Objectives: Students learn that many units can be used for measuring radiation. Students learn how to convert mrems to mSv.

Present the following information to students, using whatever concrete examples are available (12 inch rulers, meter sticks, yard sticks, measures for liquid volume, etc.)

**Variety of Units.** More than one type of unit is used for measuring most things. The choice of measurement units depends upon many factors, including:

- what standard system is used in a particular location
- the “scale” of the object or event being measured
- convenience in expressing or understanding the resulting measurements
- how meaningful a particular measurement is to a specific situation

Most people in the U.S. are accustomed to measuring distance in inches, feet, yards, or miles depending on the circumstance. They also use fractions of an inch [½, 1/4, 1/8/ 1/16, or thousandths of an inch (0.001 inch), in some applications such as making precision machinery]. However, people in most parts of the world are accustomed to measuring distance using the basic unit of distance for the metric system, the meter. They also use kilometers (1000 meters), centimeters (1/100 meter) and millimeters (1/1000 meter).

It is possible to convert measurements from one unit of measurement to another using known equivalents, such as:

1 inch = 2.54 centimeters  
1 kilometer = 0.62138 mile  
1 meter = 39.37 inches  
1 yard = 36 inches

**Units for Radiation.** Radiation, too, is measured in a variety of units (Curie, bequerel, rad, rem, sieverts, etc.)

In the U.S., it is common to measure radiation dose in rems or millirems (mrem). In certain scientific disciplines and in other parts of the world, it is common to measure radiation dose in sieverts (Sv) or millisieverts (mSv) or even microsieverts (μSv).

Measurements of radiation doses can be converted from one measuring unit to another using conversion factors, such as:

1 rem = 1000 mrem  
1 sievert (Sv) = 1000 millisieverts (mSv)  
1 Sv = 10,000 microSv (μSv)

Classroom Activity: Converting Radiation Dose Estimates from one unit to another

You can help students be aware of commonly-used units and integrate a bit of math into your science content by teaching them how to convert mrem to mSv. You could apply one of two approaches:

1) Using a conversion formula

\[ x \text{ mrem} \times 0.01 \text{ mSv/mrem} = ? \text{ mSv} \]

For example, an average annual dose of 620 mrem

\[ 620 \text{ mrem} \times 0.01 \text{ mSv/mrem} = 6.2 \text{ mSv} \]

2) Using ratios

\[ \frac{1000 \text{ mrem}}{10 \text{ mSv}} = \frac{\text{known mrem}}{? \text{ mSv}} \]

For example, the average annual radiation dose of 620 mrem can be converted, as follows:

\[ \frac{1000 \text{ mrem}}{10 \text{ mSv}} = \frac{620 \text{ mrem}}{x \text{ mSv}} \]

\[ (1000 \text{ mrem}) (x \text{ mSv}) = (10 \text{ mSv}) (620 \text{ mrem}) \]

\[ x = 6.2 \text{ mSv} \]

You can provide students with a variety of radiation doses and have them convert them to other units, including mSv and Sv. OR, you could have them convert numbers from the worksheet (exposure from TV, exposure from smoke detector, etc.) into other units (Sv and mSv).

**Question for Discussion:**

What is one reason we might choose mSv instead of Sv as a unit for expressing a person’s average annual radiation dose?

(For most people, the average annual dose is relatively small. If you measure in Sv, the value will be a decimal value. Sometimes people get confused by decimals. For example, which is a greater amount of radiation, 0.02 mSv or 0.0006 mSv? At first glance, the value with the “6” looks greater. But, because it has more decimal places, 0.006 mSv is actually a smaller radiation dose.)