

Map Scales

Because a map is much smaller than the area of the Earth's surface that it represents, we need a means of relating points on the Earth to points on a map. Features represented on the map, such as cities, parks, rivers, and mountains have been reduced to fit on a piece of paper of a more convenient size. The amount of reduction is the same for every feature represented on the map. This scaling down of features is represented as a fraction or as a ratio and is called the **map scale**. The map scale is most usually specified as a ratio, such as 1:100,000, where one unit on the map represents 100,000 of the same units on the ground. That is, 1 inch on the map equals 100,000 inches on the map, and 1 centimeter on the map equals 100,000 centimeters (which is 1,000 meters, or 1 km) on the ground. Common ratio scales for maps are 1:24,000 (such maps show the most detail but cover the least amount of area), 1:62,500, 1:100,000 and 1:250,000 (show the least amount of detail but cover the most area). Scales of 1:500,000 to 1:5,000,000 are used to show entire states and countries. A 1:1,000,000 map of Arizona is about 2 feet wide by 3 feet long.

The map scale is generally shown at the center of the bottom of the topographic map, and may be expressed as a ratio scale, graphic scale, or verbal scale:

- ◆ *Ratio scale*, such as 1:24,000, means 1 unit of measurement on the map equals 24,000 units of measurement on the ground.
- ◆ *Graphic or linear scale* is a line or bar divided into segments, which correspond to specified distances on the ground.
- ◆ *Verbal scale* usually states the distance on the Earth's surface that is represented by one inch on the map (i.e. one inch equals ten miles).

Topographic maps are commonly called “quadrangle maps” because they show a quadrangular area defined by lines of latitude and longitude. A 1:24,000 map, like those commonly used by hikers, is called a 7.5-minute quadrangle because it represents an area bounded by 7.5 minutes of latitude and 7.5 minutes of longitude. The 1:62,500 maps are called 15-minute quadrangles, and 1:250,000 maps are called 1° by 2° quadrangles because they represent an area bounded by 1° of latitude and 2° degrees of longitude. Topographic maps are usually named after the most prominent feature in the quadrangle (e.g., New River Mesa).

Measuring the Lengths of Lines on Maps

We commonly are interested in the distances of lines on maps, such as when we plan a trip and want to determine how far it is between two cities. The lengths of lines are easily measured from a map. Just measure the distance with a ruler and then multiply that by the number in the ratio scale of the map. If it's 10 cm between the cities on the map, and the map scale is 1:100,000, then the distance is 1 million centimeters ($10 \text{ cm} \times 100,000 = 1,000,000 \text{ cm}$). Since it's hard to know how long it would take to drive 1,000,000 centimeters, we'd want to convert this to meters and then to kilometers. All we have to do is know the conversions between units (e.g., meters to kilometers) and make sure the equation is arranged so that the right units cancel each other out.

$$1,000,000 \text{ cm} \times \frac{1 \text{ m}}{100 \text{ cm}} = 10,000 \text{ m}$$

$$10,000 \text{ m} \times \frac{1 \text{ km}}{1,000 \text{ m}} = 10 \text{ km (or 6 miles)}$$