Knowledge Survey Questions	Course	Bloom Level
What is ENSO?	Oceanography	1
Describe the chronology of events leading to an El Nino event.	Oceanography	1
How is the Atlantic hurricane season effected by El Nino?	Oceanography	1
Is a planula a plant or animal?	Oceanography	1
What is the extent of the global tsunami warning/buoy system?	Oceanography	1
Describe the effects on global climate if there were no isthmus connecting the America's.	Oceanography	2
How does the gulf stream current effect global climate?	Oceanography	2
Describe the role of krill in the Antarctic ecosystem.	Oceanography	2
How does a tsunami form?	Oceanography	2
What is post-glacial rebound?	Oceanography	2
What is the role of limestone formation in climate change?	Oceanography	4
Describe the stability of ocean salinity over time.	Oceanography	4
What is the fate of the Great Lake shorelines in the near future?	Oceanography	4
How could a tsunami warning system be improved to negate coastal fatalities?	Oceanography	5
Synthesize the use of oxygen and hydrogen isotopes in fossils preserved in marine sediments to changes in global climate over time.	Oceanography	6
Provided an image of global continent and ocean basin locations, interpret the surface and deep water currents and their effects on global climate.	Oceanography	6
When did the dinosaurs live?	Dinosaurs	1
What is the basic ecology of the dinosaurs?	Dinosaurs	1
Compare and contrast the two major groups of dinosaurs - saurischians vs. ornithischians.	Dinosaurs	2
Describe the general morphology of the ceratopsians.	Dinosaurs	2
Describe the general morphology of the stegosaurs.	Dinosaurs	2
Outline the major characteristics of the theropods.	Dinosaurs	2
Outline the major characteristics of the sauropods.	Dinosaurs	2
Explain how cladistic methods are used to evaluate dinosaur relationships.	Dinosaurs	4
Design a study that uses modern animals to explore dinosaur ecology and/or behavior.	Dinosaurs	6
Evaluate the evidence for dinosaur reproductive behavior.	Dinosaurs	6
Evaluate the evidence for the extinction of the dinosaurs	Dinosaurs	6
Evaluate the statement "all dinosaurs are extinct."	Dinosaurs	6
How old is our solar system?	Planetary Geology	1
What is the approximate age of the Universe?	Planetary Geology	1
How old is the Milky way Galaxy and how do we know?	Planetary Geology	2
How does the temperature and density of Venus' atmosphere affect its topography and crater distribution?	Planetary Geology	2

Compare primary, secondary, and tertiary planetary crusts.	Planetary Geology	2
Explain the currently favored model for the origin of the moon?	Planetary Geology	2
Design an experiment to study the relationships between impactor size, velocity, density and crater diameter. Make sure that your experimental design will provide estimates of errors.	Planetary Geology	3
Provided an image of the surface of Mars, interpret the geologic evolution of that region.	Planetary Geology	3
Classify the elements in the periodic table according to their mode of origin.	Planetary Geology	4
Compare the composition of the sun, solar system, and universe.	Planetary Geology	4
Contrast the composition of the terrestrial planets with the giant planets.	Planetary Geology	4
Describe the relationship between the size of a planet and its geological evolution.	Planetary Geology	4
Summarize the evidence for liquid water on the ancient surface of Mars. What implications does this have for past climate and atmosphere?	Planetary Geology	5
Evaluate the evidence and arguments for and against plate tectonics on Venus.	Planetary Geology	6
Evaluate the statement "there must be life elsewhere in the Universe."	Planetary Geology	6
How do levees affect river morphology, and why do they increase the long-term risk of damaging flooding?	Environmental Geology	2
How do septic systems differ from municipal water treatment systems, and which depends most sensitively on geology?	Environmental Geology	2
What tectonic settings are of most concern from the perspective of geologic hazard, and why?	Environmental Geology	2
What controls climate on millennial timescales?	Environmental Geology	2
Explain how natural floodplains form and argue for how we should best utilize this part of our landscape.	Environmental Geology	4
What is stage, and why is it more important than water discharge for flood prediction?	Environmental Geology	4
Why is hydrothermal power not considered a renewable resource, and explain some of the possible problems with renewable resources like solar and wind energy.	Environmental Geology	4
Explain the controls on the rate and pathway of groundwater flow, and why we should care.	Environmental Geology	4
How does urbanization affect the rate and magnitude of mass movements in mountainous environments?	Environmental Geology	6
How do dams affect sediment transport in rivers, and what effects might this have on river ecosystems?	Environmental Geology	6
What variables are important to soil formation?	Physical Geology	1

