Remote B Notes- Map Basics for Beginners

Remote Sensing B (Remote B) is a new event for the 2025-2026 Science Olympiad season. This event calls for students to understand basic principles of remote sensing and interpret imagery, data, and maps related to human interactions with land on Earth.

Competition events should have a point distribution of approximately:
1/3 on sensing and mapping concepts
2/3 on interpretation and analysis of maps, data, or images provided in the event.

Students must be familiar with many of the same skills used in Road Scholar, and additional understandings and skills relating to remote sensing. These notes will help with basic understanding of maps, and include the following areas from official rules (The Specs):

Specs Section 3bi: Fundamentals of Mapping - Topics included in this file

1.) Marginal Information

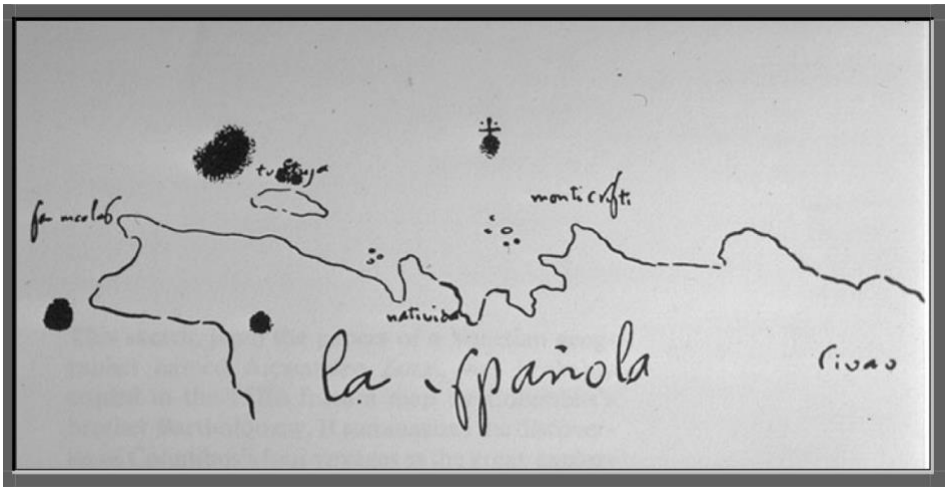
2.) Symbology and Cartographic design:
location
scale
legend
symbols

A map is a picture of the Earth's surface. Maps come in many forms and can show an enormous amount of information- but sometimes you must work hard to get all the information that is on the map.

Map of the World -about 194 BC, by Eratosthenes of Cyrene (*courtesy Myoldmaps.com*)

Eratosthenes also calculated that the Earth was round and had a circumference of about 24,000 miles, based on measuring shadows. What a guy!

Here is an example of an old hand-drawn map. It was probably drawn by Christopher Columbus in 1493, and shows the North Coast of the Island of Hispaniola (home to Haiti and the Dominican Republic):

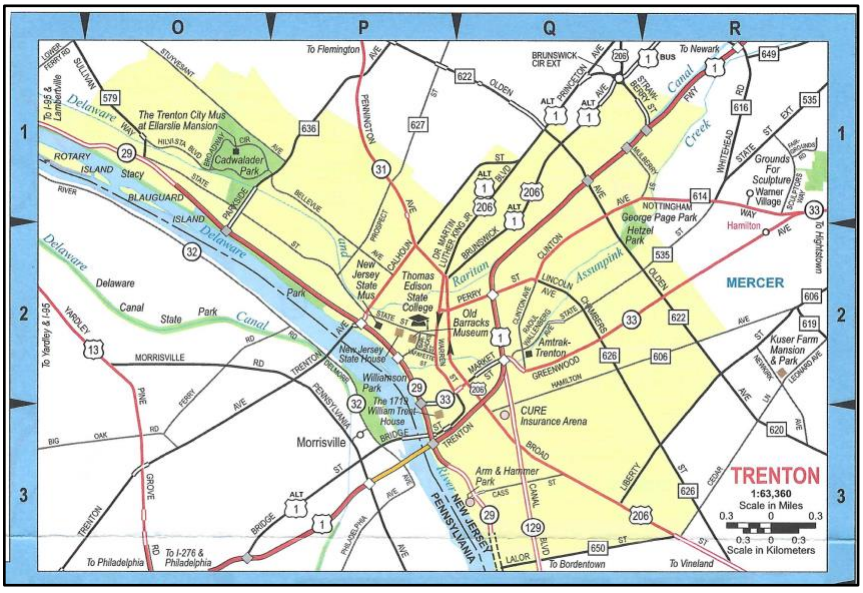


Types of Maps

Map makers (Cartographers) produce maps for many different purposes. You are probably already familiar with things like Google Maps, Road maps, and Topographic maps.

