Central Washington University
Assessment of Student Learning
Department and Program Report

Please enter the appropriate information concerning your student learning assessment activities for this year.

Academic Year of Report: __2012-2013_______ College: _____COTS_______
Department _____Geology_______ Program: _____Geology B.S., Environmental Geology, B.S., and Geology M.S._

1. What student learning outcomes were assessed this year, and why?
We performed two assessment activities in the 2012-2013 academic year:
   1. Our departmental math assessment (attached) that is used to help the geology faculty to better understand the students “working knowledge” of elementary mathematics.
   2. Our departmental content assessment (attached) that is designed to help the geology faculty to better understand if the students have a good foundation of geologic concepts.

2. How were they assessed?
We selected two courses to take part in our assessment this year. For the undergraduates, we used End-of-Major-review (GEOL 487) during the winter quarter, 2013. The undergraduate students were mainly senior working on completing their B.S. degrees. The graduate students that participated in the assessment were enrolled in Graduate Seminar (GEOL 504), also during winter quarter, 2013. The graduate students were a mix of first and second year students.

Both assessments were given to all students in the classes on February 22nd, 2013. Some of the undergraduates retook one or both assessments. Assessment retakes were done on an individual basis and completed within a week or two of the original assessment.

3. What was learned?
The following tables summarize the results of the assessment. Note that we did not collect data on whether students were native or transfer.

GEOLOGY 487: Total students assessed = 19

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<td>17/89%</td>
<td>2/11%</td>
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In the GEOL 487 class, only 42% of the students had acceptable math scores after their first attempt. After allowing the no pass students a second attempt, the rate increased to 95%. The content portion of the assessment had higher rates on the first attempt (68%) than the math. After the second attempt the rate increased to 89%.
The GEOL 504 class, had a math pass rate of 64% and a content pass rate of 82%. Keep in mind that this assessment included both first and second year graduate students.

4. What will the department or program do as a result of that information?

In response to a general concern about the content knowledge and professional skills of our graduating undergraduate students, including skills related to some of the outcomes we have measured, our department held several curriculum retreats in Fall 2013. As a result of these retreats, we have added a climate course to the Geology B.S. and divided one course in the Environmental Geology B.S. that was too broad. We are also proposing a Geology Writing class as a new elective in our majors. These course changes will address some concerns about content knowledge and writing. In addition, we took several steps towards improving the quantitative skills of our students: 1) We added math prerequisites to a number of classes. This change will force students to take their math requirements earlier and will allow us to have students use those math skills in our courses, thus reinforcing the skills. 2) Similarly, we added our Quantitative Methods course (GEOL 305) as a prerequisite for many courses so that students will take that course early on in the majors. 3) We have examined all of our classes in terms of the type of math skills that are needed for each one (which courses require algebra, statistics, calculus, etc.). This analysis is presented as a table at the end of this report. We plan to redesign our math assessment so that we have assessment tools related to each area. We can then use these tools at various points in the major to measure student progress. We will also collaborate on how we incorporate these quantitative skills so that we can help students make connections between different courses and set expectations for increasing mastery of these skills.

The graduate students are generally strong in their content knowledge. We will continue to test their knowledge to determine whether there are always a minority of students who do not pass the content knowledge test and address this problem if needed. The graduate students did not perform well on the math skills test. We will address this deficit along with the undergraduate students in our 400/500-level courses. In addition, we will consider adding more quantitative exercises to our Research Methods (GEOL 503) course.

5. What did the department or program do in response to last year’s assessment information?

As a department, we had three half- to full-day curriculum retreats during Fall term. In those retreats, we refined our program outcomes and also looked at our assessment data from the past few years. In general, one major finding from the 2011-2012 reading assessment is that students at all levels cannot read very fast. Prior to this assessment, we as faculty did not realize the extent of this problem. At our retreat, we discussed ways to address reading, writing, and quantitative skills throughout the core sequences in each major. For the reading skills, actions will include quizzes on assigned readings and time spent in class analyzing reading assignments. We currently have groups of faculty assigned to reading/writing and quantitative skills to propose a curriculum-wide plan for solidifying these skills.

For the graduate students, we feel that our current emphasis on writing literature reviews in GEOL 502, including the rubrics that we use for those assignments, are fairly successful. In two of our required graduate courses, we work with the students a great deal on writing. It did not appear that any action is needed as a result of the 2011-2012 assessment for the M.S. program other than continuing with what is working.

