PU238

POWER UP ON MARS

HALF-LIFE ACTIVITY

THIS ACTIVITY CAN BE USED AS A HAND-OUT, A TABLETOP "WALK UP" ACTIVITY OR IN THE CLASSROOM.

IT IS A VISUALIZATION OF HOW THE HALF-LIFE OF AN ELEMENT IS DETERMINED.

THE INSTRUCTIONS ARE INCLUDED ON THE SHEETS THAT ARE TO BE PLACED AS MATS FOR ROLLING AND STACKING PENNIES.

THE ACTIVITY TIME IS 1-4 MINUTES AND CAN BE EXPANDED USING THE IDEAS IN THE VIDEO LINKED ON THE INSTRUCTION SHEET.

THE "HEADS UP" AND "DECAYED" SHEETS SHOULD BE PLACED FLAT ON THE TABLE.

ADDITIONAL SHEETS ARE INCLUDED TO BE USED AS TABLE DECORATION AND MORE INFORMATION ON THE ACTIVITY AND THE MARS ROVER.

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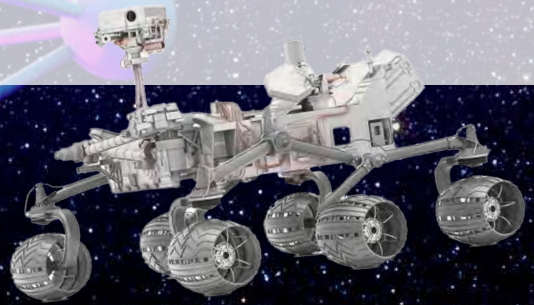

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HALF-LIFE ACTIVITY INSTRUCTIONS

FOR THIS ACTIVITY YOU WILL NEED:
50 PENNIES
1 CUP
"DECAYED" AND “HEADS UP” SHEETS (INCLUDED)

PLACE THE PENNIES IN YOUR CUP AND GO TO THE “HEADS UP” SHEET FOR THE NEXT STEP.

TO TAKE THIS ACTIVITY TO THE NEXT LEVEL USING LETTER TILES, FOLLOW THE QR OR VISIT, HTTPS://YOUTU.BE/8QFI4XFAQOG

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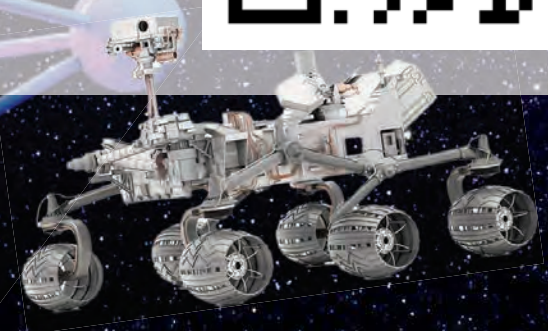

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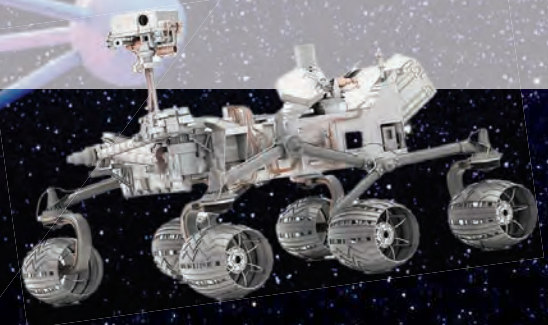
"HEADS UP"

PENNIES ARE NOT DECAYED ATOMS AND WILL STAY ON THIS SHEET TO BE SHAKEN AGAIN

MOVE ALL TAILS UP

PENNIES TO THE "DECAYED" SHEET



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DECAYED

"TAILS" PENNIES REPRESENT ATOMS THAT HAVE DECAYED. STACK PENNIES FROM EACH ROLL ON A SQUARE. DETERMINE HOW MANY ROLLS IT WOULD TAKE FOR AN ELEMENT TO COMPLETE THE DECAY PROCESS.

IF YOU HAVE PENNIES REMAINING, CONTINUE TO MAKE STACKS, UNTIL THEY ARE ALL "DECAYED".

THE NUMBER OF STACKS COULD REPRESENT SECONDS, DAYS OR YEARS. THIS IS HOW THEY DETERMINE THE HALF-LIFE OF AN ELEMENT.

