

Last Name: _____

First Name: _____

**Crandall University
GEOGRAPHY 1013**

Lab 1: Introduction to the "Tools of the Trade":

Latitude, longitude, scale, distance, direction

Print this lab off. Complete it. And then scan/photo it and send it as ONE PDF document through Canvas. Please do send it as ONE PDF document with the pages in order. Before you send it, make sure it is legible. If you cannot read it, neither can I 😊

In geography we use a variety of tools for research. These are great resources with which to become familiar because whether you enjoy camping, hiking, fishing, boating – or just driving – they will be useful tools. The labs over the first weeks of the course will introduce you to some of these resources and their characteristics. GPSs are useful for roads and towns, but they don't always help in the wilderness!

There are some basic "tools" which earth scientists, geographers, planners, land and resource managers, foresters and outdoor enthusiasts use on a regular basis:

- Topographic maps (showing rivers, mountains, etc. – what the land looks like from the **top**),
- surficial geology maps (rock and mineral types **at** the **surface**)
- bedrock geology maps (rock and mineral types **below** the surface),
- land use maps (showing urban areas, forests, etc. – how land is used),
- political maps (showing cities, counties, etc. ... a typical road or atlas map),
- aerial photographs, and
- satellite images (remote sensing)

Through electronic media, these can often be combined in "layers": any combination of variables (for example a topographic maps and a land use map can be combined to show how they are interconnected. This approach is termed "Geographic Information Systems" (GIS).

Maps, air photos, satellite images, and GIS images are all two-dimensional representations of three-dimensional surfaces. They are **models** of reality. None are totally accurate representations of the surface they describe. Many symbols and conventions are used to portray information. These exercises will help explain some of these characteristics.

A. Types of Maps

Maps come in all shapes and sizes for a variety of uses. The federal governments of most nations (including Canada and the United States) produce complete sets of maps for every corner of their country. These are available at several scales. The most useful scale for most purposes is:

In Canada: 1:50 000 (or, 1 cm on the map is 500 m [50,000 cm] on the ground)

In the United States: 1:24 000 (or cm on the map is 240 m [24,000 cm] on the ground)

In both Canada and the U.S., the entire country is mapped at this scale. For details on the system used in each country (and lots of other fascinating map information) see

For Canada: <https://www.nrcan.gc.ca/maps-tools-and-publications/maps/topographic-maps/10995>

For the U.S.: <https://www.usgs.gov/programs/national-geospatial-program/topographic-maps>

Specialty maps are often produced by other government or private agencies. For instance, Gem Trek Publishing produces a set of 12 excellent topographic maps showing roads, trails, campgrounds, points of interest and other information for the National Parks in the Canadian Rockies (www.gemtrek.com)

In this lab you will use two 1:50 000 maps produced by the Canadian government. These maps are part of a national grid. They are identified by the code number, determined by their position in the national grid system. (For details on the Canadian system check out NTS online. There is a searchable site where you can find any location in Canada by place name, map number, whatever! So, if you live in Canada, you can find your map)

The two maps we will be using are located in the University Library. **Alternatively, PDF versions of the maps you can access are online (link on the Labs home page)**

21H/16 Amherst, N.S.

83C/3 Columbia Icefields, AB

For simplicity, we will normally refer to them simply by number (21H/16 or 83C/3)

Amherst is located on the border between Nova Scotia and New Brunswick, on the Chignecto Isthmus, the thin bridge of land that connects Nova Scotia to the rest of Canada. This narrow strip of land separates the Cumberland Basin (part of the Bay of Fundy, famous for the highest tides in the world) from the Gulf of St. Lawrence. The landscape includes low hills, flat marshlands, and mudflats extending into the basin. Fort Beauséjour (almost dead centre in the map) was founded in 1751 by French forces (check out <http://www.fortbeausejour.com/>). Sackville, NB, toward the left of map, is the home Mount Allison University (see <http://www.sackville.com/> or <http://www.mta.ca/>).

