Figure 12
If a mountain's height is known with an uncertainty of 5 m, the addition of 0.20 m of rocks will not apprecia-bly change the height.

One way to solve such problems is to report all values using scientific notation. In scientific notation, the measurement is recorded to a power of 10, and all of the figures given are significant. For example, if the length of 230 cm has two significant figures, it would be recorded in scientific notation as 2.3×10^2 cm. If it has three significant figures, it would be recorded as 2.30×10^2 cm.

Scientific notation is also helpful when the zero in a recorded measurement appears in front of the measured digits. For example, a measurement such as 0.000 15 cm should be expressed in scientific notation as 1.5×10^{-4} cm if it has two significant figures. The three zeros between the decimal point and the digit 1 are not counted as significant figures because they are present only to locate the decimal point and to indicate the order of magnitude. The rules for determining how many significant figures are in a measurement that includes zeros are shown in **Table 4.**

Significant figures in calculations require special rules

In calculations, the number of significant figures in your result depends on the number of significant figures in each measurement. For example, if someone reports that the height of a mountaintop, like the one shown in **Figure 12,** is 1710 m, that implies that its actual height is between 1705 and 1715 m. If another person builds a pile of rocks 0.20 m high on top of the mountain, that would not suddenly make the mountain's new height known accurately enough to be measured as 1710.20 m. The final reported height cannot be more precise than the least precise measurement used to find the answer. Therefore, the reported height should be rounded off to 1710 m even if the pile of rocks is included.

Table 4 Rules for Determining Whether Zeros Are Significant Figures

Rule	Examples
1. Zeros between other nonzero digits are significant.	**a.** 50.3 m has three significant figures. **b.** 3.0025 s has five significant figures.
2. Zeros in front of nonzero digits are not significant.	**a.** 0.892 kg has three significant figures. **b.** 0.0008 ms has one significant figure.
3. Zeros that are at the end of a number and also to the right of the decimal are significant.	**a.** 57.00 g has four significant figures. **b.** 2.000 000 kg has seven significant figures.
4. Zeros at the end of a number but to the left of a decimal are significant if they have been measured or are the first estimated digit; otherwise, they are *not* significant. In this book, they will be treated as *not* significant. (Some books place a bar over a zero at the end of a number to indicate that it is significant. This textbook will use scientific notation for these cases instead.)	**a.** 1000 m may contain from one to four significant figures, depending on the precision of the measurement, but in this book it will be assumed that measurements like this have one significant figure. **b.** 20 m may contain one or two significant figures, but in this book it will be assumed to have one significant figure.