Reading 2, Introduction: The Physics of Business, by Edward G. Engh

Here you will learn how critical thinking is the basis of science, but also the basis of all disciplines which apply science, such as engineering and business. Business uses critical thinking to increase profits, but that is not the only application. It is also used to improve quality, safety and even employee moral. You will read about the opposition to critical thinking, specifically dogmatism, as well as how critical thinking can be lost or forgotten, as happened in the dark ages. You will read about how critical thinking increases the value of a degree in business.

THINGS TO PONDER: Think about the following questions while completing this reading. Similar or related questions may be included in the module assignment, discussion, and quiz.

- What is the difference between a science and a non-science?
- How can someone reduce confusion?
- Why is education considered humanity's greatest tool?
- How can truth be misused?
- What would cause a whole society to lose critical thinking?
- How can we minimize things that complicate discussions?
- What role does business play in building civilization?
- How is value calculated in Business?
- How do disciplines (such as Business) rise and fall and evolve?
- What is the value of a Business Degree?

Reading Vocabulary Terms and Definitions

In order to improve your comprehension of this reading, study the following words and their definitions. You will be responsible for knowing these words as part of the module quiz. Deeper explanations are available in the GLOSSARY---> Link

- **Vocabulary Word** **Definition**
- Accuracy Close to Nature's truth. "Trueness". Not the same things as Precision.
- Asceticism Religious attitude toward modern economics that says to flee or run away from it.
- Axiom 4-7 Something true because it is agreed-upon, accepted for the sake of communication
- Capital Value of a means of production, not wanted for itself but for its ability to help in produce
- Compound Interest Financial value of an investment Formula: $v = P (1 + r/n)nt$
- Dark Age thinking Unscientific thinking: that is far behind the times 2 thousand years old, obsolete,
- Delusion Something not real but accepted as real.
- Dogma 4-7 unquestionable according to authority but not critical thinking
- Error analysis Statistical process of identifying all sources of error and minimizing their impact

- Hypothesis A question that has not yet been answered by science.
- Illusion Something not real, but which one wishes was real.
- Kinetic energy Energy value of motion: the work needed to accelerate a body Formula: ke = ½[m(v2)]
- Pietism whatever is real must be part of the divine plan, or it would not exist, so embrace it.
- Precision Reproducibility of a measurement system
- Predictability goal of all science is to predict an outcome before it happens.
- Provincialism Thinking unique to a state or province that is behind the times, not current, obsolete,
- Quietism ignore any contradictions between faith and the requirements of one's job or profession
- Renunciationism renounce it because it is evil, destroy it if that is not possible,
- Theory Something that has been tested by science and found to be true.
- Total energy Absolute limit of energy (motion) from any quantity of matter. Formula: E=m(c2).
- Wealth Psychological value of a possession. Sum of all possessions.

Page: Module 1 Reading 2: The Physics of Business, by Edward G. Engh

PHOTO CAPTION: Professor Engh in 1993 when he was Assistant Vice President of Research and Development of Hercules Aerospace Corporation.

"Critical thinking is top-of-the-list when business executives go shopping for new employees,

especially if they hope to train and groom them for executive management positions." - Edward G. Engh

What is a Science?

Physics is a science. Mathematics is a science. What about Business, Engineering, Economics, Politics or Sociology, are they sciences too? Academics and scholars make a distinction, and it is useful. Physics and Math are sciences, but business and engineering are applications of science: they use the laws discovered elsewhere for their own reasons. Sometimes there is a danger in using an application without remembering the source. Without keeping the source of an idea in one's mind it is easy to make false associations. Every law of nature or theory of science comes with consequences; and these are not always taught. Or if they are taught, they are too easily forgotten. Too often the student is left completely on their own to connect a formula with a consequence. This sometimes causes us to misapply things. For example, shown below is the formula for kinetic energy:

$$ke = \frac{1}{2}[m(v2)]$$

Where: ke = kinetic energy, m = mass, and v = velocity

This is a species of formula (in the mathematical sense) using algebra, like the formula financiers use for compound interest: shown below.