What factors determine the location of deserts?	Physical Geology	1
Explain the effect of water on the eruption style of a volcano?	Physical Geology	2
Explain the formation of an angular unconformity.	Physical Geology	2
Given a geologic cross-section of a region, determine the sequence of events and history of the region.	Physical Geology	3
If you were buying a house, what would you look for to evaluate the risk of damage by mass wasting?	Physical Geology	3
The outer part of the earth consists of asthenosphere, lithosphere, crust, and mantle. Compare the compositions and properties of these different regions.	Physical Geology	4
What are the likely effects that construction of a new dam will have on a river? Specifically, how will it affect the sediment budget?	Physical Geology	4
Compare the character of erosional, depositional, drowned, and uplifted coastlines.	Physical Geology	4
What is the relationship between tectonic setting and earthquake magnitude, depth, and motion?	Physical Geology	4
Explain how two adjacent regions can experience different sea level changes (in one region sea level rises and it falls in the other) at the same time.	Physical Geology	4
What if the plate tectonics were suddenly to stop. How might the earth look in one year? A thousand years? A million years? One hundred million years?	Physical Geology	4
What would the earth be like without an "internal heat engine?"	Physical Geology	5
Formulate a plan for assessing the potential hazards of a volcano to a nearby population.	Physical Geology	5
Synthesize the evidence from volcanism, seismicity, and topography into a tectonic model for a region.	Physical Geology	5
Evaluate the types of criteria that might be used to locate the site for a new landfill. Are all criteria the same? Explain?	Physical Geology	6
How old is the Earth?	Historical Geology	1
Compare and contrast igneous, metamorphic, and sedimentary rocks.	Historical Geology	2
Describe the basic properties of sedimentary rocks that are most useful to the geologist charged with reconstructing ancient depositional environments?	Historical Geology	2
Compare and contrast the basic properties and relative ages of oceanic and continental crust.	Historical Geology	2
Briefly describe world geography at the end of the Paleozoic.	Historical Geology	3
Provide evidence of evolution.	Historical Geology	3
Describe/define key events in the history of life on Earth.	Historical Geology	3
How would you order events in Earth history / build a relative timescale?	Historical Geology	4
Describe the significance and limitations of uniformitarianism.	Historical Geology	4

Describe how mountains form.	Historical Geology	4
Explain how geologists calibrate (add actual numbers to) the geological time scale.	Historical Geology	4
Describe the evidence for the K/T (Cretaceous - Tertiary) extinction event.	Historical Geology	4
Discuss/describe the feedbacks/interrelations among the lithosphere, atmosphere, hydrosphere, and biosphere?	Historical Geology	5
Design a study to determine whether the Earth is tectonically active (what is evidence for Plate Tectonics?).	Historical Geology	5
Design a study that uses the basic properties of sedimentary rocks and/or fossils to infer aspects of ancient climates?	Historical Geology	5
Formulate a plan to use sedimentary rocks and/or fossils to reconstruct changes in sea level.	Historical Geology	5
Evaluate the significance of unconformities in relation to geologic time.	Historical Geology	6
Explain sources of heat energy on Earth, and their role in plate tectonic processes	Historical Geology	2
Draw a diagram of both the chemical and rheological boundaries of Earth, and their thicknesses. Which designation is more important for plate tectonics?	Historical Geology	2
What is the age of the Earth, and how do we know this?	Historical Geology	2
What are the requirements for life on a planet, and what evidence suggests it is difficult for complex life to form?	Historical Geology	2
Why did complex life in the oceans appear at least 150 million years before complex life on land?	Historical Geology	2
Present evidence for the cause of mass extinction at the K/T boundary.	Historical Geology	3
You have in front of you three intrusive igneous rocks, each with variable amounts of silica. Can you identify/name each rock, and compare tectonic settings in which we expect to find each?	Historical Geology	3
What evidence supports the timing of the impact that formed our moon?	Historical Geology	4
What is punctuated equilibrium, and how is this theory supported by fossil evidence?	Historical Geology	4
What have been the major causes for mass extinctions in Earth history?	Historical Geology	4
What would be the age of a zircon crystal if it contains 16 million atoms of 238U and 8.0 million atoms of 206Pb? The crystal had an initial quantity of 6.0 million atoms of 206Pb. Assume the system is closed and that T1/2 is 4.47 x 10^9 years.	Historical Geology	4
Explain how tectonic processes control Earth's climate.	Historical Geology	5

