Appendix I. Pre-/Post-Assessment Tests

Density module assessment test questions (Cronbach alpha = 0.760)

1) Which material has the highest density?
   A) Oak
   B) Air
   C) Steel
   D) Liquid mercury

2) What is the formula for calculating density?
   A) $\rho = m * V$
   B) $\rho = m / V$
   C) $\rho = m * g$
   D) $\rho = m^2/V$

3) What is the formula for calculating the volume of spherical shells
   A) $V_{shell} = [4\pi\ (3r_2 - 3r_1)]/3$
   B) $V_{shell} = (4/3)\ \pi\ (r_2 - r_1)^3$
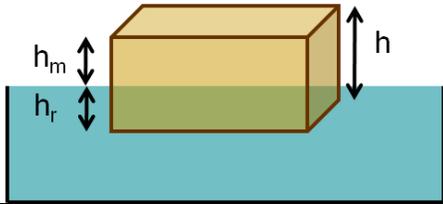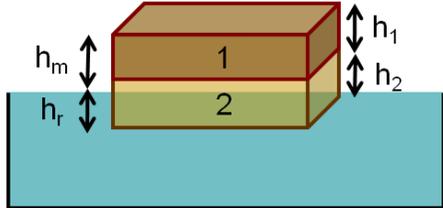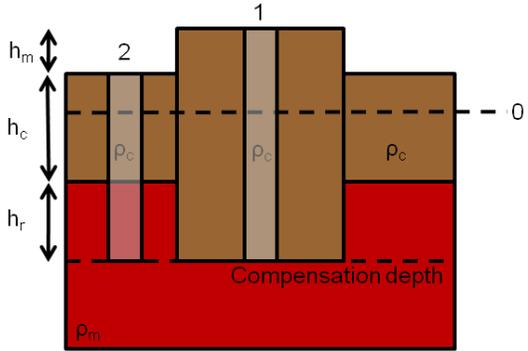   C) $V_{shell} = (4/3)\ \pi\ (r^3_2 - r^3_1)$

4) What is the largest layer of the Earth volumetrically?

5) Fill in the blank with the names of the layers of the Earth as shown in the diagram below.
   A) Layer A - _____
   B) Layer B - _____
   C) Layer C - _____
   D) Layer D - _____
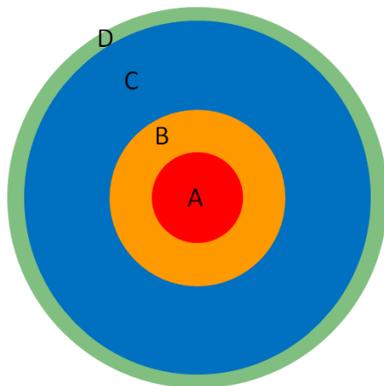
6) How does the density of the mantle compare to the density of the crust?
    A) The mantle has a higher density than the crust.
    B) The mantle has a lower density than the crust.
    C) The mantle has the exact same density as the crust.

7) What is the densest layer of the Earth?
    A) Crust
    B) Mantle
    C) Outer Core
    D) Inner Core
    E) None of the above, they are all the same density

8) Explain what density has to do with the packing of atoms in a material.

9) The density of a granite rock on Earth is 2.5 g/cm^3. How would the density change if that rock were on the Moon?
    A) The density would increase.
    B) The density would decrease.
    C) The density would remain exactly the same.
    D) The rock would not have a density at all.

10) The average density of the Earth is 5.5 g/cm^3, but the average density of the rocks that make up the crust is 2.5 g/cm^3, what makes the average density of the Earth so much higher?

11) Explain how and why the densities of the different layers change as you go from the crust down to the center of the Earth.

12) If the Earth were composed only of two layers, the outer layer 3000 km thick, and the inner layer 4000 km thick calculate the volume of material in each layer.

13) Now imagine that each layer contains 50% of the entire mass of the Earth, what would the densities of the two layers be in kg/km^3 given that the mass of the whole Earth is 5.95 x 10^{24} kg?

Isostasy module assessment test questions (Cronbach alpha = 0.903)

Equations	Example Diagram
Single layer block $h_r = (\rho_b * h) / \rho_f$ $h_m = h - [(\rho_b * h) / \rho_f]$	
Stratified block $h_r = [(\rho_1 * h_1) + (\rho_2 * h_2)] / \rho_f$ $h_m = (h_1 + h_2) - [(\rho_1 * h_1) + (\rho_2 * h_2)] / \rho_f$	
Airy model $h_m = h_r [(\rho_m - \rho_c) / \rho_c]$ $h_r = (\rho_c * h_m) / (\rho_m - \rho_c)$	
Pratt model $h_m = h_c [(\rho_B - \rho_A) / \rho_A]$ $h_c = h_m [\rho_A / (\rho_B - \rho_A)]$	
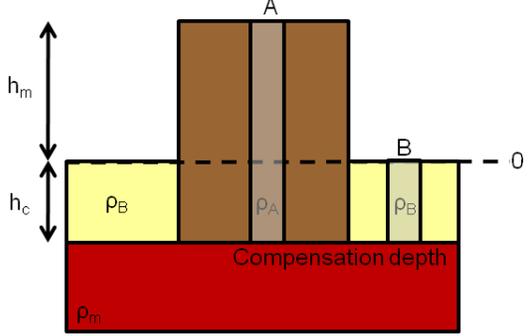
1) An ice cube that floats in water has _____ the water it is floating in?
   A) a higher density than
   B) a lower density than
   C) the same density as

2) The balance between the weight of a mountain range and the buoyancy provided by the underlying mantle is called _____.