$$v = P\ (1 + r/n)nt$$

Where: v = value, P= the principle (or beginning amount or initial investment), r = rate of interest, n = periods of times compounding occurs per period of time, t = number of years invested)

Kinetic energy is real, it exists in the Universe, it can be measured, quantified, maximized, minimized, etc. Does this also mean that financial abstractions are real? Yes, but not in the same sense. Value exists in the mind, whereas energy (like entropy) exist in the Universe. This may seem like a subtle distinction: it is like comparing love to gravity, one exists in the mind, the other everywhere. Nevertheless it is very common to find people who treat the 'laws' of Finance (banking and mortgages) as if they were laws of nature! They are not! They work, but only if one makes certain assumptions which are difficult to define scientifically. If one treats compound interest as if it were founded on physics there is great risk. If a nation makes important decisions on this kind of assumption, no one should be surprised if the results are not what was hoped for: collapsed economies, bankrupt companies, laid-off workers, defunct households. As with Politics and political science, Economics is scientific, but it is not a science, even if it uses the tools of calculus. It will remain a non-science until it adopts a fundamental theorem founded on empirical evidence, using the scientific method of hypothesis testing, in order to become a predictive tool.[1] Every discipline suffers from this disconnection of consequence.

What is Not a Science?

Kinetic energy is real, but Wealth is purely in man's head, it is not equivalent to kinetic energy. Too often this is painfully made clear when the books of a business are opened in court, revealing that the capital (or wealth) was purely imaginary! Hindsight is always perfect 20/20 vision. Why do not we see these things in advance? How many times must we see many investors accept a purely abstract accounting of their capital? Seeing a mathematical formula often implies a mathematical law of absolute predictability. Kinetic energy can be predicted. As Einstein later demonstrated kinetic energy can even be magnified exponentially until one derives the famous formula for total energy possible E=m(c2). Physicists know that perpetual motion is not possible and that energy is not infinite, but investors treat capital as if it were perpetual and infinite. Investors assume that their interest and capital are just as real as the laws of physics. They are not! These errors may lead to war, recession, depression, and even to damaged ecosystems. Value may be infinite in the mind, but the supply of fossil fuel in the ground in finite. Building an economy on the assumption of infinite value sounds wonderful. Who would argue against it? If it rests on the assumption that fossil fuels are infinite there is some danger ahead. Of course the danger may be ignored (or even denied) for a time.

Falseness is Good

In the minds of humans, Finance and Economics may strive for equality with Physics and Mathematics; but these useful, clever and imaginative laws are not equivalent to those of science.[2] What constitutes a science? Testable hypotheses, **Predictable** results, **Precision**, **Accuracy, Error Analysis**: these are the hallmarks of a Science. Even so, science is always improving old theories. Whenever an idea needs to be tested to see if it is true, it is formulated as a hypothesis. If something is a question we call it a **hypothesis**. If the question has been answered, and repeated, then we say it is a **theory**. This is important because many people use these words incorrectly, saying something is " . . merely a theory." If something is true, such as gravity, then we call it "the theory of gravity." If something is still a question it is appropriate to refer to it as a hypothesis. Using these words correctly will go a long way toward reducing errors in communications between people. After a hypothesis is formulated, a desired confidence level is assigned as a goal. Then the test is designed in such a way that there is as little doubt as possible about the results of the test. After the test is completed, the hypothesis must be rejected or not rejected, those are the only possible outcomes. You may be pleased to know that most scientists, when formulating their hypotheses word it as follows: "Ho: assume my hypothesis is probably wrong. . . " That method of writing a hypothesis is called the "scientific null hypothesis". Another principle of science is this: no theory is perfect.[3] In science, we assume that human knowledge is imperfect, but imperfect knowledge is far better than total ignorance. Every time a law of Physics is defined, it is inevitably shown to be in error by some factor. For example, it was once thought that Newton's laws of mechanical motion also implied that the universe was completely predictable upon those laws. This led to the hope that subatomic mechanics would also work identically, predictably, and that atoms were just little machines that work with perfect predictability. Every electron would then move in a **precise**, **predictable** orbit around every nucleus. All this was proven to be false. Electrons are not completely predictable; in fact, this is a proof of the now widely accepted Uncertainty Principle. The Uncertainty Principle is taken for granted by every science except those related to economics, such as business management. Why would a mathematician have the same faith in the value of his investments as he applies to sub-atomic particle predictions? He does not! It is

shown here that he should not have any such faith. Some of the formulas used by scientists include values that are called ‘imaginary’ numbers. This is not the same kind of imagination necessary to believe in the value of an investment. In fact, they are completely different. If the average investor knew of, or applied the uncertainty principle he would discount any promise of interest or value by as much as ninety-nine percent.

