Road Scholar & Geologic Mapping

Division B/C

Georgia Tech Event Workshop Series
2024-25

Science Olympiad at Georgia Tech®

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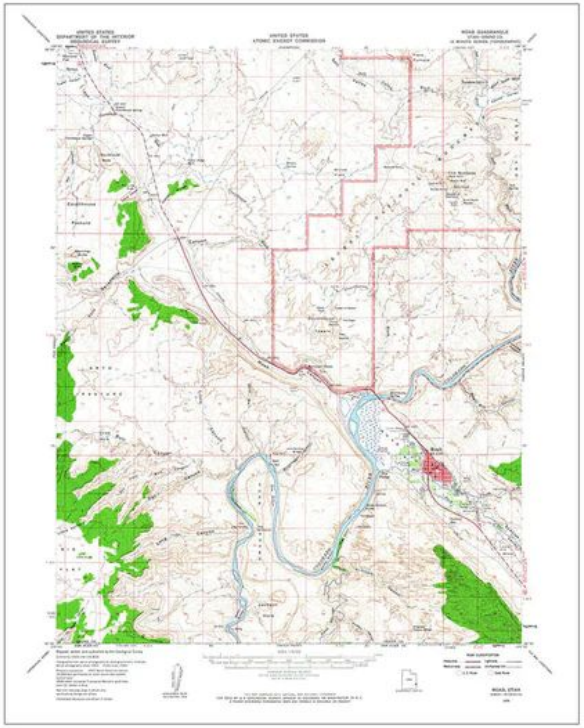

A quadrangle topographic map published by the United States Geological Survey (USGS)

The Rules Sheet:
Road Scholar vs. GeoMapping

- **Road Scholar focuses on analysis of:**
  - Topographic Maps
  - Highway Maps
  - Satellite Maps
- **In addition to topographic maps, Geologic Mapping covers:**
  - Geologic Structures
  - Geologic maps
  - Lithology (study of rocks)
- Both Road Scholar and Geologic Mapping allow students to bring **a binder of notes/information "from any source"** and **Class II calculators** (non-programmable, non-graphing)
- Topic list is vague –> research as much as possible within the scope of each bullet point

ROAD SCHOLAR B

See General Rules, Eye Protection & other Policies on www.soinc.org as they apply to every event.

1. **DESCRIPTION:** Participants will interpret questions based on one or more state highway maps, USGS topographic maps **(or portions thereof)** maps, Internet-generated maps, a road atlas, or satellite/aerial images.

A TEAM OF UP TO: 2 **CALCULATOR:** Class II **APPROXIMATE TIME:** 50 minutes

2. **EVENT PARAMETERS:**
   a. Teams may bring two stand-alone non-programmable, non-graphing calculators (Class II), protractors, rulers, other measuring devices, USGS Map Symbol Sheets (pre- and post-2010), hand lenses/magnifying glasses, hard copies of other information in any form and from any source, **and at State and National Tournaments, colored pencils consistent with the colors utilized on USGS topographic maps.** The equipment and reference materials may be in a container.
   b. The event supervisor will provide all required maps and images. Participants may NOT write on the maps. If a student-generated map is included, a one mile-square PLSS section will be printed on the answer sheets. Graphing axes will be provided for profile problems. Event supervisors will check the accuracy of scales on reproduced maps or images prior to competition.
3. **THE COMPETITION:** The satellite images, highway, and quadrangle maps may be from one or more states. The event may be presented in a storyline format. Satellite/aerial photos will be in the visible light spectrum.

Topics/Concepts Assessed

a. Topographic Map
   i. Map features
   ii. Map marginal information: location/series/scale/index/legend
   iii. Map symbols
   iv. Distances between features (English & Metric)
   v. Contours
   vi. Elevation of features and symbols
   vii. **Watersheds: Stream flow direction and flood impact areas**
   viii. Coordinate systems of map features with correct formats
      (1) Public Land Survey System (PLSS)
      (2) Sector Reference System
      (3) Latitude/Longitude in degrees, minutes, & seconds
      (4) **State/National only:** Universal Transverse Mercator (UTM)
   ix. Azimuths and bearing
   x. Magnetic declination
   xi. Survey control marks (control stations and spot elevations)
   xii. Graticule tick marks/graticule intersections
   xiii. Slope (feet per 100 feet)
   xiv. Topographic map profiles
   xv. **State/National only:** Stream gradient (feet per 1000 feet)

b. Highway Map
   Topographic map topics may also be present on highway maps.
   i. Map legend/tables/index
   ii. Map features/symbols
   iii. Map grid system
   iv. Distance between features
   v. City/Regional insets
   vi. Geographic coordinates in decimal degrees

c. Student-Created Map
   i. Map scales
   ii. USGS topographic map symbols
   iii. Distances
   iv. Azimuths and bearings
   v. Public Land Survey System
   vi. State/National only: Colors consistent with USGS Maps

d. Satellite Photos/Internet Maps
   i. Feature identification
   ii. Distances and scales
   iii. Photo time-of-day identification
   iv. Internet map symbols
   v. Road travel between points
   vi. Inferences based on satellite photos

4. **SCORING:**
   a. High score wins. Values of questions may be weighted.
   b. Ties will be broken by the accuracy and quality of answers to pre-selected questions.