Google Earth: <https://www.google.ca/maps/@45.851744,-64.1318838,28119m/data=!3m1!1e3>

The Columbia Icefields are a remote high alpine area in the midst of the Canadian Rockies, between Banff and Jasper, on the Alberta-BC border. Note there is only one road on the entire map. The area is steep mountains, sheer cliffs, and ice! More grizzly bears than people live here! It is, however, one of the most popular spots for tourists to visit in Canada. For more information visit:

<http://www.columbiaicefield.com/>

http://www.worldsat.ca/image_gallery/3d_columbia_icefields.html (cool, 3D pictures)

Google Earth: <https://www.google.ca/maps/@52.1407644,-117.3049072,24661m/data=!3m1!1e3>

B. Latitude and Longitude

Latitude measures the angle distance a place is north (up to 90° N) or south (up to 90° S) of the equator (0°). Each degree (°) is subdivided into 60 minutes ('). Each minute is subdivided into 60 seconds (").

- One degree of latitude is made up of 60' (minutes) ... note one 'tick' indicates minutes – '.
- One minute of latitude is made up of 60" (seconds) .. note two "ticks" indicate seconds – ".

1. Find the latitude numbers running **up the left- or right-hand vertical edge** of map 21H/16.

There is a number at the top and bottom of each side (in degrees and minutes).

a. What is the latitude range on map 21H/16 ([21H16 Amherst](#) (or an alternative version [here](#))?)

From _____ to _____
(in other words, what is the latitude number at the bottom of the map, and the number at the top)

b. What is the latitude range on map 83C/3 ([83C03 Columbia Icefield](#))?

From _____ to _____
(in other words, what is the latitude number at the bottom of the map, and the number at the top)

c. Which is further south, 21 H/16 or 83C/3 _____? (the smaller latitude numbers)

d. How long is one minute (') of latitude on both maps (the same)? _____ metres
 (Notice the alternating black and white bars on the side of the map a couple of centimetres long.
 Each black/white bar is one minute. Measure the length of one black bar or white bar in centimetres,
 then measure that length on the scale at the bottom centre of the map.)

NOTE one minute of latitude is ALWAYS THE SAME length because lines of latitude are parallel – they never converge or diverge.

2. Find the longitude numbers running **along the bottom or top horizontal edge** of map 21H/16.
 There is a number at the left and right hand ends along the bottom (in degrees and minutes).
Online: make sure the map is at 100% - the blue lines on the map should be 2 cm squares on your monitor.

a. What is the longitude range on 21H/16? From _____ to _____
 (what is the longitude number at the left side of the map, and the number at the right side)

b. What is the longitude range on map 83 C/3? From _____ to _____
 (what is the longitude number at the left side of the map, and the number at the right side)

c. Which is further east, 21 H/16 or 83 C/3? _____ (the smaller longitude number)

d. How long is one minute of longitude on **21 H/16?** _____ m On **83 C/3** _____ m
 (Notice the alternating black and white bars on the bottom/top of the map a couple centimetres apart.
 Each black/white bar is one minute. Measure the length of one black bar or white bar in centimetres,
 then measure that length on the scale at the bottom centre of the map.)

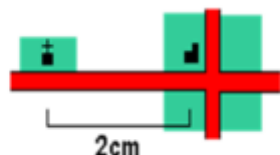
NOTE one minute of longitude is DIFFERENT at different places! Why? Because lines of longitude converge (all come together) at the poles! They are like orange sections, coming together at the top/bottom. The closer you get to the poles the shorter a minute of longitude will be! The closer you are to the equator (the middle of the orange), the longer a minute of longitude will be!

C. Scale

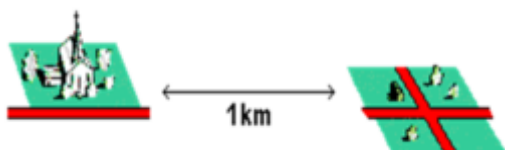
In order to represent any portion of the earth's surface on a map or to produce usable photos and images, a ratio or scale must be used to reduce all distances. Obviously maps are not (normally) life-sized! They are reductions on reality! They are *models*. The scale on a map, photo or image gives the ratio of any length measured on the map to the corresponding actual distance on the ground. Scale refers to the relationship between distance on a map and distance on the ground.

