GC 170A1 INTRO TO GLOBAL CHANGE
MIDTERM EXAM STUDY GUIDE
Fall 2013

Looking for the PRACTICE QUESTIONS?
They are now linked at the bottom of the Study Guide.

(NOTE: the link to the **ANSWER KEY** for the Practice Questions are be posted at the very end of the Practice Questions webpage.)

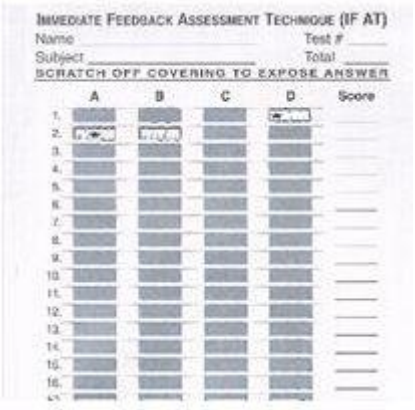
The MIDTERM EXAM is THURSDAY OCT 17th in our classroom

EWS FLASH: The preceptors for our class will be holding a
Midterm Exam Study Session
on **Wednesday Oct 16th** from **4-6 pm**
in the **BANNISTER TREE-RING BUILDING**, Room 110
Click here for directions
[The building will be locked at 5:00 pm, so you must arrive before 5:00 pm if you want to attend.]

FORMAT OF THE EXAM:

The **exam is worth 200 points** and will consist of questions in a variety of formats: **multiple choice questions** (about 30-35 four point questions), **fill-in-the-blank**, **figure or graph interpretation**, **make-a-sketch**, **short answer**, and **essay.**

· For the multiple-choice part of the test you will answer on the **IF/AT form** which allows partial credit:


IMMEDIATE FEEDBACK ASSESSMENT TECHNIQUE (IF AT)
Name Test #
Subject Total
SCRATCH OFF COVERING TO EXPOSE ANSWER
A B C D Score

It will be graded as follows:

Each multiple-point question on the IF-AT form will be worth either **4 or 5 points each**.

If it's a 4 pr 5 point question and you uncover the star that indicates the correct answer on the **first scratch-off attempt** (as in Question #1 on the example at left) you will receive **full credit (4 or 5 pts)**

If you need to scratch off **two boxes** to uncover the star, you will receive **3 points** (as in Question #2).

If you need to scratch off **three boxes** to find the star, you will receive **1 point.**

If you end up having to scratch off **all 4 boxes** to uncover the star, you will receive **0 points** for that question.

· To answer the other questions on the exam, you will **sketch or write on the test itself.**

· You may bring a **calculator** to the exam to assist you with any simple computations that may be on the test (computations will be minimal, if any.)

· No other electronic devices (smartphones, tablets, cell phones, or laptops, etc.) may be used during the exam unless you have obtained permission in advance from Dr H.

WHAT YOU ARE RESPONSIBLE FOR:

- The assigned reading material in your **SGC E-TEXT & the Robert Pirsig essay "On Scientific Method"** *[pdf file]*
  (NOTE: nothing specific from the *Dire Predictions* text will be on this exam -- that material will be covered after the Midterm)
- **CLASS NOTES PACKET: TOPICS #1 through #9**
- Information presented in all class **LECTURE PRESENTATIONS** *[see the Class Follow-Up to review them]*
- The content of the **ASSIGNMENTS** you've had so far **(G-1 on Absorption Curves & G-2 on Energy Efficiency and G-3 on Tree Rings -- G-4 will not be in this exam.)**
- The content of your **Self Checks** & **Readiness Quizzes (Practice Self Test on Global Change Overview, RQ-1, RQ -2, RQ-3, and RQ-4)**
- **Tests #1 and Test #2**

The best ways to focus your study:

· Focus on the key things listed on the **"TOP TEN THINGS TO STUDY"** for **In-Class Tests #1 & 2** (The TOP TEN lists are a succinct summary of most of the key concepts from the course that you should know and understand. If you haven't done so already, print out the Top Ten's and go through each one to structure your studying.)

· Do a quick review of all the **CLASS FOLLOW-UP PAGES thus far** to be sure you haven't missed any key topics or assignments

SOME GENERAL POINTERS ON HOW TO STUDY:

(1) FIGURES and **GRAPHS** in Class Notes, on your assignments and in your textbooks are usually important "synthesizers" of information ("a picture is worth a thousand words").

· You should be able to understand, interpret, and explain the figures in your reading material and class notes packet.

· In addition to word questions, you will be given some **FIGURES** or **GRAPHS** to interpret on the exam. (These will be taken directly from your textbooks or class notes packet, or will be very similar to graphs and figures you've seen in class.)

· You may receive a figure with some of the information on it "whited out" or without any labels and asked to fill in some missing information.

Examples of questions that might involve a figure or a graph:

· Could you sketch in what happens to an electron when a photon is emitted (e.g. leaps to a higher or lower energy level)? *[Hint: see pp 25-26 in CLASS NOTES]*

· Could you answer questions about a figure of the electromagnetic spectrum or label the areas of x-rays, UV, visible, and IR, and microwave radiation if they were "whited out" in Fig 3-3 p. 38 in SGC-E-text?

