Critical Thinking Review

(wk3) Cognitive Skill of the Week: *Analysis*

- *Analysis* is the examination of a system (or complex), its components (or ingredients), and the linkages among these components. One example of this skill is employing the unique perspective provided by satellite imagery to analyze the Earth-atmosphere system and the properties of its large-scale components (e.g., cloud cover, ocean surface, snow and ice cover).

Affective Attribute of the Week: *Systematic*

- A *systematic* learner approaches a question or challenge in a methodical manner, following a plan of inquiry that stems from scientific understanding. Understanding the capabilities and limitations of satellite imagery, a student systematically draws (infers) information about the state of the atmosphere from visible and infrared satellite images.

Examples: Cloud Height Testing, Written Language

(wk 4) Cognitive Skill of the Week: *Explanation*

- *Explanation* is a logical statement of understanding regarding the reason(s) for or cause(s) of something. As a result of the week's investigations, you should be able to provide a logical explanation of the relationship between atmospheric circulation and cold and warm air advection.

Affective Attribute of the Week: *Reasoning with confidence*

- A learner *reasons with confidence* when he or she reaches a conclusion that follows from a logical path of inquiry that is guided by scientific understanding. In doing the Examine homework assignments from the text, you have / will develop the confidence to use scientific evidence to form conclusions on such issues as global warming.

Examples: Factors governing temperature, the fate of the Vikings and the Inuits

(Wk 5) Cognitive Skill of the Week: *Testing models*

A front is a conceptual model that is represented graphically on a surface weather map. As is the case with all scientific models, a front approximates the transition zone between air masses that differ in temperature and or humidity. Those of you who are taking the lab component of this course analyzed actual weather data showing the changing atmospheric conditions at our location before, during, and after the passage of a cold front and a warm front. You had an opportunity to compare the types of atmospheric changes (e.g., temperature, wind) that theoretically take place with the passage of these fronts versus what actually happens during a real frontal passage.

Affective Attribute of the Week: *Objective*

An objective learner acts and interprets information independently of personal feelings, opinions, or bias. In this week's investigation, you are asked to be objective in comparing what you understand about fronts and frontal passages with atmospheric changes recorded during an actual frontal passage.

Examples: Lab exercise on frontal passage, Climate classification vs. experience, Crop Freezing Strategies

(wk 6) Cognitive Skill of the Week: *Formulating Significant Questions*

- Formulation of significant questions is key to defining a specific path of inquiry that will ultimately arrive at a scientifically sound solution to a problem. In the Sky Journal take home lab, you will work from your own experiences in observing the sky. You know that the sky is sometimes completely or partially cloud-covered or completely clear. You may have observed sunsets or the phases of the moon. These observations beg the fundamental questions: What causes these things to happen? Over the course of Earth Science, you will develop the basic scientific knowledge to answer these questions

Affective Attribute of the Week: *Perseverance*

- Perseverance is the habit of continuing an effort in spite of obstacles or difficulties encountered along the way. One example of this is the following: a critical thinker exercises perseverance in seeking an answer to the question: Why does the moon go through phases? In order to answer this fundamental question, you must persevere in answering a sequence of many other questions including, for example: Why does the moon go around the earth? How does the changing perspective/geometry of our view of the moon change the shape of the illuminated surface? How is the moon's position related to our ability to see it?

(wk 7) Cognitive Skill of the Week: *Transfer insights into new contexts*

A critical thinker develops the ability to transfer new insights into new contexts. That is, he or she perceives the inner nature or workings of some system and then applies that understanding to a new situation. In class, we will touch upon some of the scientific principles underlying satellite remote sensing of the oceans with the capabilities and limitations of this important surveillance tool. We then apply this knowledge to the evolution of El Niño.

Affective Attribute of the Week: *Reasoning with confidence*

Reasoning with confidence means that the student thinks logically with self-assurance. When one understands how something works, whether it is weather radar or satellite images of El Niño, one's confidence stems from understanding of how these devices work, to include capabilities and limitations. One can then use this knowledge to interpret a piece of data and surmise some of the conditions that are evolving as a consequence of El Niño.