What is SCALE?

Maps are made to **scale**. In each case, the scale represents the ratio of a distance on the map to the actual distance on the ground. For example, if 2 cm on a map ...



represents 1 km on the ground ...

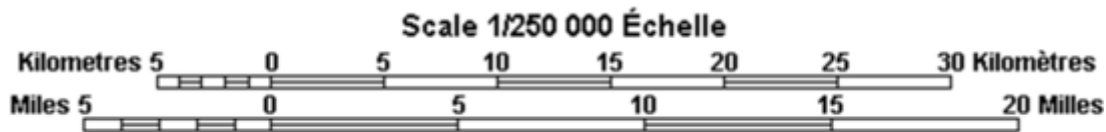


the scale would be **2 cm = 1 km**, or...

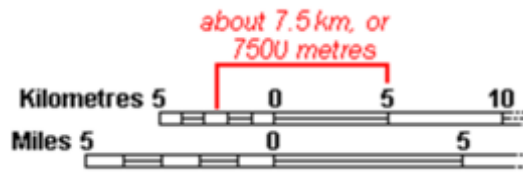
$$\begin{aligned} \frac{\text{Distance on the Map}}{\text{Distance on the Ground}} &= \frac{2 \text{ cm}}{1 \text{ km}} = \frac{2 \text{ cm}}{100\,000 \text{ cm}} \\ &= \frac{1}{50\,000} \\ &= \textbf{1/50\,000 Scale} \end{aligned}$$

Reading Distances on a Map

Use the **Scale Bar** found at the bottom of every topographic map to determine distances between points or along lines on the map sheet.



Use the secondary division on the left of the Scale Bar for measuring fractions of a kilometre. The measurement indicated is about 7.5 kilometres or 7 500 metres.



At a scale of 1:100 000, 1 cm *on the map* represents 100 000 cms *on the ground*.

Large-scale maps cover small areas in great detail (i.e. large amount of detail). They have larger fractions.

e.g. 1:10 000 (a city map)

Small-scale maps cover large areas in less detail (i.e. small amount of detail). They have smaller fractions:

e.g. 1:10 000 000 (a world map)

*At first this sounds backwards! How can 1:10 000 be a **larger** scale than 1:10 000 000? Because these are **fractions** (remember fractions!)! 1:10 000 is like 1/10000 – it is a **BIGGER** fraction (a bigger piece of pie) than 1/10000000 (1:10 000 000) ... this would be a very **SMALL** piece of pie!*

Scale is expressed three ways...

1. as a representative fraction (e.g. 1:100 000)
2. as a verbal statement (e.g. 1 cm on the map is 100 000 cm on the ground)
This may need to be converted to something more useful:

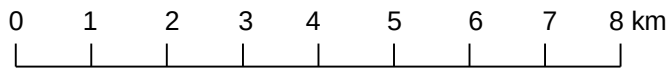
NOTE: 1 km = 1000 m = 100 000 cm

Thus 100 000 cm = 1 km!

So ... 1 cm *on the map* is 1 km *on the ground*!

*** Always specify “*on the map*” or “*on the ground*” so I know you know what you’re talking about! ***

3. in graphic form

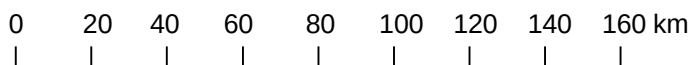


Exercises

1. Fill in this chart:

Scale	Metric (100 000 cm = 1 km). Yes, <i>please convert to km ... see text above – move the decimal point 5 places to the left.</i> <i>1:100 000 - 1 cm is 1 km 1:1 000 000 – 1 cm is 10 km.</i>
1:25 000 (street map of Moncton)	
1:50 000* the scale on your two maps for this lab	
1:2 000 000 (atlas map New Brunswick)	
1:30 000 000 (atlas map of Canada)	
1: 650 000 000 (my globe)	

2. What is the representative fraction for the following graphic scale?



Fraction: 1: _____

(move the decimal point 5 places to the right. Ex. If it were 1 km at 1 cm on the scale, the fraction would be 1:100 000)

How would you express that as a verbal statement? Answer:

*(***Remember to use the format - “___ cm **on the map** is ___ km **on the ground**” - so I know you know what you are doing! For example, if it were 10 km at 1 cm on the scale, the verbal statement would be “1 cm on the map is 10 kms on the ground”)*

3. Draw a graphic scale for a map produced at a scale of **1 cm on the map to 5 km on the ground**. Be sure to label the units, as in the example in question 2.