Recommended Resources: The Science Olympiad Store (store.soinc.org) carries a variety of resources to purchase; other resources are on the Event Pages at soinc.org.

GEOLOGIC MAPPING C

See General Rules, Eye Protection & other Policies on www.soinc.org as they apply to every event.

1. **DESCRIPTION:** Teams will demonstrate understanding in the construction and use of topographic maps, geologic maps, and cross sections, and their use in forming interpretations regarding subsurface structures and past depositional environments on Earth and other planetary bodies.

A TEAM OF UP TO: 2 **CALCULATOR:** Class II **APPROXIMATE TIME:** 50 minutes

2. **EVENT PARAMETERS:**
   a. Each team may bring one three-ring binder of any size containing information in any form and from any source. Sheet protectors, lamination, tabs and labels are permitted. If the event features a rotation through a series of laboratory stations where the participants interact with samples, specimens, or displays, no material may be removed from the binder throughout the event.
   b. Each team may bring two protractors, two rulers, and two stand-alone non-programmable, non-graphing calculators (Class II).
3. **THE COMPETITION:**
   Participants will be given one or more tasks presented as an exam and/or timed stations. The participants will be expected to use process skills (e.g., communicating, classifying, inferring, measuring, observing, predicting, and using number relationships) to answer questions on the following topics:
   a. Elements and processes of structural geology
      i. Surface and subsurface structural elements of macroscopic and regional-scale geology
      ii. Deformation forces and associated structures (e.g., folding, faulting)
      iii. Depositional sequences and erosion patterns of different lithologies and structural elements
      iv. Measurements of structural elements (e.g., strike and dip)
   b. Rock formation and lithologies - igneous, sedimentary, metamorphic
      i. Methods and environments of formation (e.g., crystallization from magma, chemical precipitation, alteration under heat & pressure)
      ii. Relationships between texture (e.g., intrusive/extrusive), composition (e.g., mafic/felsic), and environments of formation
      iii. Relationship between temperature, pressure, and depth to types of metamorphism and metamorphic facies
      iv. Connections between physical and chemical properties on smaller scales of rock formation and how they inform properties on macroscopic-regional scales
   c. Interpretation and synthesis of geologic data (real and/or simulated)
      i. Application of stratigraphic principles
      ii. Topographic and geologic maps, and related data
      iii. **Projections of mapped features (e.g., cross-sections, stereonets, map projections)**
      iv. **Analysis of geologic structures (e.g., calculating bed thickness, outcrop angles)**
      v. Geologic data collection (limited to drill cores and ground-penetrating radar)
   d. Sedimentary structures and their implications about depositional processes and environments (e.g., plane bedding, cross-bedding, sequence stratigraphy, ripple marks, mud cracks)
   e. Changes in depositional environments over time and space (e.g., transgressions, regressions, uplift)
   f. Applications of geologic mapping, including but not limited to assessment of:
      i. Groundwater quality and contamination
      ii. Earthquake, volcano, and landslide hazards
      iii. Responsible economic land management
4. **SCORING:**
   a. The high score wins. Points will be awarded for the quality and accuracy of answers, the quality of supporting reasoning, and the use of proper scientific methods of responses. Ties will be broken by the accuracy and quality of answers to pre-selected questions and/or sections.

Recommended Resources: The Science Olympiad Store (store.soinc.org) carries a variety of resources to purchase; other resources are on the Event Pages at soinc.org.

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The Rules Sheet:
Road Scholar

Topics Covered: the rules document provides a very well-organized table of this information

- Watersheds are new this year

Materials Allowed:

- *Magnifying glasses* – topographic maps are large and individual features are small
- *Protractors/Rulers/Other Measuring Devices* - important for calculation questions!!!
- *Colored Pencils* - needed for questions that ask you to create your own map

a. Topographic Map
- i. Map features
- ii. Map marginal information: location/ series/scale/index/legend
- iii. Map symbols
- iv. Distances between features (English & Metric)
- v. Contours
- vi. Elevation of features and symbols
- vii. **Watersheds: Stream flow direction and flood impact areas**
- viii. Coordinate systems of map features with correct formats
  - (1) Public Land Survey System (PLSS)
  - (2) Sector Reference System
  - (3) Latitude/Longitude in degrees, minutes, & seconds
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- ix. Azimuths and bearing
- x. Magnetic declination
- xi. Survey control marks (control stations and spot elevations)
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b. Highway Map