Why People Confuse Things

There are reasons for the confusion in people’s minds. One reason has already been mentioned, that most people imply a scientific basis to anything which is calculated from a formula. The other reasons are more fundamental; and require some historical background to understand, and then some awareness of the principles of Philosophy, and logic, and a little psychology. The initial world of each person is based completely on perception. We perceive things before birth inside the womb, though these are not recalled as memories afterward. Once we are born, we begin to store information and process it. Our perception is through five senses, seeing, hearing, touching, tasting and smelling. All information from these senses pass to the brain. Disconnect a sense from the brain and that sense is gone.[4] Reality is quite different. It exists whether we are aware of it or not, whether we perceive it or not.[5] Most infants perceive early on that those orbs suspended above them contain food; and they are not aware of the monster lurking under the bed. They experience firsthand perception of the one, and no evidence of the other. They will never perceive a monster, but they will hear of such things from others whom they are taught to place in authority, and they will trust them. There are no monsters. What we think we know is not always true. More important, there are things real, of which we have no perception. Other things are true even though we are ignorant of them. Below is Figure 1 which you saw in Reading one of this module, in the part concerning asymmetry. It is repeated here to give you the opportunity of refreshing your mind. Notice that everything humans perceive happen in the mind, whereas the things perceived are outside the mind, and there are two ways we can get things wrong.

Quandary of Reality

This leaves us in a quandary. Everyone would like to know the future. We want to know what is going to happen. We think about it all the time. Unfortunately, until the future becomes the past it is not real. We imagine things we want to happen, but will they happen? How can I be sure that I perceive things real? How can I prevent myself from misperceiving things which are not real? A man named Epicurus pondered these questions 23 centuries ago; in Athens, Greece, at that time a great center of learning.[6] Epicurus saw that most people believed things that defy logic. Why should people worry about an afterlife, or beings of awesome power? He realized it would do no good to tell them they believed in *monsters-under-the-bed*, forms of **illusions** or even **delusions**. He chose instead to explore and write about the way people think; and he sought to perfect it. Venn Diagram 1 below shows the universe according to his early science. It requires some nerve to look at it carefully, and ask all the necessary questions.

Do I accept things that are not real? Are there real things, which I know nothing about? Could there be things harmful to me lurking out there? Some look at this situation and conclude that man is unable, or not meant to know some things. Others look at this and decide to improve their perceptions. Science (or critical thinking) follows the latter method, doing all possible to minimize the possibility of misperception. This is an appropriate place to bring up misperception as it applies to the game of business. As a business owner I may use deception to increase my profits, by causing misperception in consumer's minds or in the mind of the competition: but I never want to confuse myself. Never. This is the reason business has always had an unsavory reputation in most cultures throughout history, especially in societies that have very high moral standards derived from their religion. In pagan times when there were many gods, many cultures had a god of business, and he was always a trickster a gambler, a deceiver, even a lier: such as Hermes for the ancient Greeks and Mercury for the ancient Romans. Oh these cultures thought lying was uncivilized and any honest man should never lie. For this same reason they thought that business was for the uncivilized classes in society. Aristocrats would not conduct business, it was beneath them. They would let the freedmen or slaves do that, and let the slaves suffer any consequences in the next life. That is how they accommodated the moral conflict created by trying to make a huge profit and trying to keep one's soul pure and untarnished. In the twenty-first century we do not have the same means of moral accommodation. This makes it a difficult game to maximize modern profits and also maximize one's righteousness, especially if one must deceive others to maximize profits. Modern religious society has reacted four ways to this pressure. See Figure 2 below.

