Tips for Studying Science at Swarthmore

(ask ?’s anytime)

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Slides available at: http://www.swarthmore.edu/academic-advising-support/welcome-to-office-learning-resources
College vs. High School

• Less Structured – less hours in class

Why?
Ownership

High School

- Coursework = vehicle
- Teacher = driver
- Student = passenger
Ownership

College

- Coursework = vehicle
- Professor = navigator
- Student = driver

- Where do YOU want to go?
College vs. High School

• Less Structured – less hours in class
  – More responsibility on learner
  – For every hour in class, need about 3 more hours of studying (+ HW time)

• 4 courses (without lab) = 48 hours/week (lecture + study)
  – Full time job! Study is work:
  • Requires energy, attention, discipline
Study Skills and Strategies
Make sure you have **time** to study

- Establish a studying routine, like a class schedule
- Check syllabus and note key dates in your calendar (tests, review sessions, due dates)
- Don’t procrastinate
Make sure you have **time** to study

- Strategies to avoid procrastination?
Avoid procrastination

• Make a to-do list, work down list instead of escaping into distractions

• Break down challenging tasks into bite-size chunks

• Schedule multiple due dates

• Dive in! Take a first stab without judgement or expectations.
STUDY HABITS

• FOCUS
• Place
• Reduce distractions
• One subject at a time

• Take breaks
  Replenish focus
  Yes – exercise, drink water, read, talk with friends
  No – phone apps, TV, eat salty/sweet snacks
Study Resources: USE THEM!!!

Yourself - Lecture notes
Text and other reading
Your peers
Professors
Lab instructors
Librarians
Upperclassmen/women
SCIENCE ASSOCIATES/peer tutors/Writing associates
SAMs

Beware of the web - be picky about your sources
Routine – mixed individual and group study

Before the lecture:
   Pre-read (skim)
   This is preparation, not a substitute for lecture.

How to do this?
Depends on class –
Look at end of the chapter or section summary
Look at all the section headings
Familiarize yourself with important vocabulary
Study the figures and their captions

Look at equations to understand ideas and symbols
Write equations in your own words
ATTEND LECTURE: GIVE IT YOUR FULL ATTENTION!!

Take notes by hand
Laptops are a distraction: help only with memorization based recall; writing helps your brain integrate

Write down
Whatever instructor writes on board
Whenever instructor says “this is important...”
Other big ideas or explanations of figures, slides, equations

If you miss something:
Leave a space and move on – talk to a friend later
  Don't miss the next point because you were asking your neighbor about the last point.

If something is unclear in class – ASK!
Routine – mixed individual and group study

Shortly after the lecture:
• Go over the notes with a partner(s), fill in gaps,
• Re-read the text focused on your ?s, fill in more gaps
• Answer problem sets/challenge ?s on your own (write out full answers)

The week of lecture:
• Discuss at group Q&A session – every week!
• Discuss at peer tutoring sessions – every week!
• Discuss with faculty (office hours) (have time set aside every week)
Benefits of individual study

• Independence
  (Identify the boundaries of your knowledge)

• Writing out your own ideas

  Writing = understanding
  - Thoughts are incoherent
  - Writing forces you to assemble thoughts into coherent, stable ideas.
Benefits of group study

• Verbalization
  - Thoughts are incoherent
  - Verbal communication forces you to assemble thoughts into coherent, stable ideas.

• Identify and fill gaps

• Teaching peers - optimal way to consolidate knowledge into durable structures.
What is a knowledge structure?
What is a knowledge structure?