3) Which of the forces shown in the diagram is the buoyant force?
   A) Upward directed force
   B) Downward directed force
   C) Neither
   D) Both
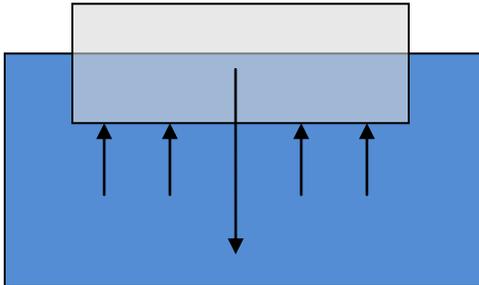
4) Which model of isostasy assumes that the density of the crust varies laterally?
   A) Pratt
   B) Airy
   C) Buoyancy
   D) None of the above

5) In reference to your answer for question 2, what does this mean for the density of the mountains compared to that of the mantle?

6) I have two blocks, Block A has a higher density than Block B, but both have a lower density than the fluid they are immersed in. Which block will float higher in the fluid?
   A) Block A
   B) Block B
   C) Both will float at the same height above the fluid surface

7) How does the density of the material (NOT the fluid) affect the value h_r (thickness of root)?

8) What are the differences between the Airy and Pratt models of isostasy?

9) Why does the Pratt model better describe the situation of the oceanic lithosphere than the Airy model does?

10) The Airy model contains a crustal root at the bottom of the mountain range, what is the purpose of this?

11) I have a block of pumice that is 5 cm in height floating in vegetable oil. The pumice has density 0.64 g/cm^3, the oil has density 0.92 g/cm^3. Calculate h_r and h_m in cm.

12) What if the block is made of birch and pumice, the pumice is 7 cm thick and birch is 3 cm thick with a density of 0.35 g/cm^3. Re-calculate h_r and h_m for these circumstances.

13) In the Bulls Mountain Range the rocks have an average density of 2.9 x10^{12} kg/km^3 and the mantle beneath them is 3.3 x10^{12} kg/km^3. If the Bulls Mountains have a root that is 20 km deep how high are they?

<u>Landslide module assessment test questions (Cronbach alpha =0.846)</u>

Equations
$f_g = m * g$
$f_s = f_g * \sin(\theta)$
$f_n = f_g * \cos(\theta)$
Degrees = radians x $(180 / \pi)$
$\rho = m/V$
$F = \{C + [\sigma * \tan(\varphi)]\} / \tau$

Variables
f_g = force of gravity
f_s = shear force
f_n = normal force
F = factor of safety
θ = angle of slope
m = mass
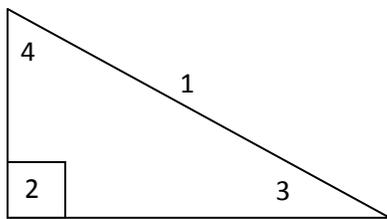g = gravitational constant (9.8 m/s^2)
ρ = density
V = volume
C = cohesion
σ = normal stress
τ = shear stress
φ = friction angle

1) The factor of safety is a way to evaluate the _____ of a slope?

2) How are force and stress related?

3) Which is the angle of the slope on the diagram below?
   A) 1
   B) 2
   C) 3
   D) 4

4) How does cohesion change for a sand versus a clay?
   A) Cohesion is higher for a sand.
   B) Cohesion is higher for a clay.
   C) Cohesion of sand and clay are the same.
   D) Neither has a cohesion.

5) What factors influence the stability of a slope?

6) What are some easy ways to increase the stability of a slope?

7) Imagine that I increase the amount of force on a 10x10 m square tile, how will this affect the stress?

A) Increase.
B) Decrease.
C) Remain the same.

8) What will happen to the stability of a slope if I increase the angle of the slope?

A) Decrease.
B) Increase.
C) Remain the same.
D) The slope will no longer be stable.

9) Does the angle of the slope have to change for the slope to become unstable?

A) Yes.
B) No.
C) It is impossible to know.

10) What will happen to the stability of the slope if I increase the cohesion of the materials?

A) The stability of the slope will decrease.
B) The stability of the slope will increase.
C) The stability of the slope will remain the same.
D) The slope will no longer be stable.

11) Everything else being equal, will a slope made of saturated sand be more stable than one made of dry sand?

A) Yes.
B) No.
C) They have the same stability.

12) Given the following table of information calculate the factor of safety and determine if the slope is stable or unstable.

Mass (kg)	7.13E+16
area (m^2)	1800
Force of Gravity (N)	1.46E+09
Normal Force (N)	1.32E+09
Shear Force (N)	6.16E+08
Normal Stress (N/m^2)	7.33E+05
Shear Stress (N/m^2)	3.42E+05
g (m/s^2)	9.81

Angle of slope (Degrees)	25
Angle of slope (Radians)	0.43
Dry Cohesion (N/m^2) - Silt	6.70E+04
Friction Angle (Degrees) - Silt	24
Friction Angle (Radians) - Silt	0.42

13) If I have a stress of 1.20×10^5 N/m^2 applied to an area of 20 m^2, what is the force?