6. Questions or suggestions concerning Assessment of Student Learning at Central Washington University:
Geol 487 Math Assessment (NO CALCULATORS)
This is to help us learn about our majors’ ‘working knowledge’ of elementary mathematics.

Name, City, State of High School _______________________________________
Geology Degree: ____________________________________________
Date & name of last Math class_______________________________

1. Arithmetic

(a) $1/0.1 =$

(b) $2^3 =$

(c) $64^{1/2} =$

(d) $2^{-2} =$

(e) $\frac{25 \times 10^3}{5 \times 10^{-5}} =$

(f) SHOW WORK $231/7 =$

2. Express in scientific notation

(a) 0.00012

(b) 300,000

GO TO NEXT PAGE
3. Geometry and Trigonometry

(a) The formula for the area of a circle is:

(b) Using the diagram at the right, \( \cos \alpha = \)

Circle the correct answer

\[
\begin{array}{cccc}
\frac{a}{b} & \frac{a}{c} & \frac{d}{a} & \frac{b}{c} \\
\end{array}
\]

4. Algebra

(a) \( PV = nRT \) Solve for \( T \).

(b) \( y = \frac{x}{(1-x)} \) Solve for \( x \).

(c) \( \frac{a}{x} = \frac{b}{c} \) Solve for \( x \) in terms of \( a, b, \) and \( c \).

DONE! THANKS!!!

Relax and tell us what you know!

1. The **scientific method**:
   a. involves only scientific measurements.
   b. is a method of discovery that scientists follow to answer questions about the natural world.
   c. involves developing a hypothesis, collecting and interpreting data (e.g., doing an experiment), modifying the hypothesis to reflect the results of the experiment...
   d. b and c.
   e. None of the above

2. **Iceland**, which straddles the Mid Atlantic Ridge,
   a. sits on the North American plate.
   b. sits on the Atlantic Ocean plate.
   c. sits on two tectonic plates.
   d. both b. and c. are true.
   e. both a. and c. are true.

3. Which of these statements relating to **tectonic plates and plate boundaries** is **FALSE**?
   a. India is on the same plate as Australia.
   b. There are more trenches in the Pacific Ocean than in the Atlantic Ocean.
   c. There are composite cones along the east coast of South America.
   d. London is moving eastward relative to New York.
   e. South America was once connected to Africa.

4. **Transform plate boundaries** are characterized by:
   a. Volcanoes
   b. Large mountains like the Himalayas
   c. Creation of oceanic crust and magnetic ‘stripes’
   d. Plates sliding past one another
   e. None of the above

5. **Earth is divided into a series of concentric layers** based on chemical composition or physical properties. Which **two layers** **play** the major roles in plate motions?
   a. mantle and core
   b. asthenosphere and crust
   c. lithosphere and outer core
   d. asthenosphere and lithosphere

6. Which statement is **FALSE**?
   a. Igneous rocks contain many of the silicates, which are rock-forming minerals.
   b. Sedimentary rocks can contain particles (grains) of any type of rock.
   c. Sedimentary rocks can melt to form igneous rocks.
   d. Metamorphic rocks form when existing rocks melt and then solidify.
7. Which two (2) critical data sets were important to the development of the idea of subduction zones?
   a. Largest concentration of earthquakes occur along ocean ridges and these earthquakes are shallow.
   b. Largest concentration of earthquakes occur along oceanic trenches and these earthquakes define a dipping plane.
   c. Largest concentration of earthquakes occur along oceanic fractures and these earthquakes are steep.
   d. Largest concentration of earthquakes occur along ocean island volcanoes and these earthquakes are shallow.

8. A magma chamber or reservoir
   a. is located at the surface of the Earth.
   b. is another name for a lava lake.
   c. is the place in the crust where magma is stored prior to eruption.
   d. is the source of mantle plumes or hotspots.
   e. makes a great graduation present.

9. Which of the following statements is TRUE about the tectonics of the Pacific Northwest:
   a. The primary plate configuration is strike-slip as the Pacific Plate slides northeast under the North American plate.
   b. The primary plate configuration is subduction as the Juan de Fuca plate slides northwest under the North American plate.
   c. The primary plate configuration is subduction as the Juan de Fuca plate slides east under the North American plate.
   d. The primary plate configuration is subduction as the North American plate slides under the Juan de Fuca plate.

