**Final Exam – 2014**

Study Guide

**Scientific Inquiry Goals**

Students will be able to:

* explain to a lay person the practices that brought about at least one major breakthrough in each of the four areas of science and how this contributed to our modern understanding of science.
* Explain what it is to “do science” and how the idealized steps of the “scientific method” do not do an adequate job of explaining what it is to do science.
* Explain and demonstrate how science is a “way of knowing”
* Describe differences in the process of scientific discovery as described in Derry: Serendipity and Methodical Work, Detailed Background and Dreamlike Vision, Idealized models and Mathematical Calculations, Exploration and Observation, the Hypothetico deductive method
* Describe what a generalization is and what it takes to prove and to disprove a generalization or scientific theory.
* Describe a hypothesis, explain when it’s appropriate to use a hypothesis and how a hypothesis differs from a prediction.
* Describe how a hypothesis and a generalization relate.
* compare and contrast “Scientific Practice” with “Engineering Design”
* describe an engineering design cycle and how to apply it to design challenges
* define and provide examples of design criteria and design constraints
* judge a student’s abilities to do design practices in an “informed” way.
* Provide examples of big ideas which flow through the sciences
* Describe how each field of science relates
* Describe the necessity for observations and characterization of patterns to understand the invisible
* Describe how organization/categorization can predict the unknown
* Explain the value of comparing and contrasting to learn about how and why something works as it does.
* Describe the value of a model regardless of whether it models the phenomena exactly.
* Provide examples of scientific contributions that did not involve experimentation
* Determine the tools used by a certain type of scientist
* Describe the activities that a given type of scientist engages in during a typical day.
* Describe how a person becomes an expert.
* distinguish effortful practice from regular practice and its necessity in becoming an expert.
* Recognize science vs. pseudoscience
* Apply the ideas of pseudoscience to a scientific claim to identify if and specifically why it’s pseudoscience. To be pseudoscience some, not necessarily all of the criteria below are required; however, it must claim to be science to be considered pseudoscience.

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| **Real science** | **Psuedoscience** |
| Ideas change over time and build on prior knowledge – old knowledge is not discarded | Static or randomly changing ideas |
| Goal is to achieve some coherent understanding of our observations. | Vague mechanisms to acquire understanding |
| Rigorous logic, a strict chain of deductive reasoning with no gaps or weak spots. | Loosely connected thoughts |
| A new idea is usually presumed wrong until sufficient evidence shows that it’s right. | Lack of organized skepticism. In fact, it’s forbidden. |
| Evidence virtually always builds on prior work. | Disregard of established results |

* Rate the Quality of Evidence used to support an argument based on its level of public verifiability.

|  |  |  |
| --- | --- | --- |
| **Quality of Evidence – Level of Public Verifiability**  (Wendy Adams and Joe Elkins, University of Northern Colorado adapted from Browne and Keeley) | | |
| **Low** | **Med** | **High** |
| Personal observation | Analogy | Peer-reviewed study |
| Personal Testimony | Appeal to authority | Survey |
| Personal Experience | Case Study | Statistics |
| Intuition |  | Meta-analysis of peer-reviewed studies |

**Content Goals.**

Basic Inheritance

Students will be able to:

* explain the difference between mitosis and meiosis.
* describe why meiosis is necessary to create gametes (eggs and sperm)
* describe simple inheritance and calculate the probability of particular traits showing up in offspring.
* explain how certain diseases and genetic defects can occur in newborns.
* explain what stem cells are, their purpose and where they exist.
* describe the basic process of invitro fertilization (IFV) and genetic testing
* describe how the two different types of twin babies can come about – fraternal and identical.

Earthquakes

Students will be able to:

* describe where earthquakes can be located and how it takes two pieces of information, the epicenter and the depth, to fully describe the location of the quake.
* explain how and why earthquakes are not predictable
* describe different types of deformation that rocks can experience due to stress and strain

Science of Sound

Students will be able to:

* identify the source of sound based on the idea that vibrations make sound
  + Our throat vibrates to make voice
  + Straw tip vibrates to make sound
  + Plucked string vibrates to make sound
* Describe how sound travels as sound waves (not particles), showing how sound waves travel through air molecules
* Apply the idea that sound carries energy and it can be transferred to other objects or into other forms
* Define pitch and frequency and how they relates to treble and bass notes.
* Describe natural frequency (The frequency an object “likes” to vibrate at) and how it affects the sounds we hear from different instruments such as:
  + Different lengths of straw “like” different frequencies so we hear a different note.
* Describe the three things that are required to make a musical instrument: 1. A source of vibration, way to change the pitch and a way to amplify the sound.
* Identify how sound is amplified in different instruments. Either via a resonance chamber or sympathetic vibration.

Students will be able to:

Describe the basic function of the ear:

* The ear flap is called the pinna and is used for funneling sound into the ear.
* sound waves travel into the ear and through the inner ear into the cochlea
* The cochlea is filled with thousands of tiny sensors called hair cells
* These hair cells turn vibrations into electrical signals that are sent to the brain and the brain interprets the source of the sound (piano vs. a guitar).
* Different parts of the cochlea resonate with certain frequencies....

Some like high pitches and some like low pitches…

* Listening to loud sounds for too long can damage the hair cells
* Damaged hair cells can’t be fixed.

Conservation of Mass

Students will be able to

* describe how mass comes into plants to form the plant material.
* how mass exits humans or other animals when they lose weight.

Conservation of Energy and metabolism

Students will be able to

* apply the concepts of conservation of energy to systems, tracing different forms of energy as they are “used” and converted by plants, animals and other mechanisms.
* Identify energy conversions between kinetic and gravitational potential energy.
* describe how scientists determine how many calories are contained in a type of food.
* explain which variables affect BMI and which do not (weight, height, body fat, age, gender)
* explain what BMI tells about a person including its limitations.
* describe what a person can do to increase their heart’s strength and what affects strain on the heart.
* Identify if a given combination of diet and activity will cause a person to gain weight, lose weight or stay the same.

Quiz solutions:

[Quiz 2](file:///C:\Users\Wendy\Documents\My%20Dropbox\NHSWeb\Everything%20465\Quiz%20genetics%20v3_key.pdf)

[Quiz 4](file:///C:\Users\Wendy\Documents\My%20Dropbox\NHSWeb\Everything%20465\Quiz%204_sound%20post_key.pdf)

[Quiz 6](Quiz%206_key.pdf)

[Quiz 8](file:///C:\Users\Wendy\Documents\My%20Dropbox\NHSWeb\Everything%20465\Quiz%208_2012_key.pdf)

[Quiz 10](file:///C:\Users\Wendy\Documents\My%20Dropbox\NHSWeb\Everything%20465\Quiz%2010_key.pdf)