Oxygen isotope ratios are arguably the most important tool we have for deducing climate history of the Cenozoic. Explain how this method works, and what information we can glean from examining these records.	Historical Geology	5
Predict earth's climate 100 million years from now, and explain what the major controls are expected to be.	Historical Geology	6
What characteristics define a "mineral?"	Mineralogy	2
Describe how x-rays can be used to study minerals?	Mineralogy	2
Explain how mineral association can be used to aid in the identification of minerals.	Mineralogy	2
If provided a wooden block model or natural crystal, determine the symmetry elements that are present.	Mineralogy	3
Na, Ca and K substitute for each other in many minerals. Some that come to mind are amphiboles, feldspars and zeolites. Why do these three elements easily replace each other in many minerals?	Mineralogy	4
C (carbon) is typically found in 3-fold coordination. Si (and sometimes Al or Ti) is typically in 4-fold coordination. Al, Ti, Fe, Mg or Mn may be found in 6-fold coordination. Mg, Mn, Na and Ca may be found in 8-fold coordination. Na, Ca and K may have even higher coordination numbers. Explain the variability and what controls it?	Mineralogy	4
Pauling's principle of parsimony says that mineral structures do not, in general, vary greatly. He said that there are limits that control how atoms combine in crystals, and the result is a surprisingly small number of basic structures. In principle, atoms could combine to make minerals in an infinite number of ways, but they don't. Why?	Mineralogy	4
Relate the physical properties of hardness, cleavage, and refractive index to the internal composition and structure of a mineral.	Mineralogy	4
In silicate minerals, silica tetrahedra may polymerize in different ways. Contrast and compare polymerization in quartz, feldspar, mica, amphibole, pyroxene, and olivine.	Mineralogy	4
Explain how the progressive substitution of Al+3 for Si+4 in a mineral can lead to the formation of new mineral groups.	Mineralogy	4
There are more than 100 elements and many possible combinations that two or more of these could be combined in minerals. Furthermore, the same combinations of elements could be combined in different structures. Despite this, there are relatively few common minerals. Why	Mineralogy	5
Explain which tool is better, optics, x-rays, or the SEM, for studying the structure and composition of a mineral.	Mineralogy	6
What is a recumbent isoclinal fold?	Structural Geology	1

What is a fault-bend fold?	Structural Geology	1
What is a Brunton compass used for?	Structural Geology	1
What are the orientations of fold axes in a thrust belt vs. a strike-slip boundary?	Structural Geology	2
What is the correlation of Mode II fractures in rock mechanics experiments to reality?	Structural Geology	2
Create a palinspastic restoration of a thrust belt where all the structures become listric to a regional detachment.	Structural Geology	3
Characterize the stereographic projections of conical vs. cylindrical folds	Structural Geology	3
While looking at a regional airphoto of the Appalachian's, identify anticlines and synclines, and their plunges.	Structural Geology	3
Describe the AMS fabric in a mafic dike swarm, and the implications for magma intrusion	Structural Geology	3
How are the compatability equations useful to structural geology?	Structural Geology	3
Describe the chronology of calcite twinning strains associated with formation of Derby Dome in the context of the Sevier-Laramide orogens.	Structural Geology	4
Evaluate the evidence for the catastrophic motion of upper plate blocks and the Heart Mountain detachment. What slide rate is required?	Structural Geology	6
Synthesize the results of various strain measuring techniques, including calcite twin analysis, and the resultant mechanism for plate motion in Iceland.	Structural Geology	6
Evaluate the evidence that annual vertical plate motions are greater in magnitude that horizontal motions and the implications of this observation to tectonics.	Structural Geology	6
Draw an equilibrium profile of a river, and explain how water discharge, slope, channel width, and water velocity change as a function of distance downstream.	Geomorphology	2
What geologic processes control large-scale geomorphology on earth?	Geomorphology	2
What are the primary controls on sediment transport in coastal environments?	Geomorphology	2
Draw a plot of water velocity in both plan view (cross-section) and along a vertical profile (bed to surface) in a river. What controls this pattern?	Geomorphology	4
Compare/contrast the process of abrasion in fluvial and glacial systems.	Geomorphology	4
Compare/contrast the processes of isostasy and flexure, and explain which is more important in supporting topography.	Geomorphology	4
Explain how cosmogenic radionuclide dating can be appropriately used to determine the age of a marine terrace.	Geomorphology	4