10. The 1980 Mt. St Helens eruption was triggered by an earthquake, followed by an avalanche. These events
    a. caused explosive eruption of pahoehoe and a’a flows
    b. caused the bulge to grow 80 feet in one day.
    c. triggered depressurization of the shallow magma chamber, causing rapid vesiculation and explosive eruption
    d. was among the largest volcanic eruptions in the rock record.
    e. caused caldera collapse.

11. Choose the statement that is FALSE.
    a. Mauna Loa is a shield volcano.
    b. Viscosity plays only a minimal role in the formation of the type of volcano (e.g., shield vs. stratovolcano).
    c. Hawaiian eruptions are typically basaltic in composition
    d. Basalt has lower SiO$_2$ wt. % than andesite.
    e. A typical Hawaiian eruption begins with a curtain of fire, followed by fire fountaining and eruption of lava flows.

12. Which of these cannot be used to determine relative ages of rock layers?
    a. principle of superposition
    b. principle of component analysis
    c. principle of crosscutting relationships
    d. principle of faunal succession
13. **Differentiation** is the process
   a. whereby a homogeneous composition planet becomes characterized by a layered structure.
   b. whereby the core, mantle and crust formed.
   c. that occurred shortly after the formation of Earth.
   d. can also be referred to as density stratification, where the densest material goes to the center of Earth and the least dense material collects at the surface.
   e. all of the above.

14. An **unconformity** is best described as:
   a. A term that describes the relationship between rocks of different types.
   b. A concept that we abbreviate as “the present is the key to the past”.
   c. A ‘time gap’ in a sequence of rocks, often caused by erosion.
   d. None of these statements accurately describe the term unconformity.

15. High **concentrations of iridium** have been found worldwide at the **Cretaceous-Tertiary boundary**. These high concentrations are interpreted to result from:
   a. arc volcanism
   b. rifting
   c. asteroid impact
   d. meteorite shower

16. In general, **chemical weathering** would occur most rapidly in which type of climate? *Hint: Think about conditions that influence chemical reactions.*
   a. cool and wet
   b. cool and dry
   c. warm and wet
   d. warm and dry

17. What is the difference between **breccia and conglomerate**?
   a. Breccia is made of clasts 3-6mm in diameter and conglomerate clasts are >6mm in diameter
   b. Conglomerate is made of clasts 3-6mm in diameter and breccia clasts are >6mm in diameter
   c. Conglomerate is made of rounded clasts and breccia is made of angular clasts
   d. Breccia is made of rounded clasts and conglomerate is made of angular clasts

18. Which transport medium is the **WORST** at sorting sediment by size:
   a. glaciers
   b. waves
   c. wind
   d. streams

19. The following are **metamorphic** rocks EXCEPT for:
   a. Schist
   b. Granite
   c. Gneiss
   d. Marble
20. Marble is created by the **metamorphism of which rock?** (What is the protolith of marble?)
   a sandstone  
   b quartzite  
   c shale  
   d schist  
   e limestone

21. Water is an **important part of metamorphism** for all of the following reasons **EXCEPT**:
   a it aids in the movement of unbonded atoms and ions  
   b it expands fractures in mineral surfaces when it freezes  
   c it helps break the bonds between some of the mineral’s ions  
   d it contributes foreign ions to metamorphic reactions (changes rock chemistry)

22. At the **base of the Mississippi River delta sequence**, rocks are undergoing which type of **metamorphism**?
   a Regional  
   b Contact  
   c Granulite facies  
   d Burial  
   e Blueschist

23. ___________ is the **type of metamorphism** that involves **chemical alteration** of preexisting rocks by **hot water**, usually near divergent plate boundaries.
   a Regional  
   b Contact  
   c Hydrothermal  
   d Burial  
   e Blueschist

24. Which type of **deformation is recoverable** (when the stress is removed the object will regain its original shape)?
   a Brittle deformation  
   b Plastic deformation  
   c Ductile deformation  
   d Elastic deformation

25. **Ductile deformation** produces:
   a fissures  
   b folds  
   c faults  
   d dikes

26. **Brittle deformation** results in the formation of:
   a dikes  
   b folds  
   c faults  
   d fumaroles

27. What type of faults is created by **horizontal slip between adjacent blocks** of rock?
   a recumbent fault  
   b thrust fault  
   c dip-slip fault  
   d strike-slip fault
28. What is the **minimum** number of **seismograph stations** you always need to accurately locate an **earthquake** epicenter?
   a. one
   b. two
   c. three
   d. four