Coherent assembly of concepts and related details
Example of a knowledge structure

Chromosomes are segregated during mitosis

Genotype $\rightarrow$ phenotype

RNA codons $\rightarrow$ Amino acids

DNA $\rightarrow$ RNA $\rightarrow$ Protein

DNA = double helix composed of complementary bases
Example of a knowledge structure

Chromosomes are segregated during mitosis

Genotype $\rightarrow$ phenotype

DNA = genetic code

Heritable information encodes organismal form and function

RNA codons $\rightarrow$ Amino acids

DNA $\rightarrow$ RNA $\rightarrow$ Protein

DNA = double helix composed of complementary bases
Example of a knowledge structure

Genotype → phenotype

DNA = genetic code

DNA → RNA → Protein

RNA codons → Amino acids

Chromosomes are segregated during mitosis

Hereditable information encodes organismal form and function

DNA = double helix composed of complementary bases
Building knowledge structures

- Understand key concepts, not just details
- Organize details around key concepts

Testing and Using your knowledge structures

- Explain key concepts and related details visually, verbally and in writing
- Can you still understand a concept when details change?
- Can you interpret diagrams and decipher graphs?
Building durable knowledge through retrieval

What is the difference between reading and retrieval?
Building durable knowledge through retrieval

Reading = passive (passenger)
Retrieval = active (driver)
- extract information and organize it
The power of repeated retrieval

• Reading over and over is not the key

• Repeated RETRIEVAL of information leads to consolidation of new knowledge

Retrieval includes placement into existing structures

• Make connections with what you know

• Build on top of a solid foundation
Other resources

- http://www.studygs.net/concent.htm
- http://www.studygs.net/
Studying SCIENCE in College

- Faster-paced
  (because more student responsibility)

- Content:
  - Cumulative
  - Integrated
  - Hierarchical
Science Learning

Vocabulary (like learning a foreign language):

Practice to attain Fluency
   Read, Write, Speak, Get feedback, Correct

Fundamental skills (also require practice)

- Fluency with graphical representation of information
- Fluency with writing clear explanations
Science Knowledge:

Use it or lose it........
Opportunities to USE your knowledge

Homework/Challenge Questions

• Identify central concepts and related ideas
• link to previous material
• place in new contexts

• Manipulate
  (problem solving, experimental, theoretical)

• Transfer
  (use concept to understand something new)
Opportunities to USE your knowledge

Exams and quizzes

As you prepare for exam you use your knowledge

• link to previous material
• place in new contexts
• Manipulate and Transfer
Opportunities to USE your knowledge

Exams and quizzes

College exams are not recitals! (Memorization is not sufficient.)

Exams are like –

‘sight-reading’ – knowing general principles and applying them to new situations

‘going to a new country’ and having a conversation in language you have learned – apply to a new situation

Valuable feedback about your knowledge structures and study habits.
Use it or lose it

Correcting misconceptions... (refining your knowledge)

- test your understanding through honest, frank discourse with peers or instructors
- test your understanding by completing challenge questions and problem sets
- test your understanding by analyzing mistakes on exams problem sets or papers.
Using knowledge raises the level of your understanding. "Owning", not "renting", course material:

Bloom's Taxonomy

1956, Benjamin Bloom, Max Englehart, Edward Furst, Walter Hill, and David Krathwohl
## An example in biology:

<table>
<thead>
<tr>
<th>SKILL</th>
<th>Example</th>
<th>Associated verbs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Create</td>
<td><em>Suggest a hypothesis &amp; design an experiment to test it.</em></td>
<td>Create, Combine, Infer</td>
</tr>
<tr>
<td>Evaluate</td>
<td>Given data from an experiment, determine if they support your hypothesis;</td>
<td>Judge, Choose, Decide, Recommend</td>
</tr>
<tr>
<td>Analysis</td>
<td><em>Formulate a hypothesis about what step of DNA repair is affected.</em></td>
<td>Classify, Compare, Survey Contrast</td>
</tr>
<tr>
<td>Application</td>
<td>The cell’s ability to repair DNA (mutations) has been compromised – what are the consequences?</td>
<td>Use, Demonstrate, Interpret Illustrate</td>
</tr>
<tr>
<td>Comprehension</td>
<td>The information for a cell to function is encoded in the DNA</td>
<td>Describe, Identify, Explain, Tell</td>
</tr>
<tr>
<td>Remember</td>
<td><em>DNA is the genetic material</em></td>
<td>Define, Repeat, List, Match</td>
</tr>
</tbody>
</table>
General tips:

BALANCE!!!!!!!

Eat! – nutrition, variety, social

Sleep! – regularly; short term memory -> long term memory

Move! – Physical activity – daily

Play! – guard your time off – reset your brain.