Topographic map topics may also be present on highway maps.
- i. Map legend/tables/index
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c. Student-Created Map
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d. Satellite Photos/Internet Maps
- i. Feature identification
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- v. Road travel between points
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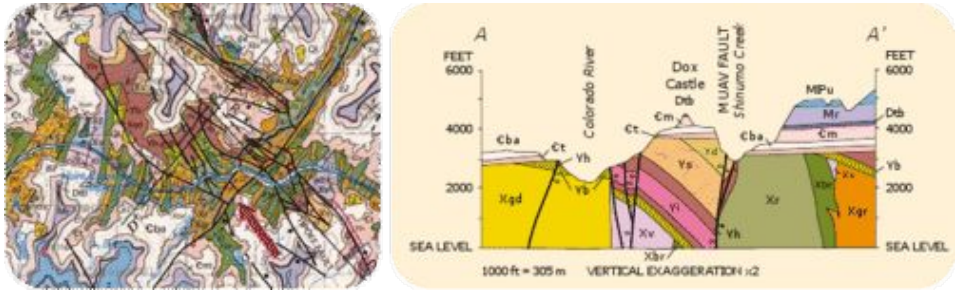
The Rules Sheet:
Geologic Mapping

Topics Covered (*this is one of the most comprehensive SciOly events, so your finalized notes binder should be thick*)**:**

- Structural Geology Processes and Elements – mechanisms of deposition, deformation, erosion and the geologic features that result from these phenomena
- Rocks – the rock cycle, types of rocks, characteristics of rocks
- Analyzing Geologic Data - topographic/geologic maps, map projections, **calculations**
- Applications of Geologic Mapping - why do we do it?
    - Natural disaster preparedness
    - Water quality
    - Effective land management



Topographic vs. Geologic Map


DIFFICULT
TOPICS

Topic 1: Topographic Maps

- Comprises at least 50% of any Road Scholar exam
  - You will most likely be given a quadrangle and will be asked a series of questions about it, sometimes in a story format, to test your ability to read the map
- THE MOST HELPFUL ROAD SCHOLAR RESOURCE:
  A Coach's Handbook for Road Scholar
  - Will walk you through a topographic map feature by feature

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Topographic Maps - display terrain on a 2-D surface using contour lines and other symbols:
USGS Topographic Map Symbols

- You can download almost every topographic map every created here, which is great for practice (make sure you download a recent version)

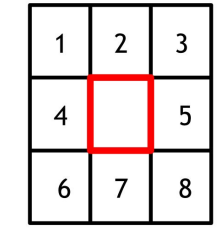
Quadrangle - 4-sided topographic maps that vary between 7.5 x 7.5 minutes to 60 x 60 minutes in size

- A **minute (')** is 1/60 of a degree of latitude or longitude, and a **second (")** is 1/60 of a minute

Topic 2: Topographic Map Features

Adjacent Quadrangles:

- Found at the bottom of the map, indicates quadrangles W, E, S, etc.

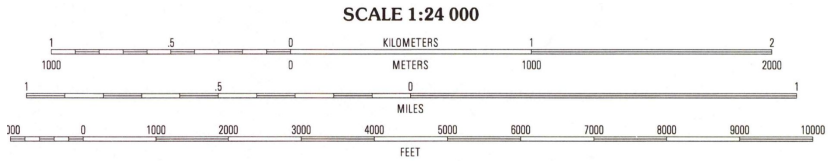


1 Marietta
2 Sandy Springs
3 Chamblee
4 Mableton
5 Northeast Atlanta
6 Ben Hill
7 Southwest Atlanta
8 Southeast Atlanta

ADJOINING QUADRANGLES

Scale:

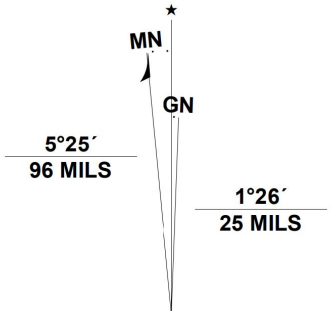
- 1:24,000 is a standard scale for 7.5' quadrangles
  - 1 inch on map = 24,000 inches in reality = 2000 ft
  - This scale is important when asked to find the approximate distance between two places
  - Watch out! Certain maps, like Alaska quadrangles use a different scale, but you should be okay if you reference your measurements to the bars provided



Topic 2: Topographic Map Features

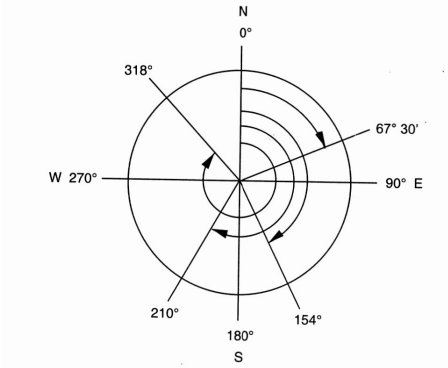
Magnetic Declination:

- Describes the difference between magnetic north (MN) – what a compass would point to – and true geographic north (GN)
- Convection currents and certain geological features slightly shift the Earth's magnetic field from its rotational axis

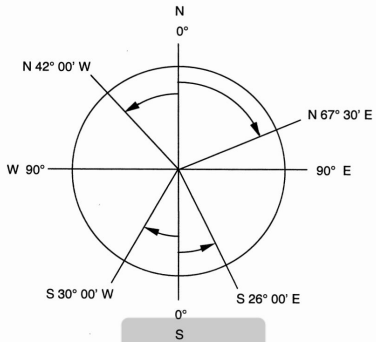


Azimuth/Bearing:

- Time to take out your protractor!
- Azimuth is expressed as a value between 0 and 359 degrees, measured clockwise from North
- Bearing is expressed as a value between 0 and 90 degrees, measured either East or West from North or South



Azimuth



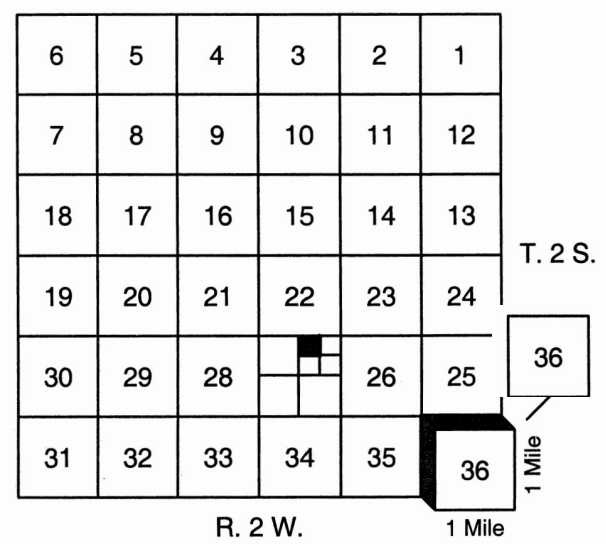
Bearing

Topic 3: PLSS System

- Created by Thomas Jefferson in 1785 and stands for **Public Land Survey System**
- Useful for locating specific features within a map
- Divides "townships" into 36 1 x 1 mi squares
- Each square is further divided
- The filled in black square would be designated as:

NW 1/4 , NE ¼, Sec 27, T 2 S, R 2 W

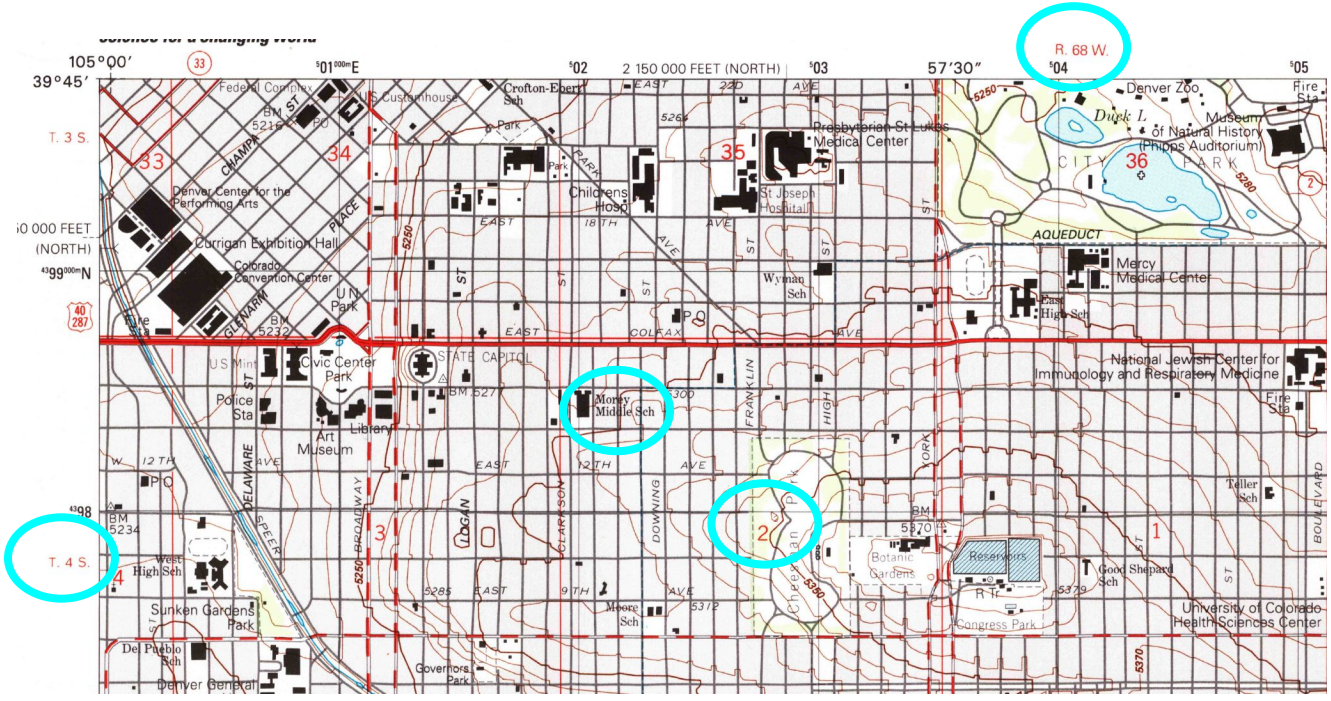
Notice how the notation runs from smallest square to largest square



Question 1: PLSS System

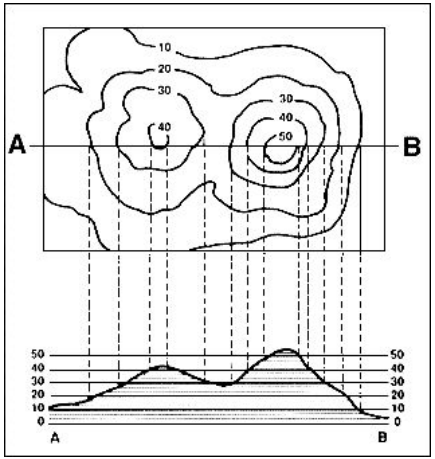
Describe the location of Morey Middle School using PLSS sectionating notation.