Critical Thinking Topic: Analysis and Systematic

Cognitive Skill of the Week: Analysis

- Analysis is the examination of a system (or complex), its components (or ingredients), and the linkages among these components. As part of this week's investigations, the learner employs the unique perspective provided by satellite imagery to analyze the Earth-atmosphere system and the properties of its large-scale components (e.g., cloud cover, ocean surface, snow and ice cover).

Affective Attribute of the Week: Systematic

- A systematic learner approaches a question or challenge in a methodical manner, following a plan of inquiry that stems from scientific understanding. Understanding the capabilities and limitations of satellite imagery, a student systematically draws (infers) information about the state of the atmosphere from visible and infrared satellite images.

Critical Thinking Topic: Interpretation & Truth Seeking

Cognitive Skill: Interpretation

An example is the interpretation of satellite imagery to learn more about the structure of thunderstorm cell clusters and their possible relationship to the synoptic-scale circulation pattern. Through interpretation, one expresses the meaning or significance of situations, data, or experiences.

Affective Attribute: Truth-seeking

In this week's investigations, the student seeks to acquire a scientifically sound understanding of the properties of thunderstorms and tornadoes. In this quest for truth, the student must be cognizant of the capabilities and limitations of weather observation tools (e.g., satellite or radar imagery).

Critical Thinking Topic: Evaluating Theories & Open-mindedness

Cognitive Skill: Evaluating theories

The circulation, track, and weather associated with extratropical cyclones are incorporated in the Norwegian cyclone model. As with all scientific models, the Norwegian cyclone model is an approximation of real conditions. The student evaluates this model and tests the theory of the middle latitude cyclone (upon which the model is based) by analyzing actual storms plotted on weather maps.

Affective Attribute: Open-minded

In order to arrive at truth and understanding, the scientific method must be applied with an objectivity that is unfettered by personal bias or preconceived notions. In analyzing the extratropical cyclone, students must be open-minded when comparing theory to actual cases.

Critical Thinking Topic: Explanation & Truth Seeking

Cognitive Skill: Explanation

An explanation is a logically structured statement of the reasons for or causes of some phenomenon that is not immediately obvious or initially understood.

Affective Attribute: Truth seeking

In this week's investigations, the student embarks on a logical scientific course of inquiry in seeking truth and understanding. Student inquiry includes analysis of changes in atmospheric and oceanic conditions across the Tropical Pacific leading to an explanation of El Niño.

Critical Thinking Topic: New Contexts and Insight

Cognitive Skill: Transfer Insights to New Contexts

In this week's investigations, the student learns how Earth's rotation affects the large-scale circulation of the atmosphere, that is, the Coriolis effect. In the process, the student develops some basic understandings regarding frames of reference. The student then applies this understanding (insight) in interpreting wind patterns as plotted on a weather chart.

Affective Attribute: Insightful

In this week's investigations, the student acquires valuable insight on the forces that govern the movement of air relative to the familiar north-south, east-west frame of reference. They understand that these forces combine to initiate and govern the motion of air.

Critical Thinking Topic: Developing Criteria for Evaluation & Being Judicious

Cognitive Skill of the Week: Developing Criteria for Evaluation

A major feature of this week's tropical cyclone investigations engages the student in evaluating the potential impacts of a land falling hurricane. The type and extent of impact depend to a great degree on the specific track taken by a hurricane as it approaches the coast. Through these investigations, the student is able to develop criteria (conditions) that are most favorable for a specific impact. For example, the likelihood of a storm surge is greatest in low-lying coastal plains on the side of an approaching hurricane where winds are directed onshore.

Affective Attribute of the Week: Judicious

Forecasters issue hurricane watches and warnings for portions of the coastline based on anticipated storm track. But as demonstrated in this week's investigations, hurricane tracks can be very erratic and abrupt changes in hurricane direction and intensity are not unusual. Hence, forecasters must apply a combination of solid science with good judgment (based on prior experience with similar land falling hurricanes) in specifying the portion of the coast for which hurricane watches and warnings are issued. In addition to meteorological and physical factors, they must consider societal factors such as efficiency of the local road network, time of day, and nature of the local economy. This scientific/judicious approach requires forecasters to over-warn the public; that is, hurricane watches and warnings are issued for a stretch of coastline that is much longer than the width of an approaching hurricane.