Education May be the Best Tool of All

Tools are necessary to expand our ability to sense things. Man seems to have pursued tool making from ancient times. In fact we now define a culture by the tools it makes. Tools range from the first, most primitive machines; the plain, the lever, the pulley, the wheel, and the axle, to roads, cities, trade and warfare. A great tool is one, which systematically tests new tools; this is Science. Another great tool is one, which designs better tools, this is Engineering. Finally, there are tools, which efficiently build other tools for use; this is Manufacturing or Industry. In spite of all these advances toward improved reality man is plagued by two problems; ignorance and attitudes, which linger for thousands of years, effectively retarding human progress. One cure for this is another tool, Education. Improved Education seeks to make all men reasonable; that is, it tries to guide all people to improve their perceptions of reality. This way humankind may be free from some of the effects of disease, early death, starvation or pain. Ignorance is treated with healthy doses of Education. How do we cure the plague of human attitudes, which

hold millions of people hostage? Throughout history people are led to build up massive cultural efforts as monuments, but many times in retrospect, these efforts seem to be founded on bad thinking. Sometimes they depart from common sense and wage war against neighboring countries. It makes me sad knowing man is capable of such bitter attitudes as to destroy one's own people. Nevertheless, these attitudes come in many forms from genocide, to ethnic repression, racism, and complexes of gender superiority. Solving the problem of human attitudes is difficult but not impossible. Again, it starts with education. This means fundamental education of millions. Yet, it is very difficult to predict when a single ignorant man or woman will rise to persuade millions to pursue a destructive course. How many times must humanity suffer when just a few lunatics cleverly rise through the ranks of tolerance and democracy only to reveal their true colors after they are already firmly seated in power, which seemingly no one can defeat?[7]

Anything Can be Misused

Reality can be misused by anyone, but the misuse often begins with malicious or selfish people. Anyone who uses the facts to mislead is a difficult opponent, especially if they are supported by a population who are generally poorly educated. Widespread ignorance facilitates abuse by others, making it more likely for abusive people to rise to great influence. Even the most well-meaning nations find they are bankrupt at some point in their history. By 'bankrupt', we mean a whole range of disasters.[8] For example: the ancient Romans believed the worst thing a people could do was to fight an unjust war. For this reason they set up a democratic system of government, because they did not trust such decisions to kings or autocrats. The Republican mind of ancient Rome believed one should never put someone in power who cannot also be removed from power. Roman ideas of Justice made them very careful about putting people in charge, made them cautious when electing someone to lead. Many times this belief kept them out of trouble. However, the Romans were not immune to corruption or misuse of power. Over a long period of successful wars this lead to national arrogance and pride. Arrogance and pride have a long history of handicapping a society's ability to use critical thinking. After a thousand years of hard work and good luck, the Roman-mind eventually fell, not to overwhelming odds against invaders; but to rising fear of science-and-the-natural-world [10] carried into the Empire by well-meaning people of a new faith. Perhaps it is better to call it "The Fall of Critical Thinking" rather than the "Fall of Rome". [You will learn more about this in the second part of Module two.]

Fall of Critical Thinking (But Only for a Time)

The time after the fall of Rome is called the dark ages, primarily because it was a period of intellectual-intolerance. People prospered under a thousand years of Roman law, and they benefited from the freedom to mingle and assemble in private intellectual conversation: but when things fell the people began to believe that this life was evil. They were taught to moderate the evidence of their own senses. This life did not matter because this life is not the one that matters: This life is a deception, put forward to tempt mankind into thinking the physical Universe mattered, it does not matter because the only life that matters is the next one. This kind of thinking was quite foreign to Romans. It had a strange effect: it led them to believe that civilization-building the old way was unnecessary. Instead of using debate and consensus, instead of using the evidence of one's senses, unquestioned belief swept away discussion and

new systems of loyalty quickly rose. As a side effect the libraries were burned, the colleges and academies destroyed, and the philosophers and teachers put to death, and progress halted. The fall of critical thinking had other, more practical effects. Western civilization soon forgot how to make concrete and cement. Metallurgy and mining collapsed. Medicine became a lost art. They forgot how to navigate ships across the seas. The world became flat in people's minds, even though the ancient Greeks and Romans knew it was round. The maps vanished with the books. The world of the mind suddenly became very small, dark, and superstitious. None of this was to be questioned.