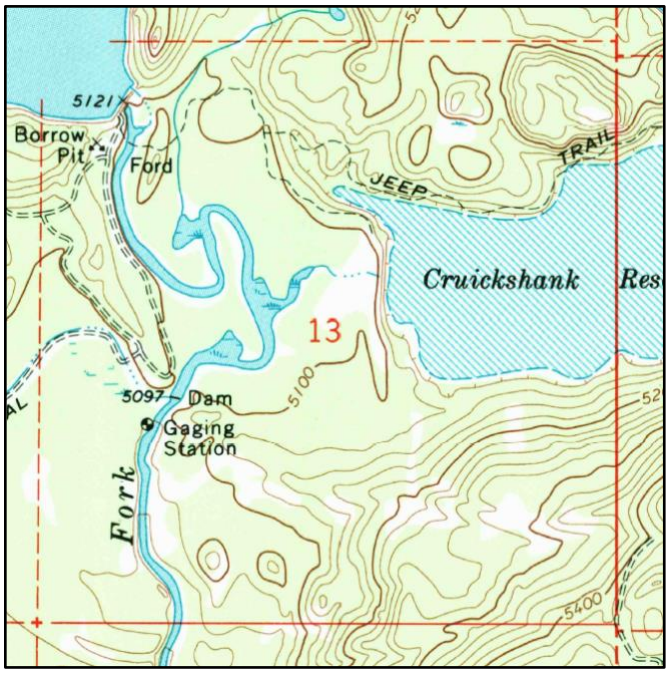
Road maps:

Road Maps are drawn to help drivers get to their destination, so they have information mostly about roads.



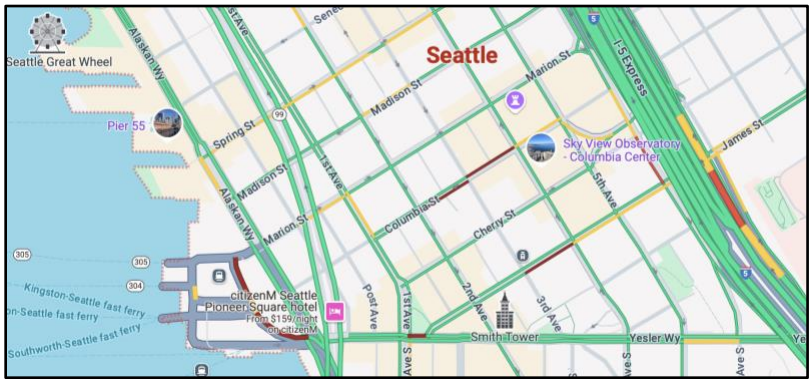
Topographic maps

Topographic maps show natural and human features, including water and land elevations.
The U.S Geological Survey (USGS) produces, and posts online, topographic maps for all areas in the United States. These maps are often used in construction, engineering, and outdoor sports.



Electronic maps

Electronic maps like this Google map of downtown Seattle below can show real-time features such as traffic slow spots.



Location

A map must have a location, such as "Oregon", "Mount St. Helens, WA" or "North Coast of Hispaniola" so the map reader knows what is being shown. Since map features change with time, modern maps often include the date the map was created.

Map symbols

Maps use symbols and colors to show features. A f**eature** is anything interesting - maybe a building, a river, a city , or a mountain. Sometimes the symbol is easy to understand, sometimes it needs some work to get used to. Map legends serve as a key to symbols on the map. Examples of easy symbols:

Ski Area

Airport (LAX)

Contour Line on topographic map 

Map Scale

The area shown on the map is usually much smaller than the actual map. Having a map of the world the same size as the actual planet would be hard to carry around!

An index card is usually 3" long by 5" wide. Imagine that you see an index card with objects on it--some dominoes, paper clips, and pennies. You want to make a totally accurate drawing of it, so you get another index card and draw the dominoes, pennies and paper clips in exactly the right size in exactly the right places. You just drew a map! Great work! Your teacher gives you a little smile sticker with glitter. On your map, each inch of the original card (with the real dominoes, etc.) is shown by one inch on your map. That is a proportion, or **scale**, of 1:1

What if you wanted to draw a football field? You would need a 100 yard (300 feet) long piece of paper. So ,you take a 12 inch (one foot) piece of paper and make an accurate drawing. Wow! You just invented a map **scale**. Your map is 300 times smaller than the real football field. Saying it differently, your map of one foot shows 300 feet in real life- that's a **scale of 1:300.** With a scale of 1:300, something that is 1 inch long on your drawing is 300 inches long in real life. If you accurately measure anything on your map and multiply by 300, that would be the actual size.

