(MUSIC)

Student 1: Hey, what’s going on with the power?

Student 2: I don’t know. Joan, what’s with the power?

Joan Cartan-Hansen, Host: Power? Well, we in the United States get about 20 percent of its power from nuclear energy.

Student 2: No, I mean the lights.

Cartan-Hansen: Well, energy does come in many forms including light.

But since you asked about nuclear energy, can I tell you more?

Student 1: No, we meant about…oh never mind.

Student 2: No, I’d really like to learn about nuclear energy.

Cartan-Hansen: Well, if you’re going to learn about nuclear energy, the first place you have to start is with the atom.

ATOMS ARE TINY PARTICLES THAT MAKE UP ALL MATTER.

ATOMS EACH HAVE A NUCLEUS MADE UP OF A PROTONS AND NEUTRONS AND THEN ELECTRONS WHICH CIRCLE THE NUCLEUS.

ATOMS DIFFER IN THE NUMBER OF PROTONS, NEUTRONS AND ELECTRONS.

EACH INDIVIDUAL COMBINATION IS KNOWN AS AN ELEMENT.

THERE ARE AT LEAST 92 DIFFERENT KINDS ELEMENTS IN NATURE.

YOU CAN SEE THEM LISTED ON THE PERIODIC TABLE OF ELEMENTS.

NOW, NUCLEAR ENERGY IS THAT ENERGY IN THE CORE OF AN ATOM.

THAT ENERGY THAT HOLDS THE ATOM TOGETHER IS THE STRONGEST FORCE IN NATURE.

AND WHEN WE BREAK THAT BOND, THE ENERGY THAT GETS RELEASED CAN BE USED TO PRODUCE ELECTRICITY.

Student 2: But how?

Cartan-Hansen: Well, It’s a process called nuclear fission

And it starts with uranium.

URANIUM IS A METAL FOUND IN ROCKS.

WE MINE IT AND THEN PROCESS IT.

URANIUM OCCURS IN SLIGHTLY DIFFERENT FORMS KNOWN AS ISOTOPES.

EACH ISOTOPE CONTAINS A SLIGHTLY DIFFERENT NUMBER OF NEUTRONS IN ITS NUCLEUS.

URANIUM’S ISOTOPES ARE URANIUM-238 AND URANIUM-235.

MOST NUCLEAR PLANTS USE URANIUM 235 AS ITS FUEL BECAUSE, UNDER THE RIGHT CONDITIONS, IT CAN BE SPLIT.

AND WHEN AN ATOM IS SPLIT, IT RELEASES ENERGY.

NUCLEAR POWER PLANTS USE THE HEAT GENERATED FROM SPLITTING ATOMS TO HEAT WATER, WHICH IS THEN TURNED INTO STEAM.

THAT STEAM TURNS A TURBINE CONNECTED TO A GENERATOR WHICH PRODUCES ELECTRICITY.

A NUCLEAR POWER PLANT PRODUCES ELECTRICITY IN PRETTY MUCH THE SAME WAY AS A COAL PLANT DOES…BUT INSTEAD BURNING A FOSSIL FUEL, THE NUCLEAR POWER PLANT GETS ITS HEAT FROM SPLITTING ATOMS.

Student 1: But how does that work?

Cartan-Hansen: The core of a nuclear reactor has a number of rods filled with uranium.

Then operators shoot neutrons into the uranium and it starts a chain reaction.

Student 2: What do you mean by a chain reaction?

Cartan-hansen: Well, kind of like this over here.

So Imagine that these dominos are the core of a nuclear reactor.

So you send in a neutron to split the first atom, it then sends out more neutrons to split the next atoms and then sends out more neutrons and splits more atoms. And each time you split an atom it releases energy in the form of heat.

Student 1: You mean it could just keep going on and on. Does it ever stop?

Cartan-Hansen: Well Nuclear reactors have things called control rods that help slow down or stop the chain reaction. Here let me show you.

You guys put in the rulers and I’ll start the dominos.

What happened?

Student 2: It stopped.

Cartan-hansen: Right, so an operator can put in control rods into the reactor and control the process of nuclear fission and in that way it controls how much heat the reactor puts out.

BUT NUCLEAR POWER, LIKE ALL SOURCES OF ENERGY WE PRODUCE, HAS ITS PROS AND CONS.