Complications for Critical Thinking

This makes it difficult to have a discussion. What is modern humanity supposed to do? Twenty-first century earth is a post-industrial, global society, but with tradition, superstition and authority from a pre-industrial time. To get people to accept things without question: to put things beyond rational testing, modern systems of authority employ a very old strategy. They make uncritical thinking socially acceptable, and then a social requirement. They teach uncritical thinking while they are young and impressionable, and make the belief system a precondition to sex. They create a sense of pride and then appeal to it. Modern examples of authoritative societies from around the world work this way: controlling the system of education and the system of marriage. In many places where society is not controlled by an authority-system this is not so, and people are not afraid of critical-thinking. In societies where people are opposed to critical-thinking, there are controls on education and marriage rights. What example is more obvious than I.S.I.S. or Islamic State? All of these problems face the typical modern, multinational corporation, trying to do business all over the world. If a modern multinational corporation collapses due to bankruptcy, it can cause many thousands of people to lose their jobs, to lose their life savings, it can destroy whole economies. Thus if modern businesses make poor decisions, the hazards are very high. The need for critical thinking is very high. However, presently many aspects of business are political, and therefore outside of science, and unpredictable.[9] Nevertheless, things are improving all the time.

Societies Rise and Fall

In reality, civilization building is necessary. Business is civilization building, and civilization is business building. Things must get done. Society must profit. Without it things begin to crumble back into the dust. This principle has a name in Physics: it is called the law of Entropy, or the Second Law of Thermodynamics. We either build up order in the form of Civilization, or we succumb to the laws of nature and decay. Some people, not a majority, do not want to understand how nature works. They also do not want others to discover how the Universe works. Luckily this is a minority. Some even prevent their children from getting a good education. Fortunately you are here to get an education and will not be denied it. There is great risk that while humanity is preoccupied by an unnatural struggle against understanding Nature, the dangers of nature herself may be ignored or obscured. Climate change may be an example. How strange that fossil fuels, which made the modern industrial revolution possible, should turn out to be a danger and a threat to our prosperity and survival? How odd that we would use fossil fuels so vigorously that the generation that discovered them might also live to see them run out. To profit in the business of life we probably ought to use our best thinking. That is what we teach. How you use it is a choice, something you determine by your own free will.

How "Value" is Calculated in Business

Consider this: what is the value of a big pay check if one loses your family to get it? What is the value of a profitable business if the profits are achieved by underpaying those doing the hard work? What is the value of a cheap product if the manufacturer harms the environment and nowhere includes environmental degradation in the cost/profitability analysis? What is the value of anything in business if the accounting formula does not account for these True costs? What is the value of any "asset" if the measure of "value" is unscientific? If "value" cannot be measured scientifically the other means of measurement is to use emotion or rhetoric. When we look at how "value" is defined in contemporary society, it is so vague, so confusing, that we must conclude that the definition depends on the situation, whatever that means---a meaningless answer. Why does it matter? Answer: it matters because a discipline (or profession) that cannot demonstrate results needs to be discarded as an obsolete tool. Science has always done this. Someday we will have better tools to describe what happens in business and economics. Some of those tools are being developed right now. Some of you may choose to study business as a science and become one of the pioneers of Business Analytics. Meanwhile, those who value their conscience should distance themselves from business situations where profits put too much pressure on ethics and morals. High profits are valuable, but not at the cost of one's respect and conscience.

