NARRATION: A star explodes in a blinding supernova, spraying X-rays across the galaxy to tell its tale. X-rays also tell a dentist which tooth to drill, and a surgeon which bones to mend. In 1895, Wilhelm Röntgen discovered that firing streams of X-rays through arms and hands created eerie, but detailed, images of the bones inside.

X-rays are high energy light rays with wavelengths between 3 and 0.03 nanometers, so small that some X-rays are no bigger than many individual atoms. In laboratories, scientists fire beams of X-rays at unknown substances to learn what elements they contain and to decode their atomic structure. This is how scientists unraveled complex molecules like penicillin and DNA.

Scientists can also detect the X-rays emitted from extremely hot and energetic objects in the universe. NASA’s robotic rovers recorded X-rays to identify the spectral signatures of elements, such as zinc and nickel, in Martian rocks.

X-rays can also reveal an object’s temperature, since temperature determines the wavelength of its radiation. The hotter the object, the shorter that wavelength is. X-rays come from objects that seed at millions of degrees, such as pulsars, black holes, supernovas, or the plasma in our Sun’s corona. Our Sun has a surface temperature of around 6 thousand degrees Celsius and radiates most of its energy in visible wavelengths. But it is easier to study the massive energy flows in the corona’s energetic plasma by observing X-rays, like this image from the Hinode satellite, a joint Japanese-NASA mission. NASA’s SOHO satellite produced these X-ray images of the Sun that allows scientists to see and record these energy flows within the corona.

NASA’s orbiting Chandra X-ray observatory detects X-rays created by objects spread far across space, such as this supernova explosion that occurred 10 thousand light years from Earth. The colors of the gas and dust cloud correspond to different energy levels of the X-rays created by the blast.

X-rays at different wavelengths provide information about an object’s composition, temperature, density, or its magnetic field. Human eyes may not be able to see X-rays, but, from seeding cosmic bodies to individual atomic elements, X-rays provide a wealth of information to exploring scientists.