Scale:

What would the representative fraction be for this map be?

1: _____

(no units are necessary in a representative fraction. By definition, both sides of the fraction are the same units, but they can be any units! ... cms and cms, or inches and inches, or metres and metres. So, you will wish to convert 40 kms to the equivalent amount of cms ... 5 decimal places)

3. Express the following representative fractions as verbal statements of scale *(in the form: “1 cm on the map is _____ km on the ground”)* **and** draw graphic scales for them *(using kms as the units)*.

- Verbal statement: remember to write out a complete statement including units and “on the map,” and “on the ground” so I know you know what you’re talking about;
- Graphic scale: please measure, and remember to write in the units in each case (kms)

1:20 000

Verbal:

Graphic:

1:200 000

Verbal:

Graphic:

1:20 000 000

Verbal:

Graphic:

Which of these three maps has **the smallest scale** (smallest detail, smallest “piece of the pie”)?

Which of these three maps has **the largest scale** (largest detail, largest “piece of the pie”)?

D. Distance

Closely related to scale is distance. In order to tell real world distances, you must measure distances on a map and convert using the scale. The two maps you are using are at a scale of 1:50 000. From the previous section you know that: *(yes, please fill in the blanks!)*

1 cm on the map is equal to: _____ metres or _____ km on the ground.
(yes, please fill this sentence in; it's worth 1 mark!)

NOTE: If you are using the online maps, make sure you enlarge it so the blue line squares are 2 cm by 2 cm so you get the right distance.

1. On the 83C/3 1:50 000 mapsheet (Columbia Icefield), what is the straight-line distance between the road turnoff to the Athabasca Glacier ((top, centre of the map; where the 1986.8 arrow points) and

a. summit of Mount Kitchener (west)? _____ cm on the map or _____ km on the ground/real life

b. top of Castleguard Mountain (south)? _____ cm on the map or _____ km on the ground/real life

2. On the 21H/16 1:50 000 map sheet (Amherst), what is the straight-line distance between Fort Beauséjour National Historic Site (the diamond-shaped symbol near Aulac in the centre of the map) and the hospital in Sackville, NB?

_____ cm on the map, or _____ km on the ground/real life

E. Direction

All maps/photos/images indicate direction, normally by an arrow pointing and labelled "North." On all National Topographic Survey (NTS) maps (e.g. 83C/3) north is (more or less) at the top of the map. On many other maps and photos, north may be in another direction ... so be careful! Notice that on the NTS maps, 3 north arrows are given in the right hand margin.

1. *Grid North* - this refers to the "artificial" lines the mapmakers used when creating the map, related to the map projection used.

2. *True North* - if you were to draw a straight line to the geographic North Pole, this would be its direction.