How does climate affect landscape evolution?	Geomorphology	4
Write the equation for shear stress and describe at least three geomorphic processes that are controlled by this parameter.	Geomorphology	5
Explain the triggers for debris flows, and give at least three examples of how humans exacerbate the frequency and magnitude of these events.	Geomorphology	5
Develop a field study for determining the rate and controls on chemical and physical weathering. Assume you have only 3 years to conduct the study.	Geomorphology	6
Explore the relationship between climate change and karst development in temperate environments.	Geomorphology	6
What is the definition of a formation?	Sedimentology & Stratigraphy	1
Outline the basic descriptive parameters needed to characterize sedimentary rocks in detail.	Sedimentology & Stratigraphy	2
Compare and contrast braided and meandering fluvial systems, both in the modern and in the rock record.	Sedimentology & Stratigraphy	2
Compare and contrast lithostratigraphy, biostratigraphy, and chronostratigraphy.	Sedimentology & Stratigraphy	2
Identify the major rock-forming minerals common to siliciclastic rocks.	Sedimentology & Stratigraphy	2
Explain why the stratigraphic records of transgression and regression are commonly disproportionate (asymmetrical)?	Sedimentology & Stratigraphy	3
Explain how regression might occur during relative sea-level rise.	Sedimentology & Stratigraphy	3
Measure a stratigraphic section through well exposed outcrop.	Sedimentology & Stratigraphy	3
Describe how you would draft a detailed measured section.	Sedimentology & Stratigraphy	3
Explain the concepts of transgression and regression.	Sedimentology & Stratigraphy	4
Explain how climate can be inferred from sedimentary deposits.	Sedimentology & Stratigraphy	4
Explain the nature of the stratigraphic record to a non-geologist, with emphasis on rocks vs. time.	Sedimentology & Stratigraphy	4
Generate a cross section through a basin using sedimentological data (several measured sections).	Sedimentology & Stratigraphy	4
How can sedimentary rocks and fossils be used to reconstruct the history of a basin?	Sedimentology & Stratigraphy	4
Design a study that uses a stylolitic seam to estimate the extent of carbonate dissolution in the cliffs along the Mississippi River.	Sedimentology & Stratigraphy	4
Design a study that reveals the types of evaporite minerals that might form in a land-locked (evaporating) marine basin.	Sedimentology & Stratigraphy	4

Design a study that links bedforms to their sedimentary structures.	Sedimentology & Stratigraphy	5
Design a study that uses texture, mineralogy, and sedimentary structures to infer the history of a sedimentary rock.	Sedimentology & Stratigraphy	5
Design a study that uses sandstone petrology to decipher tectonic provenance of sedimentary rocks.	Sedimentology & Stratigraphy	5
Compare and contrast sequence stratigraphy with other types of stratigraphic analysis.	Sedimentology & Stratigraphy	5
Explain why it is difficult to extend sequence stratigraphic methodology into terrestrial strata.	Sedimentology & Stratigraphy	5
Explain the significance of the facies concept.	Sedimentology & Stratigraphy	6
Evaluate alluvial architecture in relation to basin subsidence.	Sedimentology & Stratigraphy	6
Describe the difference between weather and climate, and explain which contributes more to glacier health.	Glaciers	2
Explain why ice streams are of potential concern to climate scientists.	Glaciers	2
Describe how eccentricity, obliquity, and precession are important to climate variability in the last 2 million years.	Glaciers	2
What evidence has been used to determine the magnitude and extent of past glaciations, and how has this evidence changed on geologic timescales?	Glaciers	2
Calculate the temperature of the earth in the absence of greenhouse gases.	Glaciers	2
How does ice thickness play a role in both internal deformation and sliding of glaciers?	Glaciers	3
Explain why there are unlikely to be glacial erosional features in Minnesota.	Glaciers	4
Detail the relationship between climate and glacier behavior.	Glaciers	4
Explain the two primary erosional processes that occur underneath glaciers, and explain how they control the roughness of subglacial environments.	Glaciers	4
Explain the process of fractionation of oxygen isotopes and describe at least two ways in which we can use it to determine past climate.	Glaciers	4
Describe at least two important feedbacks between ice sheets and rapid climate change in the North Atlantic.	Glaciers	5
Describe at least 5 paleoclimate proxies geologists use to determine past terrestrial climates, and explain how they work.	Glaciers	5
What characteristics define a "fossil?"	Paleobiology	2
Provide evidence for evolution, using both modern and ancient examples.	Paleobiology	2