Answer: NW ¼, NW ¼, Sec 2, T 4 S, R 68 W



Topic 4: Drawing a Topographic Profile

- Almost guaranteed to be asked on a Road Scholar Exam
- **Topographic Profile:** a side view of a topographic map segment that highlights its changes in elevation
- **Steps:**
  1. Line the edge of a piece of scrap paper along two points A and B
  2. Every time the edge intersects with a contour line, mark that spot with the written elevation
  3. Translate the marks over to the given graph with position along the horizontal axis and elevation on the vertical axis
  4. Roughly connect the points to draw the shape of the land segment
  5. Draw in the symbols of any notable geologic features like rivers or roads (the symbols can be found here)



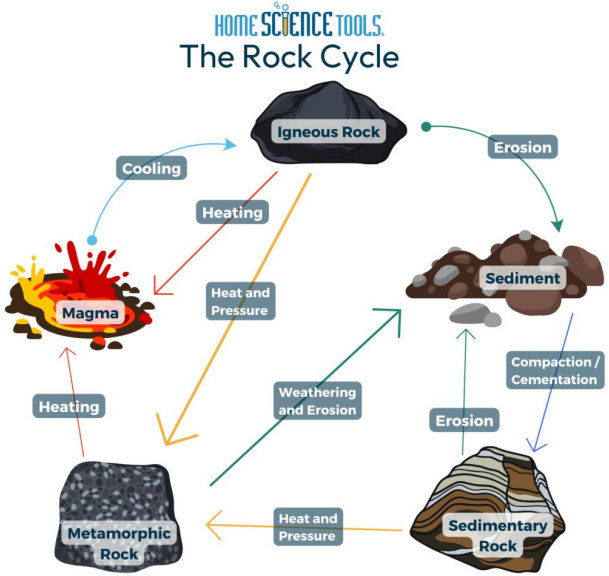
Topic 5: Highways

- Make sure you're familiar with the types of highways and their symbols
  - **Turnpike vs. Freeway** - a turnpike charges tolls while a freeway is free
  - **State Route** - maintained by a singular state
  - **Interstate** - crosses state borders (ex: I-95)

- A good way to practice!
  - While riding in the back of your parents car, try observing the signs and mapping out your path on a physical highway map
  - What is the name of the highway your currently on? What exits do you have to take to get to your destination?

Topic 6: Lithology

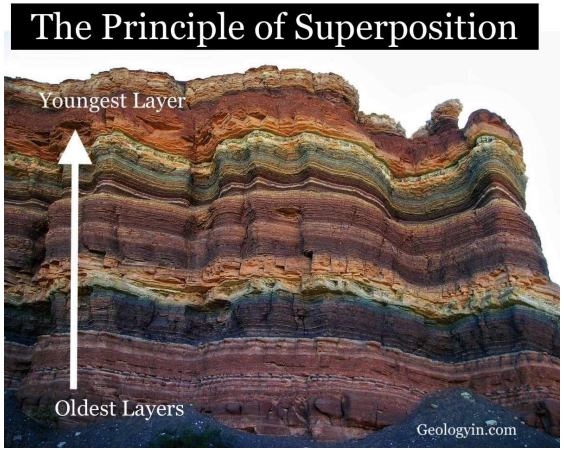
- **The Rock Cycle:**
  - Most likely, questions won't be as simple as, "How does a rock transition from [state] to [state]?"
  - Must investigate into the individual processes and ask questions like the following to guide research:
    - "How does erosion occur?"
    - "In what settings does a rock experience heat and pressure?"
- Create a **list of common rocks and minerals** for your notes for ID questions. Include:
  - A picture
  - Characteristics like color, texture, luster, hardness, etc.
  - Unique features