NUCLEAR PLANTS ARE EXPENSIVE TO BUILD BECAUSE THEY PUT IN SO MANY SAFETY FEATURES, BUT THE FUEL IS LESS EXPENSIVE.

NUCLEAR POWER IS LESS DESTRUCTIVE TO THE ENVIRONMENT BECAUSE YOU DON’T NEED A LOT OF URANIUM TO GET ELECTRICITY.

For example, IT WOULD TAKE 2,000 POUNDS OF COAL, 149 GALLONS OF OIL, 17,000 CUBIC FEET OF NATURAL GAS,

OR 5,000 POUNDS OF WOOD TO PRODUCE THE SAME AMOUNT OF ENERGY AS A ONE-INCH PELLET OF URANIUM FUEL!

NUCLEAR POWER ALSO DOESN’T RELEASE AS MUCH CARBON DIOXIDE SO UNLIKE COAL OR GAS POWER PLANTS, IT DOESN’T REALLY ADD TO THE PROBLEM OF GLOBAL WARMING.

AND UNLIKE SOLAR OR WIND POWER, NUCLEAR ENERGY CAN BE PRODUCED ELECTRICITY ANYTIME, MAKING IT A RELIABLE SOURCE OF ELECTRICITY.

BUT NUCLEAR POWER does HAVE SOME SERIOUS DRAWBACKS.

LIKE ANY TECHNOLOGY, IT CAN BE APPLIED FOR BENEFICIAL OR DESTRUCTIVE PURPOSES.

FOR EXAMPLE, DURING WORLD WAR 2, WE DEVELOPED BOMBS THAT USED ATOMIC ENERGY.

COUNTRIES AROUND THE WORLD NOW HAVE NUCLEAR BOMBS AND OFFICIALS ARE WORKING TO PREVENT THEIR USE.

ANOTHER PROBLEM: A FEW NUCLEAR POWER PLANTS HAVE HAD ACCIDENTS AND EXPOSED PEOPLE IN THE AREA TO NUCLEAR RADIATION.

AND CREATING NUCLEAR POWER LEAVES BEHIND HIGH AND LOW LEVEL RADIOACTIVE WASTE.

EXPOSURE TO A HIGH ENOUGH LEVEL OF NUCLEAR RADIATION OR RADIOACTIVE MATERIAL CAN BE DEADLY.

HIGH LEVEL NUCLEAR WASTE LIKE THE FUEL INSIDE A NUCLEAR REACTOR CAN REMAIN DANGEROUS FOR THOUSANDS OF YEARS.

LOW LEVEL NUCLEAR WASTE IS LESS DANGEROUS BUT STILL NEEDS TO BE DISPOSED OF SAFELY.

AS A SOCIETY, WE ARE STILL TRYING TO FIGURE OUT HOW TO SOLVE THE PROBLEM OF THE PROPER DISPOSAL OF NUCLEAR WASTE.

AND THERE IS ALSO THE RISK OF AN ACCIDENT AT A NUCLEAR POWER PLANT WHICH COULD CAUSE SERIOUS PROBLEMS FOR A VERY LONG TIME.

We have to consider a lot of choices when we make electricity and nuclear ENERGY is one option.

And by the way, POWER PLANTS AREN’T THE ONLY WAY WE USE nuclear energy to MAKE heat.

THE Stars LIKE our Sun use a form of nuclear energy to shine, but that’s a different video.

STUDENT 1: Can we set up that chain reaction again?

CARTAN-HANSE: Sure. and for the rest of you. If you want to learn more about nuclear energy, check out that area on the Science Trek website.

You’ll find it at idahoptv.org/science trek

(music)

Narrator: Presentation of Science Trek on Idaho Public Television is made possible through the generous support of the Laura Moore Cunningham Foundation, committed to fulfilling the Moore and Bettis Family legacy of building the great state of Idaho; by the Idaho National Laboratory, mentoring talent and finding solutions for energy and security challenges; BY WALMART AND THE WALMART FOUNDATION, INCREASING ACCESS FOR IDAHO’S CHILDREN TO EXPLORE THE POSSIBILITIES OF SCIENCE AND TECHNOLOGY AND SPARKING THEIR INTEREST IN CAREERS THAT SHAPE OUR WORLD; by the Friends of Idaho Public Television; by the Corporation for Public Broadcasting AND BY VIEWERS LIKE YOU, THANK YOU.