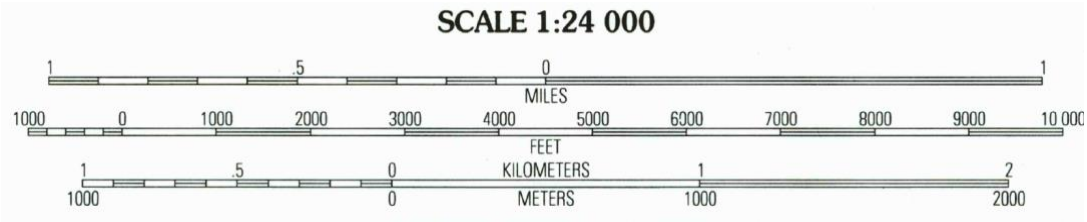
Topographic maps used in Remote B will usually have scales of 1:24,000, and show an area about six miles wide. Road maps may be 1: 1,350,000 and show several states.

Problem # 1: If two points are 1 cm apart on a 1:24,000 scale map, how far apart are they ?

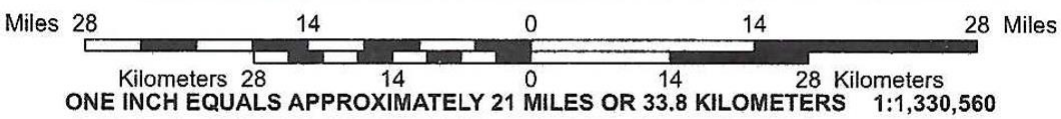
Ans: 1 cm x 24,000= 24,000 cm (since there are 100 cm per meter, that is also 240 meters)

Map Scale is very important in understanding what the map shows. It is always written someplace on the map. Scale may show as a math ratio like 1:24,000 or as a "**scale bar**".