Topic 7: Law of Superposition

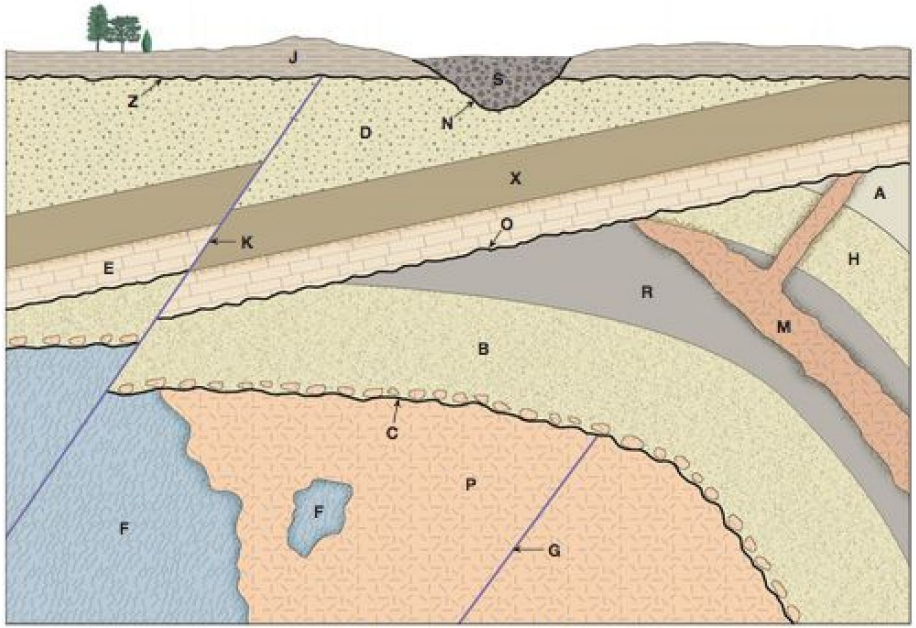
- Concerns **stratigraphy**, a field of study that describes rock successions
- States that the oldest rock beds are positioned at the bottom and the youngest ones are at the top of a cross-section of the ground
- Intuitively, this makes sense

- **Exceptions:**
  - When strata is folded or faulted, the arrangement of layers can be disrupted
  - Dikes, such as slivers of igneous rock, can insert themselves into the layering



Question 2: Law of Superposition

Extremely common question (pulled from Test Exchange):
Using their letters, put the geologic features in order from oldest to youngest.

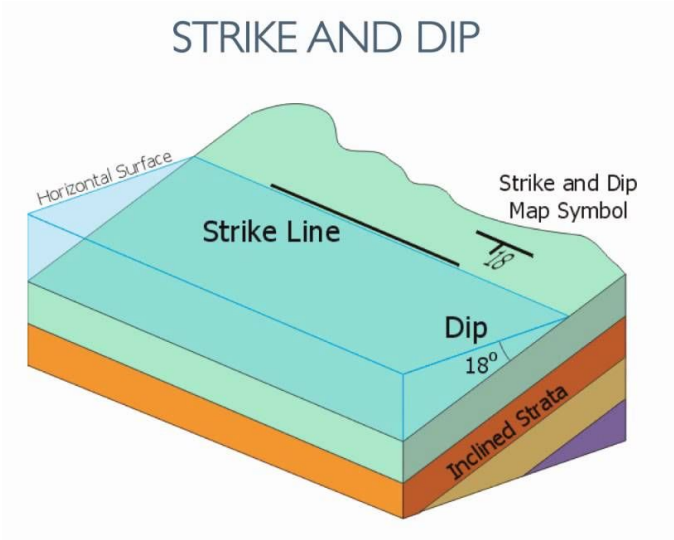


Answer:

F, P, G, C, B, R, H, A, M, O, E, X, D, K, Z, J, N, S

Topic 8: Three-Point Problem

- You will be given three points on a map at different elevations and must find the strike and dip of the outcrop from that information
- **Strike:** the compass bearing of the strike line, or the line perpendicular to the slope of the land
- **Dip:** the angle at which an outcrop slopes downwards, measured from the horizontal



Topic 8: Three-Point Problem

- **Steps:**
  1. Find where the contour line running through point B (A > B > C) intersects the line connecting A and C
     a. If not given the contour line, you can find this intersection point by analyzing elevations:
     b. The elevation of B is 300 ft. above C and 700 ft. below A, so B' will lie 30% of the distance from C to A
     c. The compass bearing of this line is **strike**

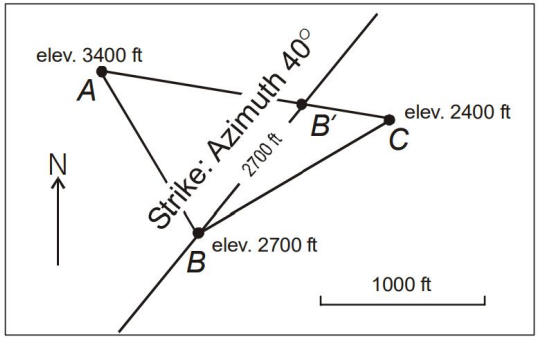


Figure 2. Map showing the location of the line of strike from data in Figure 1.