Describe the major anatomical features that distinguish among the common invertebrate phyla represented in the fossil record.	Paleobiology	3
Describe cladistics, and explain why is it important to identify monophyletic groups.	Paleobiology	3
Explain why it is important to study evolution in a phylogenetic framework.	Paleobiology	3
Explain how a single morphological character can be either a synapomorphy or a symplesiomorphy to a cladist.	Paleobiology	3
Compare and contrast gradualistic vs. punctuated modes / patterns of evolution.	Paleobiology	3
Describe the features that link Phylum Echinodermata to Phylum Chordata.	Paleobiology	3
Explain why taphonomic analysis is a critical first step in the study of paleobiological / paleoecological questions.	Paleobiology	4
Design a figure that illustrates morphological change over time.	Paleobiology	4
Describe how predation has played a role in evolution.	Paleobiology	4
Design a study that explores the timing/mode (e.g., gradual vs. abrupt) of mass extinctions in the rock record.	Paleobiology	5
Design a study that explores and reveals the general conditions conducive to fossilization.	Paleobiology	6
Evaluate the role that extinction plays in evolution.	Paleobiology	6
What is the orientation of the di-polar vs. non di-polar field?	Geophysics	1
Describe the "snowball earth" hypothesis.	Geophysics	1
What is a wavelet?	Geophysics	1
How does gravitational acceleration vary with latitude?	Geophysics	2
How does magnetic field strength vary with latitude?	Geophysics	2
How does mantle viscosity and lithospheric flexure differ?	Geophysics	2
How do you interpret a 2-component Zjiderveld diagram?	Geophysics	2
How are focal mechanism solutions derived?	Geophysics	2
How do campaign and continuous GPS surveys differ?	Geophysics	2
Given seismic reflection and refraction profiles of the same section, how would they differ?	Geophysics	3
What is the application of GPR technology to environmental site assessment?	Geophysics	3
How does the location of Earth's rotation axis vary over time?	Geophysics	4
What focal mechanism solution is most common along a divergent plate boundary?	Geophysics	4
How would you interpret the results of a GPS array with large error ellipses?	Geophysics	4
Summarize the observed geoidal variations on Earth and the change in planetary shape observed in 1997. What are the future implications?	Geophysics	5
What are the properties of the REE that give them their unique chemical behavior?	Petrology	1

Briefly, describe the average composition of continental crust and three ways that this can be estimated.	Petrology	2
Describe the evidence for a change in the composition of continental crust through time.	Petrology	2
Describe how the mineral textures of an igneous rock be used to infer its origin.	Petrology	2
Why are the peak metamorphic conditions of a rock commonly preserved?	Petrology	2
What is a mineral paragenesis?	Petrology	2
Explain how geothermometers and geobarometers work.	Petrology	2
Provided a metamorphic rock, determine its metamorphic grade and facies.	Petrology	3
Use the IUGS classification system to classify igneous rock samples.	Petrology	3
Use the trace element and isotope compositions of a suite of rocks to infer their origin and evolution.	Petrology	3
Why are shales regarded to be 'representative' of average continental crust?	Petrology	4
Why are chondrites typically used for normalization of REE data? What other normalizing compositions might be used, and when would you use them?	Petrology	4
How would your recognize crustal contamination in a basaltic magma?	Petrology	4
What is an ophiolite? Describe its composition, structure, and origin.	Petrology	4
Compare the metamorphic conditions observed with depth in an accretionary wedge with those in an arc.	Petrology	4
Construct a table that compares the characteristics of magmatism in a variety of tectonic settings. You should select at least one criterion from each of the following categories: petrography, rock types, major element chemistry. Also choose three other criteria that you think are diagnostic. For each of these three additional criteria, also note why you think that criteria is significant.	Petrology	4
Formulate a plan for estimating the average composition of continental crust in Minnesota.	Petrology	5
Draw a plot showing the abundances of the elements in the solar nebula. Make sure that key features of the diagram are clearly indicated. Classify the elements on the diagram according to their origin. How are the trends in abundance reflected in the composition of various terrestrial reservoirs?	Petrology	5
Evaluate the different models of crustal growth rates through time.	Petrology	6

What is the theoretical base of phase diagrams? How can they be applied to natural rocks? What are their limitations and benefits?	Petrology	6
Evaluate the argument that "dating methods utilizing radioactive isotopes are unreliable because different isotopic systems often yield different ages for the same rock"	Petrology	6