Final Exam – 2014

Study Guide

Scientific Inquiry Goals

Students will be able to:

- 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 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.
- 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 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 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.
- Recognize science vs. pseudoscience
- Rate the quality of evidence used to support an argument
- Provide examples of big ideas which flow through the sciences
- Describe how each field of science relates
- Describe how a person becomes an expert.
- 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.

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 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

Quiz 4

Quiz 6

Quiz 8

Quiz 10