· Could you sketch in a theoretical ABSORPTION CURVE (see p 32 in Class Notes and the G-1 activity) (for the answer, see Topic # 6 Part II on The Radiation Laws in CLASS FOLLOW UP)

(2) Reviewing the **Self Checks** and the **"Top Ten"** things to study listed for Test #1 & # 2 is a good place to begin your studying to be sure you recall what you read in the textbook. The exam questions, however, will be more demanding than the Readiness Quiz-type questions. In particular, they will ***emphasize the application and synthesis of the knowledge*** you've gained since the beginning of the semester, not just the memorization of facts, ideas, and concepts.

(3) An important part of your studying should be to **TIE TOGETHER** different topics that we've covered and to make connections between how the same topic is addressed in Class Notes, lecture notes, and the SGC E-text. **This is also the point in the semester when you should be able to start tying the concepts together into "a big picture."** Questions will be asked that require you to link up different parts of the course. As you read over the material and study it, be constantly asking yourself questions (and answering them) to test your own understanding.

Examples of questions that tie concepts from different parts of the semester together:

· How does knowing that ozone in the stratosphere absorbs incoming shortwave radiation help you explain why the atmospheric temperature heats up in the stratosphere?

· On an absorption curve of the whole atmosphere (see bottom of p 34 in Class Notes and Topic #6 Part II) where are the two "atmospheric windows" mentioned in class (i.e., wavelength ranges where radiation moves through the atmosphere relatively unimpeded)? Why are they called windows? What is the difference between the UV/Visible "atmospheric window" and the "outgoing IR" atmospheric window?

(4) The EXAM will NOT cover the following reading: Pages 9-17 in SGC-E-Text Chapter 1.

THE MAIN TOPICS THE EXAM WILL COVER:

Topics # 1, # 2, and #3 Global Change Science and Issues, On Being a Scientist, & Quantifying Global Change -- go over the notes on this in Class Notes and review the key themes about science, hypotheses, theories, laws etc, that we went over in class and discussed with the**Science Cartoons & Quotes Activity** --CLICK HERE to review this activity & the answers). Review the concepts of **sustainability** (p 7 in Class Notes) and **Ecological Footprints** (l-1 assignment and p 18 in Class Notes ; be familiar with the Powers of Ten and scientific notation (pp 14 in Class Notes); know how to describe different types of time series plots (pp 15-16 in Class Notes).

Topic # 4 Energy & Matter Overview

· Can you describe what **matter** is and what it is made up of?

· Can you explain the basis for how elements are arranged in the **Periodic Table**? Could you arrange an element in its proper row or column if you were given a way to figure out the number of protons in the element and the number of electrons in its outermost shell?*(We did this in class -- and you can review it again on your own in the Periodic Table Background activity in Class Notes pp 111 - 115.*

· Can you describe or sketch the unique way that **electrons** behave and how **photons** of electromagnetic energy are emitted or absorbed when electrons make **quantum leaps** between energy levels in their orbit around an atomic nucleus? (Remember, electrons are*matter* and they do the quantum "leaping" while photons are *energy* which is emitted or absorbed – see pp 25-26 in Class Notes)

· Can you describe the **quantum behavior of molecules** (not atoms) when certain molecules rotate and vibrate at specific frequencies and why this explains why some gases are greenhouse gases and some are not? (Remember, atoms, & molecules are *matter* and they do the quantum rotating/vibrating, while photons are *energy* which is emitted or absorbed – see pp 48-50 in SGC-E-text

Topic #5 Electromagnetic Radiation & the Electromagnetic Spectrum

· Can you explain how **electromagnetic energy** behaves (wave & photons, wavelength & frequency)?

· Do you understand the **electromagnetic spectrum**, know its order, and the **wavelength ranges of UV, visible, and IR radiation**? By "order" I mean the relative wavelength from short to long: of gamma, x-rays, UV, visible, IR, microwaves & radio waves? Which wavelengths tend to be harmful to life on Earth?

· Do you know what the **typical sources** of the different wavelengths of electromagnetic radiation are? *(see p 28 in Class Notes and the additional reading on* The Electromagnetic Spectrum) **UV, visible light and IR radiation**, can you link this back to the discussion of matter (Topic #4) and the **quantum** behavior of electrons and molecules -- i.e. Do you know **which wavelengths of the Electromagnetic Spectrum** involve quantum leaps in atoms and which involve vibrational and rotational behavior in molecules?

- Can you tie what you know about electromagnetic radiation and the radiation laws (see next topic) to the S**AVED BY THE SUN**video?

Topic # 6 The Radiation Laws

· Do you **understand the radiation laws** (e.g. Wien's Law, Stefan-Boltzmann Law, inverse-square law, concept of a blackbody and why these concepts are keys to understanding many global change concepts?