Topic 2: Three-Point Problem

- **Steps:**
  1. Draw a line perpendicular to the strike line outside of the outcrop
  2. Mirror AB'C on the other side of the line you just drew, creating a kind of trapezoid
  3. Measure the angle between the mirrored AB'C and your drawn line. This is the **dip**

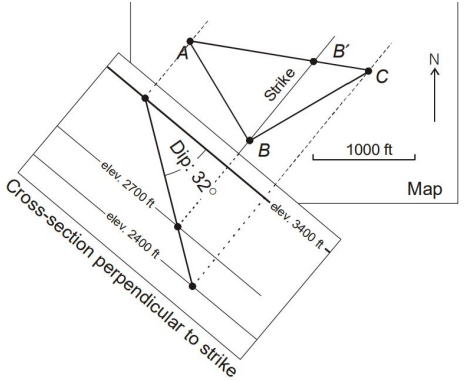
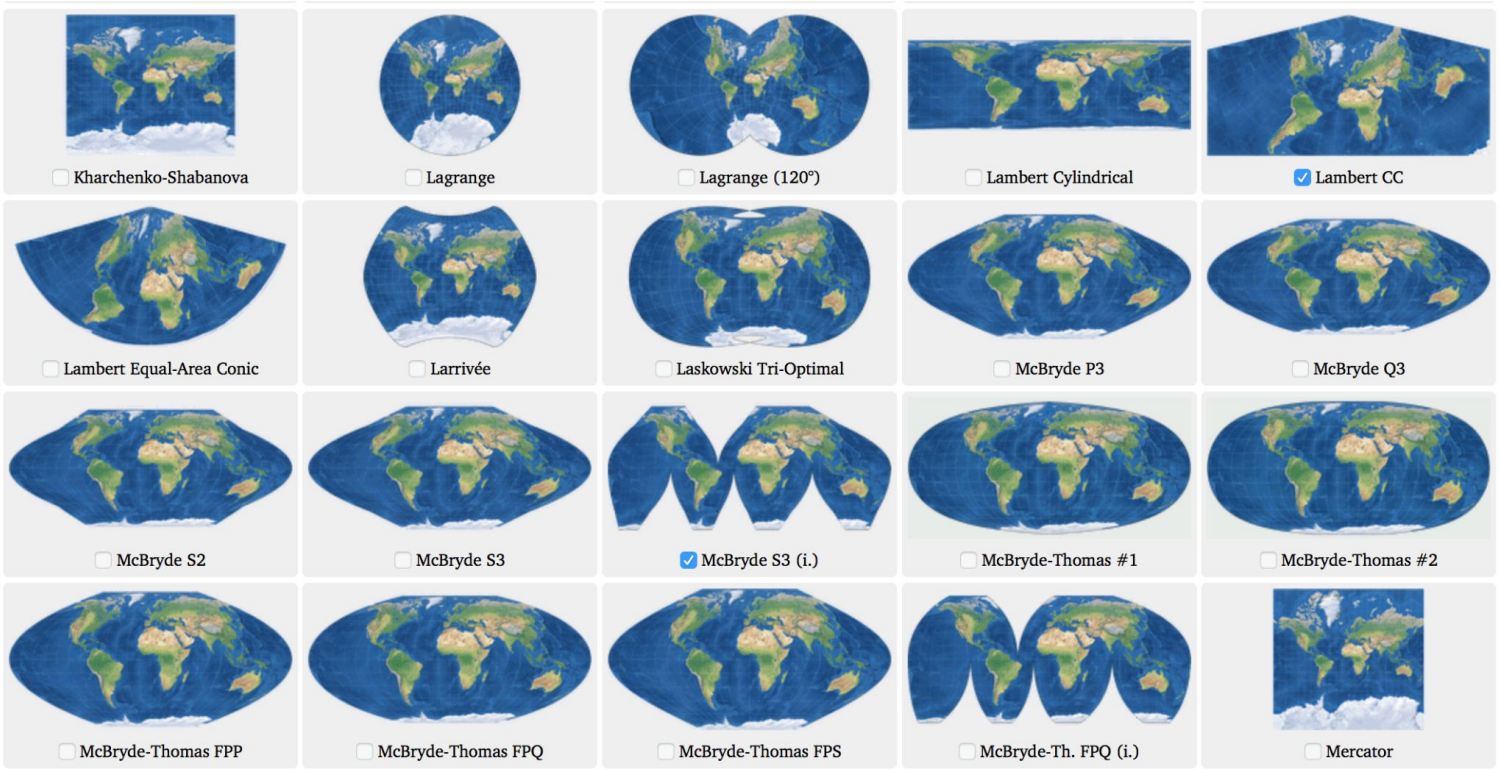
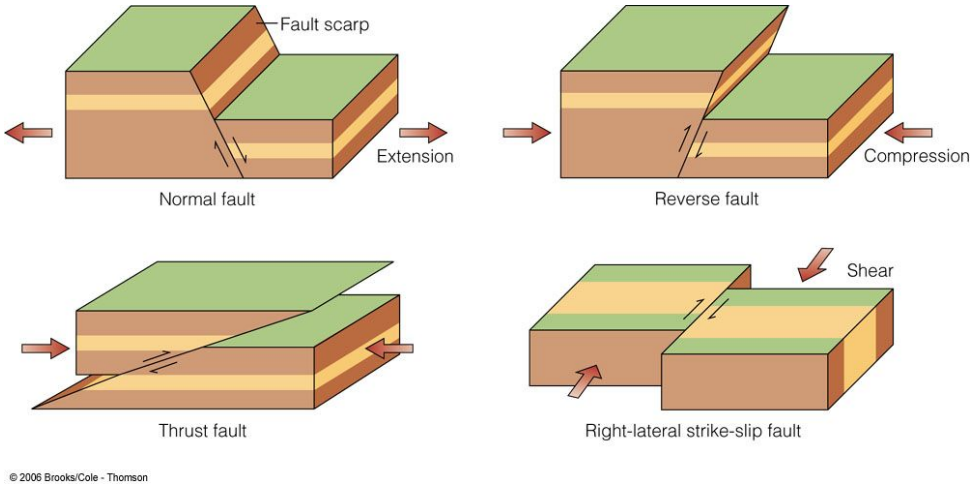


