AND SOME MORE QUESTIONS LET'S GO BACK TO GODDARD SPACE FLIGHT CENTER, AND THEY HAVE SOME STUDENTS ON THE READY RIGHT NOW WHO WOULD LIKE TO ASK A FEW MORE QUESTIONS TO OUR PANELISTS.

GODDARD, HOW ARE YOU?

MY NAME IS TAKIRA.

HOW OLD IS OUR SUN AND HOW LONG WILL IT BE SHINING?

YEAH, WE THINK THE SUN IS ABOUT 5 BILLION YEARS OLD.

AND WE CAN TELL THAT BY LOOKING AT THE EARTH AND ALSO ESPECIALLY THE MOON, WHICH ARE ABOUT THAT OLD AND WE THINK THE SUN'S A LITTLE BIT OLDER.

AND WE EXPECT IT TO LAST FOR ANOTHER 5 BILLION YEARS.

SO THESE ARE REALLY LONG TIMES COMPARED TO WHAT HUMANS ARE USED TO THINKING ABOUT.

THANK YOU DR. KUCERA.

I WOULD LIKE TO SEE IF WE HAVE ONE MORE QUESTION FROM GODDARD.

GODDARD, ARE YOU STILL WITH US?

OH, OKAY.

SO GODDARD HAS SHUT DOWN FOR US FOR THE DAY.

BUT WE DO HAVE A COMMENT, I'M HEARING, FROM OUR SPACE WEATHER ACTION TEAM.

THIS SHOULD BE VERY INTERESTING.

PAUL, WHAT'S HAPPENING OVER THERE?

WELL, OUR OWN TEAM ALSO HAS SOME QUESTIONS TO POSE TO OUR EXPERT SCIENTISTS, SO HERE'S

ANOTHER QUESTION FOR YOU.

WELL, I KNOW THAT THE SUN IS QUIET RIGHT NOW, SO I WOULD LIKE TO KNOW WHEN WILL IT BE ACTIVE AGAIN?

THAT'S A VERY GOOD QUESTION. THE SUN GOES THROUGH AN 11-YEAR CYCLE WHERE IT GOES FROM QUIET TO ACTIVE TO QUIET AGAIN. WE'RE RIGHT NOW IN THE QUIET PART OF THE SOLAR CYCLE. IT SHOULD SOMETIME SOON, IN A COUPLE MONTHS, SIX MONTHS, SOMETHING LIKE THAT, SHOULD START RAMPING UP AND BECOME MORE AND MORE ACTIVE. AND SO, IN FIVE YEARS OR SO, IT WILL BE VERY ACTIVE. BUT RIGHT NOW WE'RE IN THE QUIET PERIOD.

THANK YOU VERY MUCH. AND WITH THAT, WE WOULD LIKE TO THANK YOU TODAY FOR JOINING US FOR OUR SUN-EARTH DAY WEBCAST. WE HAVE SEEN THAT THERE ARE A LOT MORE WAYS TO OBSERVE THE SUN THAN BY JUST LOOKING THROUGH A TELESCOPE THE WAY GALILEO DID OVER 400 YEARS AGO.

TODAY WE HAVE SOPHISTICATED SATELLITES AND GROUND BASED OBSERVATORIES THAT CONTINUALLY GATHER IN WAVELENGTHS AND MAGNITUDES BEYOND ANYTHING THAT OUR EYES CAN SEE.

WE ARE LEARNING MORE ABOUT THE ORIGINS OF SPACE WEATHER, PREDICTING THE INTENSITY OF SOLAR STORMS, AND HOW THOSE STORMS IMPACT OUR PLANET. AND WHILE WE HAVE COME A LONG

WAY SINCE THE DAYS OF GALILEO,
WE ARE STILL ONLY BEGINNING TO
UNDERSTAND THE COMPLEXITIES OF
HOW THE EARTH TRULY LIVES WITH A
STAR.
THANK YOU.