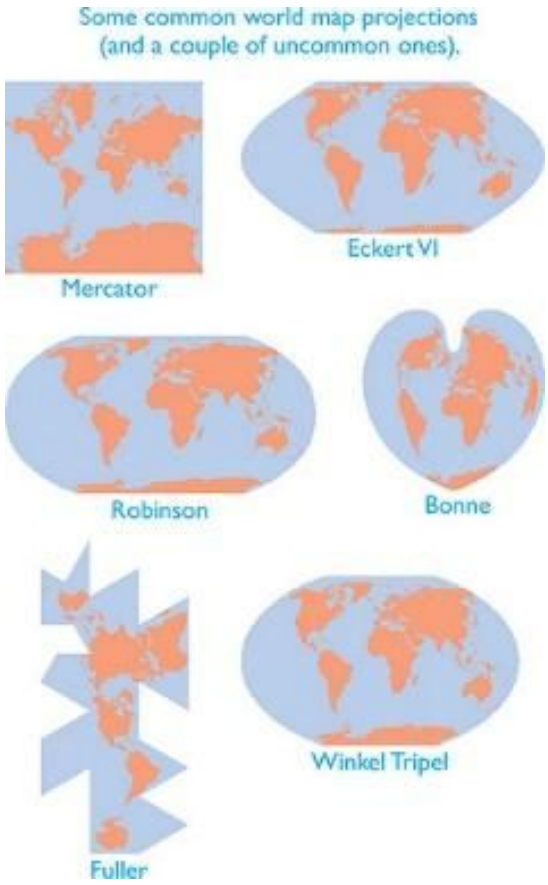
PROJECTED COORDINATE SYSTEMS

The earth's surface can be modeled very well on a spheroid, but not as well (except over small areas) on a plane. To make a map, you more or less have to flatten a sphere, which is like squaring a circle, only harder. It can't be done without radically adjusting the spatial properties and relationships of features on the surface: their shapes, sizes, and relative distances and directions.

The name for any such radical adjustment is a *map projection*. A projection is a mathematical formula (there are lots of different ones) for translating the world into flat space. All map projections introduce spatial distortion. They are variously designed to minimize certain kinds of distortion or to distribute it in certain ways over the map surface. Some projections correctly preserve feature shapes but distort their areas. Some preserve areas but distort shapes. Some compromise. Some have special properties, such as keeping true distance measurements from a single point to all others, or ensuring that courses of constant compass bearing are plotted as straight lines. The smaller the area being mapped, the less distortion there is of any spatial properties. Areas up to medium-size countries (say about the size of Nigeria or Bolivia) can be mapped with distortion low enough to be insignificant for most purposes.

A projected coordinate system consists of a map projection, a length-based unit of measure, an origin point for measurements, and other parameters, such as standard lines that define the distortion pattern on the map. Manipulating these parameters is what allows you to customize a coordinate system for a specific area of interest. Because a projection is applied to a particular spheroid and its definition of latitude-longitude values, a projected coordinate system also includes, or presupposes, a geographic coordinate system.

The idea of projection includes both going from a geographic (unprojected) system to a projected system, and going from one projected system to another (sometimes called *reprojection*). To go from one projected system to another, ArcGIS Pro undoes the map projection, goes back to the underlying geographic coordinate system, and applies a new projection to it. ArcGIS Pro stores thousands of map projection formulas and can run these calculations quickly.



When you add an unprojected dataset to a map (that is, a dataset that stores feature coordinates as latitude-longitude values), the data still must be projected in some sense to be viewed as a flat map on your monitor. In ArcGIS Pro, this default "pseudoprojection" has the display properties of a map projection (specifically, the Plate Carrée), but none of the other properties or parameters of a projected coordinate system.


Geographic pseudoprojection