Scale Bar from a USGS Topographic Map



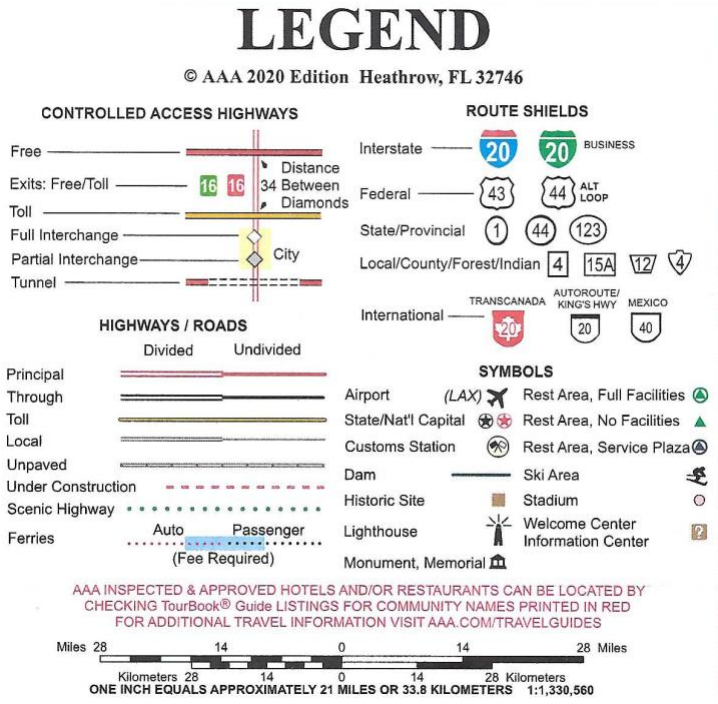
Scale Bar from a Road Map



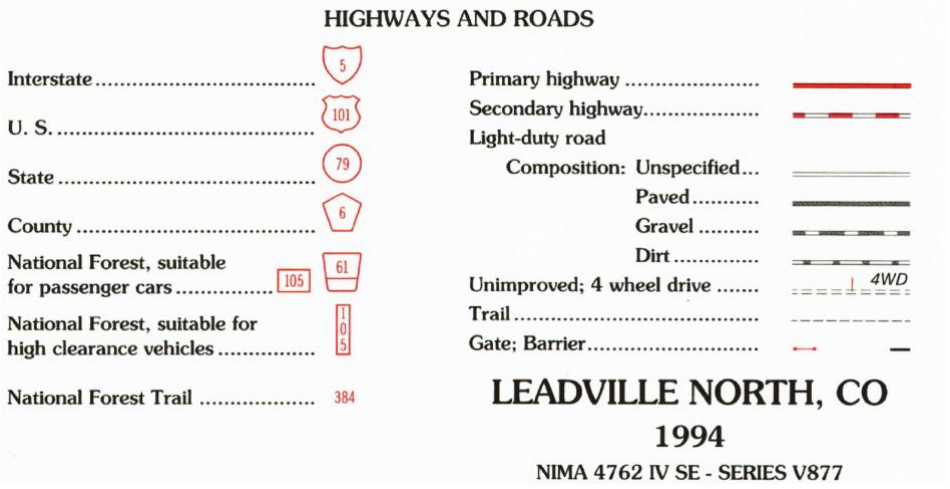
Map Legend

Maps usually include a box showing all the symbols with labels, the map scale, publishing date, and information about the publisher. The legend, sometimes called the key, is near the edges, or margins, of the map. Because of that, the term "marginal information " is used to describe it.

Map legend on an AAA Road Map- published by the American Automobile Club (AAA):



Map Legend - USGS Topographic Map



***** End of Map Basics for Beginners** See Resources Below*****

Remote Sensing B Internet Resources

Three good starting points at soinc.org-
Remote Sensing Topic List - The spec topics in a checklist form. Easier for kids to organize.

Fundamentals of Remote Sensing - NASA ARSET The first of two basic Remote Sensing Tutorials. This NASA tutorial uses basic explanations, with frequent links to other NASA and USGS websites.

Fundamentals of Remote Sensing - Canada Centre for Remote Sensing - The other basic tutorial. The Canadian tutorial is very thorough by itself, with frequent quizzes, but not many links.

More links on soinc:
USGS Remote Sensing Resources
Eyes on Earth LandSat Podcast
Earth Observatory Kids
LandSat Activities
Multi-Resolution Land Characteristics

Other links and websites -
Copernicus Dataspace- Like Google Earth high resolution close ups. Enter a destination (*Try Mt . St. Helens national Volcanic Monument").* View images in various wavelengths or on different dates.

ESRI Living Atlas- similar to Copernicus for finding images.
Landsat Image Gallery - A wide variety of images available. Sort by topic.

USGS The United States Geologic Survey. This site is excellent for all sorts of things. Use this for viewing or downloading topo maps. Numerous satellite images. See steps below to find maps.

NASA Headlines space. Going to "Earth" will take you to many satellite images.

NASA Earth Observatory - Many images. Global mapping can visualize changes over time.

Earth Observatory Kids A NASA site, aimed at middle school students.

NASA Worldview - Many images, no keys.

NASA Online Story Maps images, both natural and human features. "Before and After" images.

MultiResolution Land Characteristics Shows changes in areas over time

Mapviewer Gives a world map, zoomable to street level. USGS national map is more current in US.

Maptools a commercial source for special map rulers, grids, etc. Some free downloads

To Get USGS Topo Maps Online from USGS : Example using Questa, NM 1:24000 map dated 1995

1. Try ***Google***. Enter "USGS Questa NM 1995 topo map". Make sure you get to the official USGS.gov site rather than a commercial site that will sell you the map.

2. ***www.usgs.gov*** Is the website for The United States Geologic Survey. USGS no longer prints paper topo maps. For about $20, order custom printed maps. You can download most older USGS topo maps for free.

If you have a large monitor, you can display downloaded maps actual size on your screen. This allows you to make measurements and calculations. You can thus do practice events without the hard topo map. How cool is that?

The USGS site changes constantly but this worked as of October 2025:
Example using Questa, NM 1:24000 map dated 1995 needed for *Zombie Bedtime Rhymes* (a Road Scholar resource event on soinc.org)

Steps: usgs.gov → products → topographic maps → get topo maps → historical topo map collection → (see menu) search by map name → Enter "Questa, NM" in search box → click "24K" below search box → Slide date bar to about 1980 → Results should show: Questa, NM 1995" → pick "↓GEOPDF 17 MB" from menu. Downloading may take a while.

On your own computer: by adjusting "view" to 100% you will have the same map used in competitions.
Save any maps as, for example, "USGS Questa NM 1995" and all your downloaded maps will be together. You can make measurements right on your screen but be careful- 100% or "actual size" on your screen is probably different than the same setting on another screen. Try adjusting your screen so that the black UTM grid measures 42 x 42 mm squares. You cannot print a whole map on a standard printer, but you can screen grab one map sector at a time and print it actual size on an 8.5" x 11" sheet of paper. Nine printed sectors give you a complete map. In Science Olympiad, many mapping or satellite image events use a printed "one sector" map and several smaller screen grabs (Mapscans).

Thanks to Mark Kramer, New York State SO, and Dan Haggarty, Michigan SO, for their contributions to the "Notes" series of lessons.

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