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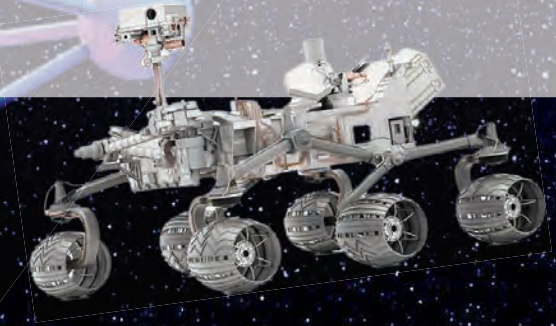

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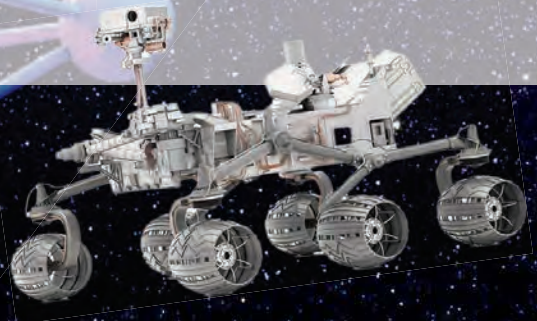
The Lambda symbol is used in the half-life equation to represent the decay constant, or rate of decay, in an element.



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POWER UP ON MARS

The electricity for NASA's Mars 2020 rover is provided by a power system called a Multi-Mission Radioisotope Thermoelectric Generator, or MMRTG. Essentially a nuclear battery, an MMRTG uses the heat from the natural radioactive decay of plutonium-238 to generate about 110 W of electricity at the start of a mission.

Plutonium-238 is a radioactive isotope of plutonium that has a half-life of 87.7 years. Plutonium-238 is a very powerful alpha emitter; as alpha particles are easily blocked, this makes the plutonium-238 isotope suitable for usage in radioisotope thermoelectric generators and radioisotope heater units.

While Perseverance's mission is simple—to find signs of life and collect rock and soil samples for possible return to Earth—its sophisticated MMRTG will be crucial to keep "Percy's" instruments running and help keep it warm as it explores the frigid planet.

A Long-Lasting Nuclear Battery, MMRTGs essentially use radioisotope power systems (RPS) to convert heat from the natural decay of radioisotope materials into electricity. RPSs are ideal for space missions because they are compact, durable and reliable, providing continuous power over long periods of time.

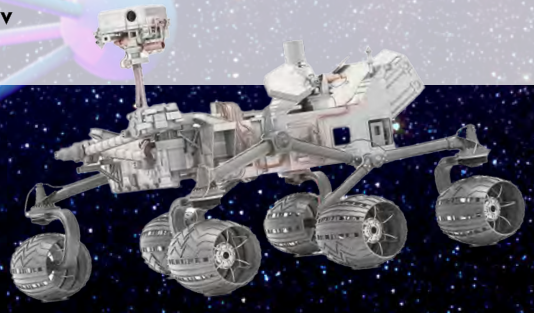
Perseverance's MMRTG falls under an RPS technology subset known as a radioisotope thermoelectric generator (RTG). It consists of two major elements: a heat source that contains plutonium-238 (Pu-238) and a thermocouple, which is a device that makes electricity without moving parts that might fail during a long space mission.

"Thermocouples are common in everyday items that must monitor or regulate their temperature, such as air conditioners, refrigerators and medical thermometers," NASA says. "The principle of a thermocouple involves two plates, each made of a different metal that conducts electricity. Joining these two plates to form a closed electrical circuit while keeping the two junctions at different temperatures produces an electric current. Each of these pairs of junctions forms an individual thermocouple."

In an RTG, the natural decay of Pu-238 produces heat that is then transferred to one of these junctions while the other junction remains unheated and is cooled by the space environment or a planetary atmosphere. The thermocouple produces power by exploiting the temperature differential between the hot side and the cool side. "This electricity production is based on a well-known scientific effect called the Seebeck effect."

Information and facts found at: NASA.GOV

For more information about NASA's use of Radioisotope Power Systems, see https://rps.nasa.govor email NASA-RPS@mail.nasa.gov



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WHAT IS HALF-LIFE?

HALF-LIFE IS A WAY TO

DETERMINE HOW

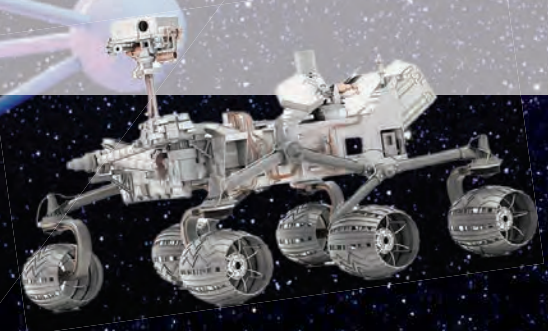
QUICKLY AN ELEMENT WILL DECAY

THE HALF-LIFE EQUATION IS USED TO MAKE

SURE WE WILL HAVE ENOUGH

ENERGY TO POWER A ROVER ON MARS

FOR YEARS TO COME!



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