Figure 3. Map and cross-section showing true dip from data in Figure 1 (after Davis and Reynolds, 1996, Fig. G.7)

Topic 9: Map Projections



Topic 10: Faults & Unconformities

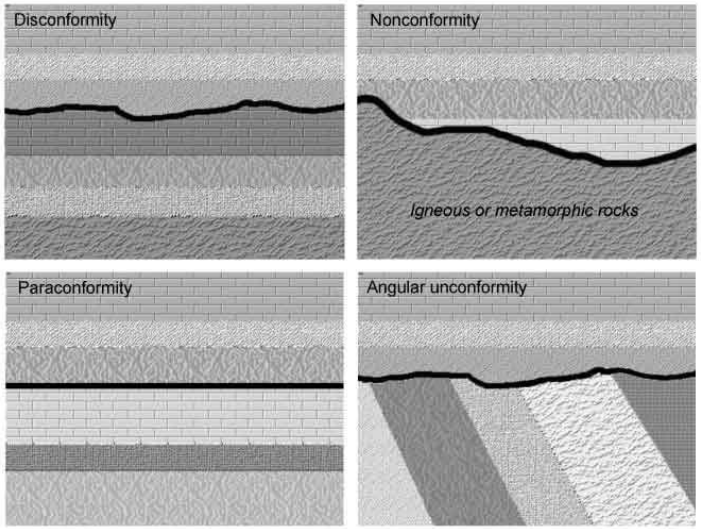


Fault Types:

There are more than are listed here -> always make sure that you are digging deeper

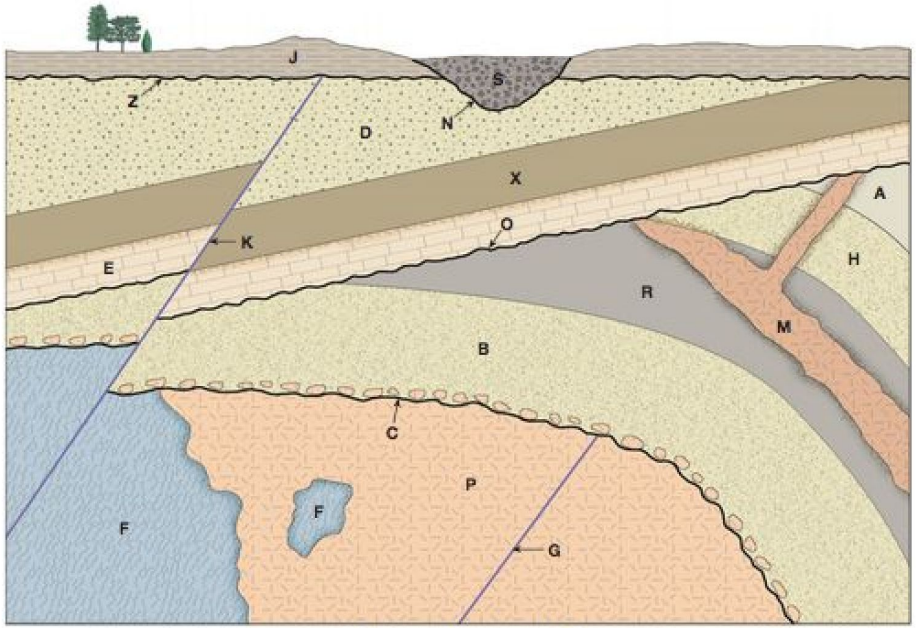
Unconformities:

Any contact between strata of different ages



Question 3: Unconformities

Now knowing what unconformities are, what type are letters C and O?



Answer:

C is a nonconformity – it lies on top of igneous rock

O is an angular unconformity – the strata below it angle towards it

Final Question

How many degrees of longitude wide is one Universal Tranverse Mercator zone?

a. 3
b. 4
c. 5
d. 6

Answer: D, Universal Transverse Mercator (UTM) is a system used to assign coordinates to different locations on Earth, just like latitude/longitude. It divides the Earth into 60 zones, each 6 degrees wide in longitude (makes sense, 60*6 = 360 degrees)

Tips from a Veteran

- Keep your binder organized with a bookmarking system
  - While you have a binder of notes that you can bring, your binder has no use if you can't find anything in it
- Avoid printing out entire Wikipedia pages
- Make a research schedule – assign specific topics for each partner to research and set deadlines to make sure you cover all material by the competition date
- Allot a month or more to just taking practice tests and supplementing your notes with any additional topics that you encounter

Additional Resources

Geologic Mapping Notes

Road Scholar Website

Geologic Mapping Website

THANKS!