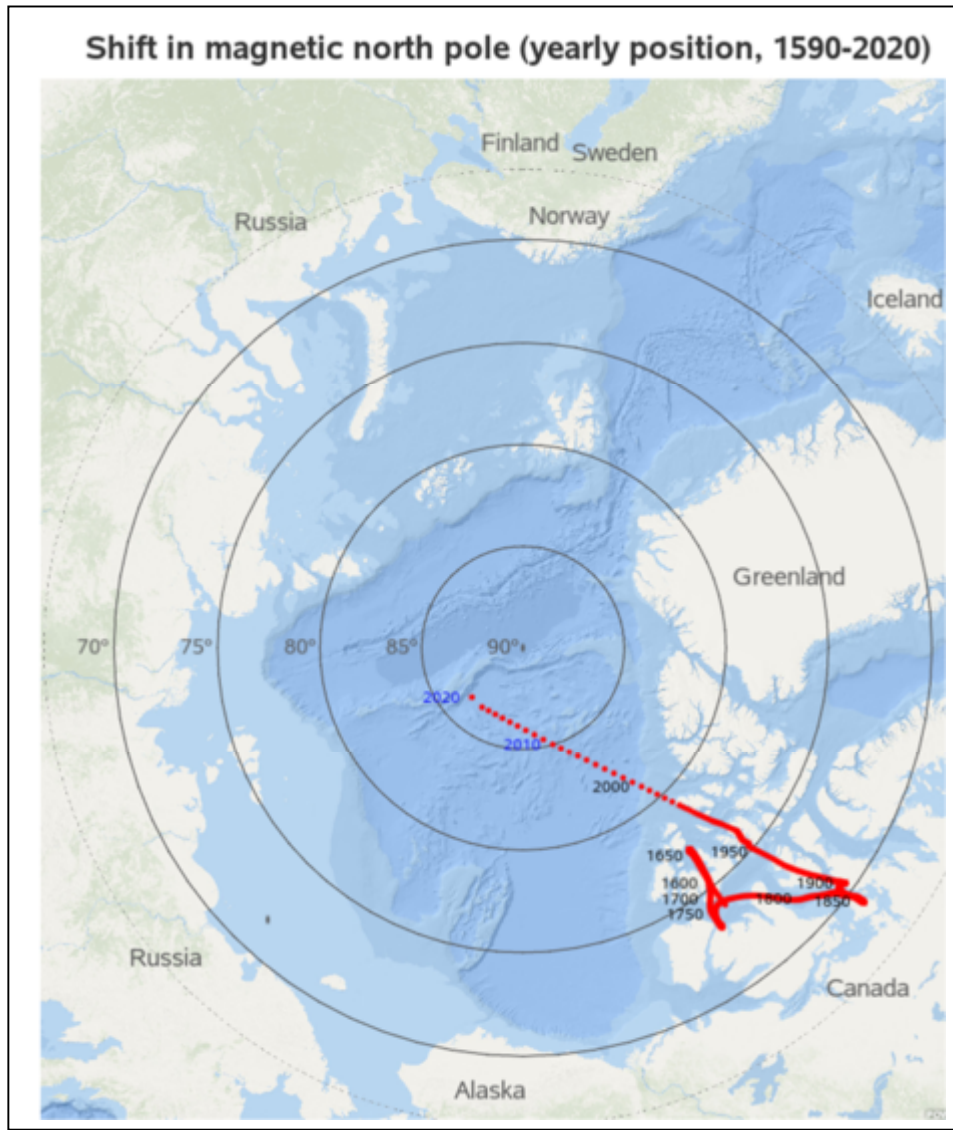
3. *Magnetic North* - this is the point to which your compass would point.

This may seem trivial ... but if you were to try to find direction using a compass this is an important point of which to be aware. If you were to use a topographic map in the wilderness, be sure you know which "north" you are using! If you are using a compass, magnetic north is most important!

Notice that in western Canada (83C/3) magnetic north to the right of true north, while in eastern Canada (21H/16 - Amherst) magnetic north is to the left of true north! Why is this so? Think about it ...

Your compass will not point to true north in most of Canada! The magnetic north pole (where your compass actually points) is not at the true north pole (where Santa lives). The magnetic north pole is actually south of the true north pole. The map below shows how the magnetic north pole has moved over time. On a daily basis it may move in an elliptical circle as much as 80 km! This plays havoc with navigation (sea, air, and land) in the Arctic. You can be below the true north pole, but your magnetic compass will tell you the north pole is actually south of you!

Global Positioning Systems (GPS), which locate your position by satellite, are much more useful in the Arctic than compasses! This is good to know as you fly your private jet to Alert, Nunavut, the most northerly inhabited settlement in the world (83° N), only 817 kilometres south of the geographic North Pole, but an increasing distance from the magnetic north pole. It is also good to know if you are using a compass anywhere in Canada – **your compass will “lie.”** That’s why NTS maps include this information!



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