· Do you know the **peak wavelengths** of transmission of **solar energy (0. 5 µm)** and **terrestrial energy (10. 0 µm**)? [memorize this – note how it looks in a figure as well (Fig 3-8 on p 42 of SGC-E-text)

· Do you understand what **absorption curves** are (including how to read them and draw a simple, hypothetical one as on p 32 in Class Notes and in G-1)? Do you understand what they reveal about the greenhouse effect, atmospheric transmissivity and absorption by different gases, and the interaction of atmospheric gases with solar (shortwave) and terrestrial (longwave, IR) radiation? ç **a TIE-TOGETHER concept!**

· Can you succinctly explain **what greenhouse gases are** and what **the natural greenhouse effect** is? Here's are some definitions – be sure you understand these and be able to re-state these in your OWN words:

Greenhouse gases (GHG's) (def): Gases such as carbon dioxide, methane, nitrous oxide, and water vapor that warm a planet's surface by absorbing infrared radiation and reradiating some of it back toward the surface.

IMPORTANT: reradiating is NOT "reflecting" or "bouncing" !! Terrestrial infrared radiation (IR) is absorbed by the GHG's, then emitted (radiated back out) by the GHG's. The IR does not "bounce off" or "reflect off" the GHG's or the atmosphere!

Greenhouse effect (GHE) (def): The natural mechanism by which a planet's surface is warmed by infrared –absorbing gases in its atmosphere. (NOTE: we use the term **"anthropogenically enhanced greenhouse effect"** to describe the increase of the GHE due to the accumulation of additional GHG's contributed by human activities such as the burning of fossil fuels).

Can you explain the processes associated with the **natural greenhouse effect** in words or a cartoon diagram? [Go through the **Class Concepts Self Test** on p 35 of Class Notes to be sure you understand these concepts.] **NOTE: only these two arrows (representing IR)are involved in the GHE è**

REMEMBER: the **GHE involves longwave (LW) infrared (IR) radiation ONLY** – the parts of the cartoon diagram showing shortwave (SW) solar radiation are NOT part of the GHE and should not be used in an explanation of the GHE!!

Topic # 7 Atmospheric Structure & Composition

· Can you explain how the atmosphere's **structure and temperature** varies with altitude, and what causes these variations?. (See Fig. 3-9 and 3-11 in SGC-E-text and pp 37-38 in Class Notes.)

· Can you reason out and answer the Q's about the **Transfer & Absorption of Solar Radiation figure on p 38** of Class Notes?

· Do you know what **gases are the most abundant** in the atmosphere and which gases are considered **GREENHOUSE GASES** (Table 3-2 in SGC-E-text & p 39-40 in Class Notes). Do you understand that nearly all of the major GH gases come from *both* natural and anthropogenic sources, but that their concentration began to increase rapidly in the 20th century, primarily due to the anthropogenic sources (be familiar with some of the these sources). Know which type of GH gases are human-made only.

· Can you describe and explain the "Greenhouse Signature" (see p 39 in Class Notes) and why cooling in the stratosphere would take place with a stronger greenhouse effect warming in the troposphere?

· Review the **KEY CONCEPTS** on p 41 in Class Notes -- it's a good summary of some important points!

Topic #8 Laws of Thermodynamics & Motion

· Do you understand the what **specific heat** is and how to interpret the table on p 45 in Class Notes?

· Can you describe the differences between the **energy transfer** processes of: **conduction**, **convection**, and **radiation**?

· If the 1st & 2nd Laws of Thermodynamics were stated for you, could you match them with a real-world application (e.g. direction of heat energy flow from hotter to colder body) *(You don't have to memorize the Laws, just be know what they mean if they are stated for you.)*

· Do you know how to read and interpret an energy flow diagram like those you drew for the light bulbs in class? Can you depict the energy flow in a diagram for a very inefficient lightbulb vs a very efficient lightbulb

· Do you understand how the **Law of Inertia** (Newton's 1st Law) and a body's **mass** (as in Newton's 2nd Law) determine the amount of**force** (and the energy needed to apply the force) to get a big, heavy vehicle **accelerating** from a stop vs. a small, light vehicle?

Topic #9 Intro to Tree Rings & Dendrochronology

· Do you know what **sensitive and complacent tree rings series** are and why they are important? Could you recognize a sensitive tree-ring pattern vs. a complacent tree-ring pattern in a figure, like those on p52 in Class Notes?

· Do you know which type of pattern (sensitive or complacent) is important for accurate cross-dating? Could you decide if a wood sample **was useful or not useful for dendrochronology** (Kit's lecture on Oct 8th and G-3 Wood Kit Assignment)

Synthesis and Tying Topics Together

- Can you now see how items in the individual topics we've been covering are related to each other? Can you fit the "pieces of the puzzle" together into a connected understanding? *Some examples:*
  - How does atmospheric composition (Topic #7) relate to the Radiation Laws & the Greenhouse Effect? (Topic #6)
  - How do photons(Topic #5 relate to the energy transfer process of radiation? (Topic #8)?
  - How does dendrochronology help us identify climate change (Topic #9)
  - How does the nature of matter and energy (Topic #4) relate to the energy transfer process of conduction (Topic #8)

Click here for: **PRACTICE QUESTIONS**