Disciplines Rise, Disciplines Fall

Once upon a time there was a theory of energy called "The Phlogistonic Theory," in which they thought that energy was a substance, and that when the substance ran out the engine would stop running. In spite of a complete lack of evidence this theory was upheld for over a century, and was used to make decisions (all with bad results). The Phlogiston theory was even used to make arguments in treaties affecting world peace and in legislatures: all for nothing. Academic disciplines such as politics and business (or economics) have always had trouble demonstrating scientifically credible results. This was embarrassing to them, so they began to defend themselves by trying to make a distinction: they tried to divide science into two classes of science: the hard sciences and the "soft" ones. Hard science meant the real ones like physics, chemistry, mathematics, biochemistry, genetics, which were scientific only because the fundamental theory had been tested over and over again, and no one had yet been able to produce statistically significant results to cause us to question it, it worked every time. Soft science meant things like politics, which even went so far as to call itself "political science", as if the rules of scientific evidence were somehow different. Of course this was all nonsense. A science is either scientific or not. If a discipline cannot be used to make a prediction, and then see that prediction verified in measurable results, it is not scientific.

Disciplines Evolve

Occasionally the academic world does some house cleaning, just like nature does, and it is usually loud and angry: whole disciplines are thrown out, they are no longer taught in accredited schools, colleges and universities. Phlogistonic Energy Theory is an example. This gives us hope rather than concern, because all science must be self-critical, self-correcting, able to abandon ideas that cannot pass the test of evidence. Science is founded on critical thinking which avoids all Type One errors: recall that a Type One error is rejecting something that is true. Science also

avoids all Type Two errors which occur when you believe something that you should not believe, because it is false.

Value of a Business Degree

If Business students are interested in making a lot of money, it might seem strange that they would avoid the highest paying disciplines and professions when they actually go to college or university. Through years of research we know many college students choose to study business not because they know what they really want to do, or can explain their interest in business, but because they are mortally afraid of science and math. Aversion-to-science, not love of business is their motive to avoid many of the highest paying professions. Why do students shun math and science? Many grow up in an environment hostile to science and critical thinking, and this makes it hard to develop scientific attitudes and interests. This might explain why people avoid certain things, but does it explain why they would drift toward a certain discipline, such as business? Perhaps they are thinking: "of all the professions that do not require science and math, business is the highest paying." Unfortunately this is poor reason to choose a profession that will impact one's career for a lifetime. Fear is not a motivator in long term career planning, it is an inhibitor, something that holds you back, it blocks pathways. Curiosity is a motivator in long term career planning, with sufficient curiosity one can break through all kinds of barriers. Business is evolving, becoming more reliant on scientific methods all the time, especially large enterprises relying on statistical quality control, logistics, supply chain management, and information systems. Fear of science can inhibit anyone going into these fields, but curiosity can motivate one to value science and critical thinking in business. Apparently many students have grown up with the idea that business is not very mathematical, and that critical thinking and science are not part of the course of study to become a professional business person. The reality is quite the opposite: business uses critical thinking, mathematics, statistics, calculus, psychology, history, even biology. In fact critical thinking is top of the list when business executives go shopping for new employees, especially if they hope to train and groom them for executive management positions.

Notes and Bibliography:

[1] Game Theory, discovered by Dr. John Nash, et al, has opened the path to what may become a new science. Game Theory combined with a new branch of modern Biology may lead to the development of a predictive science of economy. It will have little or no resemblance to the old schools of Social Economics or Political Economy. Someday, those schools will seem as useful as alchemy is today, interesting, humorous in a tragic sense, until one remembers how many generations have suffered under the ignorance so often put forward as truth. As humanity progresses and discovers new things, old ideas often seen naive, but this is the nature of progress.

[2] Nations wage war over the firm belief in the so-called value of things: setting more value on capital than anything else, yet capital is not scientific. Unless there is a scientific justification for something, it is very hard to come up with a reason to support it.

[3] In science, something that is true is called a theory. Theory = truth. A question is called a hypothesis. Students must not use the word 'theory' in such a way as to imply the subject is not true. Speaking that way causes confusion. Nothing becomes a theory in science until it has been tested, again and again. If a student wants to refer to something untrue, or untested, they should use the word "hypothesis".

[4] The range of our senses seems to be infinite until we begin to understand the world of science. Science displays a cosmos far beyond our ordinary senses, but well within our perception; if we use a tool to extend the power of our senses. Microscopes permit us to see the very small, telescopes the very far, distant or weak.

[5] The purpose here is not to be trapped in pointless rhetoric or worse, dialectics. Defenders of so-called soft sciences often cling to rhetoric and dialectic to suggest that all science suffers under the handicap of their own discipline. This is not true.

