

Teacher Notes: Map Projections

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Given that the Earth is a sphere and maps are two-dimensional, a mathematical operation called a projection is required to represent the curved surface of the Earth on the flat surface of a map. There are many types of map projections, and each one uses a different mathematical formula to transpose locations from the globe onto the map. Projections vary according to the particular purpose of the map.

Map projections are similar to projections of the lines of latitude and longitude from a lit-up globe onto the surface of a cone, a cylinder, or a plane surface. Projections are very complicated and cartographers are constantly in the process of adjusting and comparing them.

All map projections involve some degree of imprecision or distortion in one or more of the characteristics of the globe:

- **size** (area) of land and water masses
- **shape** of land and water masses
- **distance** between two points
- **direction** (N, S, E, W)

Often the distortion is greater around the edges of the map, particularly in the polar regions. Each projection has certain advantages and disadvantages, making it more useful for certain purposes. Cartographers select projections based on the purpose of the map or the elements they wish to study. For example, a Mercator projection is not accurate for comparing the area of the continents, but it is useful for navigation purposes as north, south, east, and west are true and accurate. The scale of the map and the region to be studied are also factors that affect the accuracy of a projection; generally, the larger the scale, the greater the distortion.

By an international treaty in 1884, the Prime Meridian was agreed upon as the line of longitude 0°, passing through the former Greenwich Observatory in England. For this reason, most world maps place the Prime Meridian at the centre, which tends to create the perception that western Europe and North America are more "important" or more central to the world.

In the same way, the distortion of shape and size created by certain map projections can create the impression that certain continents are larger than they actually are. On the other hand, projections that accurately reflect size or area accurately often compromise shape or distance. For example, the controversial Peters projection, introduced in 1974 to create a more "objective" perspective of the world, is accurate with respect to size, but it considerably deforms the shape of the continents. The Peters projection is useful for purposes of comparing thematic elements among continents, such as population distribution or other elements of human geography. It is used by a number of international aid and development organizations.

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Comparing Map Projections

The following chart includes examples of map projections and their general characteristics. Provide students with two or three visual comparisons and pose guiding questions to help them compare the accuracy of different projections compared to the globe, as well as (and perhaps more importantly) the perceptions of the world the various projections create. Encourage students to recognize that no map is 100% accurate, and that every map can create a particular view of the world. Help them reflect on and develop their own "mental map" of the world, which they will be drawing and refining throughout the year. (Note: Maps that place the South Pole at the top of the map, or Asia at the centre, are available for purchase or are accessible online. They make for very interesting discussions and help students understand the political nature of maps.)

Characteristics of Map Projections			
Elements Represented	Property of the Projection	Example	Perceptions, Usefulness
Shape	Conformal projection (does not distort shape)	<i>Mercator</i> <i>Lambert Conformal</i>	- Accurate continent shape; size of continents is distorted in higher latitudes and longitudes - Useful for navigation
Area/size	Equal area or equivalent projection (does not distort area or size)	<i>Peters</i> <i>Mollweide</i> <i>Goode</i>	- Areas of continents are correct but the shapes are distorted - Useful for specific tasks (e.g., comparing population density)
Distance	Equidistant projection (distances are accurately represented)	<i>Plate Carré</i> <i>Miller Equidistant</i>	- Distortion increases near the edges of the map; distances are accurate but area and direction are compromised. - Useful for studying characteristics of polar regions or for studying routes within a region
Direction	Azimuthal projection (N,S,E,W are accurate)	<i>Winkel Tripel</i> (used by National Geographic Society for world maps since 1998) <i>Robinson</i> : preserves direction and "appearance" of continents in world maps but distance, size, and shape are not accurate	- Useful for international air routes, thematic world maps - Direction is always true but there is some compromise in distance and area