TOP TEN THINGS TO KNOW FOR TEST #2 – Fall 2015

Test Date: Wednesday Oct 7th *Test #2 will consist **of 10 multiple choice questions.** As in Test #1, some questions will be slight variations of the Self Test or RQ questions, but other questions will be a bit harder than those in the RQ's and they will cover the material in class presentations and the group assignments, in addition to the reading you've been doing for the RQ's.*

The preceptors and TAs for our class will be holding a **Test #2 Study Session** on **Monday Oct 5th** from **3:30 -4:45** pm **in the BANNISTER TREE-RING BUILDING**, Room 110

IMPORTANT: If you plan to attend the Study Session on Monday, you **need to prepare in advance** by going through the "TOP TEN" Study Guide. Come to the session with QUESTIONS about things you don't understand!! Also, **be sure to bring your Class Notes and a copy of the Test #2 "Top Ten" Study Guide with you!**

TOPICS COVERED ON THE TEST:

Topic #5 (Radiation Law 6), Topic #6 Atmospheric Structure and Composition , and Topic #7 Laws of Thermodynamics & Motion. –Study the presentations and the corresponding material in CLASS NOTES. If you missed any classes, see the class follow-up that is posted in D2L and is also linked on the main GC 170A class webpage.

ASSIGNMENTS: G-1 Group Activity on Understanding Absorption Curves *(p 26-28 in Class Notes)*
G-2 Energy Efficiency you should be able to recognize, interpret, and answer questions on SIMPLE Energy Flow Diagrams, like the diagrams of different types of lightbulbs

SELF TESTS & READINESS QUIZZES: All the questions (and the feedback for both right and wrong answers) in the Self Tests and Readiness Quizzes: **ST/ RQ-3 on Atmospheric Structure and Composition, ST/ RQ-4 on Thermodynamics.** You should also **go back and review ST/RQ-2 on the Electromagnetic Spectrum because it covered many of the Radiation Laws** – which will be tested in Test #2.

TEXTBOOK READING: In **SGC-E-Text review Chapter 3** (pp 34 -49) and all the readings on Thermodynamics: **Appendix D: Second Lawof Thermodynamics** plus the **additional reading material** in thr **Online Reading List** (linked in the Checklist and Self Test for RQ-4)**.**

CLASS NOTES / TOPICS: All the reading and notes relating to the following topics:
-- Topic #5 - Part II The Radiation Laws -- Laws #6 (Selective Absorption & Emission) pp 25-29 **in Class notes** (Also review pp 21-25 in Class Notes to refresh your memory on the other laws and the Electromagnetic Spectrum)
-- Topic #6 Atmospheric Structure & Chemical Composition – pp 31-35
-- Topic #7 Thermodynamics and Energy Transformations – pp 36-43

NOTE: There will not be any specific questions about the Equinox and Earth-Sun "Orbital" Relationships. We will be returning to these concepts later in the semester when we cover Topic #10. There will also not be any questions on the Laws of Motion on Test #2 (although they may be addressed in Topic #7 on Oct 5th)

And now, here are . . . THE TOP TEN!

TOPIC #5 THE RADIATION LAWS (Law #6)

1. **Law #6: Selective Emission & Absorption** - be able to state this important Law in simple words and explain what it has to do with wavelengths of energy, the electromagnetic spectrum, and atmospheric gases, and the vertical structure of the atmosphere. Understand why this law is important and what its implications are for how electromagnetic radiation of different wavelengths is transmitted through, or absorbed by, the Earth's atmosphere. *Specific Hints:* Know how to read and interpret an **absorption curve** and how to sketch in hypothetical curves (as on p 26 of Class Notes and Assignment G-1. Also be able to match an absorption curve to the gas it represents (as on p 28 of Class Notes and Assignment G-1). Be able to recognize O_3's absorption curve (curve B on p 28 in Class Notes) and describe what is different about it, when compared to the other greenhouse gases. (*Hint:* one part of the curve involves the **absorption of solar UV radiation** (related to the global change topic of stratospheric ozone depletion) and the other part of the curve involves **absorption of terrestrial IR radiation** (related to the global change topic of the greenhouse effect and global warming).

2**. Atmospheric windows** -- Know what **"atmospheric windows"** are (as seen in the "Absorption Curve for the Whole Atmosphere" on p 28 of Class Notes) *Specific Hint:* Know what the difference is between the UV/Visible Atmospheric Window and the IR Atmospheric Window -- what kind of electromagnetic radiation is being transmitted through each window without being absorbed? What are the effects of these two windows on Earth's overall climate? (*Answer*: one warms the Earth naturally, the other cools the Earth naturally -- Can you explain how?)

3. Solar vs Terrestrial Radiation Class Concepts Self Test (p 29 in Class Notes) -- Be sure you understand the answers to this page. (They were covered given in class on Sept 23rd -- see the posted presentation.) *Specific Hint:* Understand the difference between **solar vs. terrestrial (IR) radiation** and what is going on at each of the numbered circles in the **diagram on the botto**m of p 29. Which numbered circle on the diagram represents GH gases absorbing and re-radiating IR back to the Earth's surface? Which numbered circle on the diagram represents GC gases absorbing and re-radiating IR out to space? Which numbered circle on the diagram represents IR being radiated from the Earth's surface and going right out to space through the "IR atmospheric window"? What process is missing on the diagram? (This was explained in class on Sep 28 in conjunction with the figure on p 32 in Class Notes.)