[6] The Encyclopedia of World History, Sixth Edition, Peter N. Stearns, General Editor, see under Epicurus.

[7] See Adolph Hitler, in The Encyclopedia of World History, Sixth Edition, Peter N. Stearns, General Editor.

[8] Disaster comes from an ancient word for 'contradiction', Dis; and the ancient word for 'star', Aster. In other words, star-crossed. Stars were believed to have influence in the affairs of humankind, because they might just be gods of some kind. Therefore, when two stars crossed each other it can only mean one of two things they are in love, or in conflict. Today a disaster is comparable to a type two error, thinking something is true when it is not true at all. "Someone will save us!" may be the sentiment of millions, but reality may be there is no one to save us but ourselves.

[9] At the present time, Political Science is anything but a predictive science, and therefore of very limited use. There is hope on the horizon. A new science is budding inside the science of Biology, called the Science of Social Organisms. This is very exciting. Humans are not the only species to survive by working together in communities, there are many. Scientific study of these phenomena is leading to incredible discoveries that some of these issues are determined genetically, others are determined cognitively, and yet others by the collective consciousness of the society. This new science will likely displace the old political science. The old political science is already a subset of history, Political History rather than a science. The new discipline will probably be of great use in managing the roll of humans in wider biosphere. Something similar is happening in other areas: Psychology and Psychiatry are being replaced by Neuroscience. What a fascinating world we live in?!

[10] Gibbons, Edward, "Decline and Fall of the Roman Empire," Vol 1, published in 1776 CE.

HOMEWORK

- **PART** A: Ten Vocabulary words. As you read the text above select 10 vocabulary words (minimum). You select the words new to you, or words used in a way new to you. List each word and then a definition that fits the usage of the word. Look up the definition in an academic dictionary (such as *Oxford* or *Miriam Webster's New Collegiate*, but not Google.) Then write the definition IN YOUR OWN WORDS. Select as many vocabulary words as needed to fill up the requirement of 10.
- **PART B:** Answer the following questions. Follow the same procedure you used in Reading 1 "Critical Thinking". Do NOT retype the question.

1. Explain the danger of confusing a formula for a law of science.
2. Explain why laws of science are self correcting. How does this benefit us?
3. Explain why laws based on dogma and axiom are not self correcting.
4. Explain the danger of unchanging laws based on dogma and axiom.
5. Describe how ignorance and human attitudes retard human progress.
6. Outline how education is a tool to cure human errors.
7. Explain how barbarian invaders did not cause the fall of Rome, and something else did. What caused it?
8. How did the dark ages, from the fall of Rome get started? How could everyone forget things?
9. Has modern society fully recovered from the dark ages?
10. At the end of this question is a link to the *Chronology* folder. PLEASE DO NOT OPEN THE LINK IN THIS WINDOW. OPEN IT IN A NEW WINDOW SO THAT YOU

CAN USE THE GLOSSARY TOOL OVER THERE AND INPUT YOUR ANSWERS HERE. It also appears on the Course Homepage under Tools. HOVER over the link, RIGHT CLICK, select OPEN IN A NEW WINDOW. Then in the new window type CONTROL F, a word-search box appears. Type "energy" in the box, use the arrows to search up and down for entries about **energy**. Read them. They are very brief. Come back to this assignment and Explain where energy comes from, how old it is, and how it got to be in a material form on Earth. Link

11. Explain the roll of energy in the Industrial Revolution (where factories replace human labor with machine labor and machines require some form of energy).
12. Speculate on the difference and/or differences between e*nergy* and *economic-value*.
13. Explain why people get confused by formulas: such as those for Kinetic Energy and for Capital.
14. Explain at least two examples of dark age thinking in our time? NOTE: In answering this question, many students jump to North Korea as an answer. It is always better to look INWARD at your own community--your own state, not outward whenever answering questions like this. Is there a difference between the "dark ages" of North Korea and that "dark age thinking" of Utahns? The scientific term for this phenomena is *provincialism*. Try to answer this question by using examples around you. Who around you uses Dark Age thinking?