29. Which of the following changes would **increase** a **stream’s velocity**?
   a. paving the streambed to make it very smooth
   b. increasing the gradient of the stream
   c. decreasing the width of the stream
   d. all of the above

30. A **stream's base level** is:
   a. the gradient of the stream where it enters the ocean
   b. the average elevation of the stream channel
   c. the elevation of the head of a stream
   d. the lowest level to which a stream can erode its channel

31. Which of the following would best characterize the **typical morphology** of a **mountain stream high above its base level**?
   a. meandering stream in a V-shaped valley
   b. braided stream in a U-shaped valley
   c. meandering stream in a wide valley
   d. narrow stream in a V-shaped valley

32. **Permeability** refers to:
   a. the volume of open space (or pore space) in a rock
   b. the ability of water to flow through the rock
   c. the thickness of the capillary fringe
   d. The combination of a. and b.

33. Which of the following factors **LEAST** influences the **porosity of a mature sandstone**?
   a. how well sorted the rock is
   b. roundness of the sand grains
   c. how well cemented the rock is
   d. the composition of the sand grains

34. The term **groundwater recharge** refers to:
   a. the frequency of precipitation
   b. the infiltration of water into the groundwater
   c. absorption of precipitation by the soil
   d. the rate of flow of groundwater

35. The term **water table** refers to:
   a. all of the water within the zone of saturation
   b. all of the water within the soil
   c. the boundary between the zone of aeration and the capillary fringe
   d. the boundary between the zone of aeration and the zone of saturation
36. In order to be an aquifer, a rock unit must be:
   a both permeable and porous
   b neither permeable nor porous
   c permeable, but not necessarily porous
   d porous, but not necessarily permeable

37. The Greenhouse Effect:
   a is a natural occurrence, or phenomenon, that has taken place for millions of years.
   b has only occurred in the last 50-100 years.
   c is the trapping of heat by atmospheric gases.
   d occurs primarily because the oceans have caused the atmosphere to warm up.
   e both a. and c.

38. Carbon-14 dating is used to date:
   a Organic material
   b Sedimentary rocks
   c Metamorphic rocks
   d Igneous rocks

39. The relative ages of dikes are best constrained by which principle of relative dating?
   a principle of original horizontality
   b principle of superposition
   c principle of cross-cutting relationships
   d principle of uniformitarianism

40. The half-life of a radioactive isotope refers to:
   a one-half of the total lifespan of a parent isotope.
   b the time it takes for the ratio of parent to daughter isotopes to be 1:2 (half as many parent isotopes as daughter isotopes).
   c the time it takes for the ratio of parent to daughter isotopes to be 2:1 (twice as many parent isotopes as daughter isotopes).
   d the time it takes for half of the parent isotopes to decay to daughter isotopes.

41. The seismic waves that travel the fastest are the ___________.
   a P waves
   b S waves
   c Rayleigh waves
   d Love waves

42. The location within the Earth where the earthquake begins (the initial rupture point)?
   a depocenter
   b epicenter
   c seismogram
   d focus/hypocenter
   e seismocenter

43. A magnitude 5 earthquake releases how much more energy than a magnitude 4 earthquake?
   a ~5 times
   b ~10 times
   c ~30 times
   d ~100 times
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<th>Basics</th>
<th>Functions</th>
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<td>c-1, c-2</td>
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la logical analysis
la-1 problem solving

b basic
    b-1 graphing, graph interpretation, rates
    b-2 unit conversion
    b-3 dimensional analysis
    b-4 back of the envelope, sanity check, order of magnitude
    qualititative understanding of algebraic equations, and how varying variables affects
    b-5 unknown
    b-6 sig-figs
    b-7 measurements, accuracy and precision

f functions
    f-1 dependent vs independent variables
    f-2 separation of variables (solve for x)
    f-3 types of functions (linear, power, exponential, logarithmic)
    f-4 periodic (trig)
    f-5 solving systems of equations

mf multivariable functions
    mf-1 vectors
    mf-2 matrices
    linear
    mf-3 algebra
    mf-4 directional derivative
    mf-5 sensitivity analysis

sp statistics and probability
    sp-1 descriptive statistics (univariate; mean, sd, uncertainty...)
    sp-2 regression analysis
    sp-3 probability distributions
    sp-4 error propagation

c calculus
    c-1 discrete sum vs continuous integral
    c-2 derivative, average vs instantaneous rate of change
    c-3 partial derivative
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<th>basics: functions</th>
<th>multivariable functions</th>
<th>statistics and prob</th>
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