TOPIC # 6 ATMOSPHERIC STRUCTURE & COMPOSITION

4. Atmospheric Structure-- Know how the atmosphere's **STRUCTURE and TEMPERATURE** vary with altitude, and what the names of the different layers are. *Specific Hint*: what **causes** these variations. (See Fig. 3-9 and 3-11 and pp 46-48 in SGC-E-text. And in Class Notes, see pp 31-35.) Understand what the **figure on p 32 in Class Notes** is illustrating about how solar radiation of different wavelengths gets transferred or absorbed on its way to the Earth's surface. (See the presentation on Sep 28th where this was explained.)

5. The "Greenhouse Warming Signature"-- Know the layer in which the greenhouse gases (GHGs) are most abundant and have their greatest effect. [NOTE: This was covered in class on Sep 28 and is shown in the figure in the middle of p 33 in Class Notes]. The figure contrasts what's going on in the different atmospheric layers to Incoming Solar radiation (UV+ VIS + Near IR) vs. outgoing Terrestrial radiation (IR).] *Specific Hint:* Understand how the outgoing IR that gets absorbed and re-radiated or re-emitted back down to the surface in the troposphere leads to a "Greenhouse Signature" of warming in the Troposphere and cooling in the Stratosphere. Can you explain why a stronger GH Effect in the Troposphere make the Stratosphere colder? Why is it said that "The atmsophere is primarily heated from below?"

6. Atmospheric Composition -- Start out by going through the 4 Key Concepts on p 35 of Class Notes . Know which **GASES** are the *most abundant* in the atmosphere, which are *greenhouse (GH)* gases and which are *non-greenhouse gases* (non-GH gases N, O_2, + Ar comprise 99.96 % / GH gases H_2O & CO_2 are the next most abundant); see Tables 3-2 and 3-3 in SGC-E-Text and p 39 in Class Notes. *Specific Hint:* Know the definition of a GREENHOUSE GAS: "a gas which can absorb and emit infrared (IR) radiation." (synonyms for "emit" = radiate, re-radiate, give off). Know which GH gases are the most abundant. *Bonus Question:* H_2O is a greenhouse gas that is not increasing in the atmosphere directly by fossil-fuel burning and other human activities, but it is increasing indirectly in the atmosphere. How is this happneing?

7. Sources & Trends of Greenhouse Gases -- Know that nearly all of the major GH come from both natural and anthropogenic sources and be familiar with some of the these sources (see p 34 in Class Notes and the "Name That Gas" section of the presentation for class on Sep 28th . *Specific Hints*: Know which GH gases are human-made only. Know whether or not increasing trends have been observed in the concentration of GH gases (as seen in ther GHG graphs that were shown during the Topic #6 presentation -- also at the bottom of p 34 in Class Notes). Do some have GH gases have longer lifetime's than others? (see table on p 34 in Class Notes.) Can you articulate why the "lifetime" of a GH Gas (once it gets into the atmosphere) is an important factor to consider when assessing how climate will change in the future?

TOPIC #7 THERMODYNAMICS & ENERGY TRANSFORMATIONS

8. Specific Heat, & Heat Capacity Know the difference between **thermal energy**, **heat** and **temperature**; understand the concept of **specific heat** and **heat capacity**, and what a calorie is. *Specific Hints:* Do you understand that the **specific heat** of a substance (water vs. air vs. sand) indicates how fast or slowly a given volume of the substance will warm up - and that a substance's **heat capactiy** indicates how long a substance will store heat? Do you know which substance (water, air or sand has the *highest* specific heat and heat capacity? The lowest? How does this affect temperature patterns at the Earth's surface ? Do you see how these same concepts are related to the graphs and two questions in the "Exploring the Evidence . . ." section on the bottom of p 39 in Class Notes? Can you answer the two questions on the bottom of p 39? *(see Class Follow Up for Sep 30th if you can't!)*

9. Heat Transfer -- Know and understand the difference between the 3 modes of heat transfer: **convection, conduction, & radiation** as described in the box on p 39 in Class Notes and in class on Sep 30th. *Specific Hint:* Know in what way -- if at all -- ***matter*** is involved in each one of these forms of heat transfer. Review the Heat Transfer Rap video shown in class -- it communicates all the key info on the 3 ways of heat transfer very succinctly - plus it may help you remember the concepts better (music and songs have a way of doing that)!

10. The Two Laws of Thermodynamics are and Energy Flow Diagrams (to be covered in class on Oct 5th) - Know the 1st Law of Thermodynamics (energy can be transformed from one form to another, but is always conserved). It's the same Law you learned back on p 18 of Class Notes. Know the 2nd Law of Thermodynamics (heat flows from a hot ==> cold object until they reach equilibrium / thermal energy input does work, some energy dissipates as output (exhaust), which leads to a process being less than 100% efficient). *Specific Hints:* Do you understand how to read and interpret **energy flow diagrams** like those on pp 40 -41. Can you explain how an Energy Flow Diagram illustrates aspects of both Laws? Can you reason your way through the Self Check questions Q1-Q3 in the middle of p 41? Could you label the pipes properly in a flow diagram like that on the bottom of p 41? Can you properly label or recognize an energy flow diagram of an incandescent light bulb ?

*To review the Heat Transfer rap video **CLICK HERE** or see CLASS FOLLOW UP for Sep 30th.*