Planning lively science sections - a few tips

This tip-sheet is meant as a practical guide to some good habits for preparing science sections. The last page is a work-sheet to help you plan a section.

Before the actual planning
Get an overview of the material you have to teach: What are the most important elements – and what are the most difficult elements? What are the most important skills? What do the students need to know, i.e. what will be on their homework and exams? What have the students been having trouble with? Also, are there any practical issues you need to address (e.g. upcoming/recent exams)?

Based on this, decide on your key goals for the sections: the topics you want to address, the skills you want to teach your students, and the central ideas you want them to take away.

15 tips for lesson planning
A few things to keep in mind when you sit down to plan a section

1. Put an agenda on the board at the beginning of each section to make it clear what you are going to cover, and motivate each part of the section as you move along, explaining why it is worth doing.

2. A brief summary of the relevant concepts at the beginning of section can be a good way of reminding the students of the tools they need – but never turn a section into a lecture (even if you are unhappy about the actual lectures).

3. Plan what you will put on the blackboard (text, diagrams, graphs...) and where it should go – it keeps board order good. Consider writing your sections notes as “scale models” of what goes on the board.

4. Make sure that what you want to put on the blackboard will make sense to the students when they look at their notes weeks later.

5. Do not be afraid to set priorities but always explain to your students why you set them. Or let the students set the priorities by letting them vote on which problems they prefer to see solved.

6. For laboratory courses, use incubation times for discussion/working in groups.

7. Explicitly draw connections between different parts of the course (lecture material, lecture demonstrations, labs, previously covered material...).

8. Make frequent use of graphical elements (diagrams, graphs, ”mind-maps”, etc.) to clarify ideas and further intuitive understanding of the topics at hand.

9. Pick your problems carefully to ensure they are concrete, interesting and informative.

10. Discuss and share problems for section with other TFs in your course – or ask a TF who has taught it before.

11. Bring up bits of interesting trivia and anecdotes that will make the topic more interesting (e.g. each human cell contains about 3 meters of DNA).

12. Share useful mnemonics and other ways of organizing what has been taught (e.g. King Phillip Cried, “Oh for Goodness Sakes!” for Kingdom, Phylum, Class, Order, Genus, Species).

13. Use early feedback from your students to check if your section format is working.

14. If you have a lot of material to cover, make sure you do the most important things first in case you run out of time.

15. Try to convey the “glory of the subject” – tap into the things you thought were interesting about the topic when you learned it yourself (but make sure the class stays at the right academic level!). Make the section fun for yourself to teach – students also enjoy enthusiasm!
An ideal problem for section...

- ... is directly relevant to the homework and exams, but focuses on general principles and problem-solving skills rather than specific details
- ... applies what the students have learned to interesting concrete examples from real life (from everyday life, from a recent or classic experiment etc.) wherever possible
- ... makes the students actively think about the topic by drawing on their input, either by letting them solve it in small groups, or by having them fill in missing steps as you work it through at the blackboard (preferably conceptual steps rather than just supplying an equation, a name, etc.)
- ... has several parts, moving from broad concepts to concrete calculation/problem-solving
- ... brings in material that was covered earlier so that the students see it again (but without overloading it with too many complications)
- ... uses graphical elements (diagrams, graphs...) where applicable
- ... makes an interesting point so that you, as a TF, also think it's fun to present

Not every problem can be ideal! – but it’s worth trying to include at least some of the ideal ingredients.

Ways to get people involved and talking in section
What works varies from class to class. Be open with your students – they like interactive classes, too – and experiment with them to see what works.

- Try to get people talking from the very first section. Let everybody introduce themselves, explicitly encourage questions, and ask a lot of questions yourself to show that you mean it.
- Let people take part in the problem-solving and use questions to ensure that everyone is following the material.
- Very specific questions with clear right/wrong answers can sometimes be intimidating because the students are afraid of giving the wrong answer. Try to use more conceptual questions, e.g. ask “What information do we need to describe the trajectory of a cannonball?” rather than “What is Newton’s 2nd law?” Note that conceptual questions need not be easy questions!
- Be sure to give people enough time to come up with an answer to your questions before answering yourself (even if the silence is getting uncomfortable).
- Have students work in small groups and then present to the whole class (working in groups takes the pressure off the individual student).
- Be creative! – especially in non-major or introductory classes, creative activities can be a good way to get people involved. A few examples:
  - Give each group a diagram from the text and a list of key words, then have them explain the diagram to their classmates
  - Have groups write questions for an upcoming exam. Then have each group answer a different group’s questions.
  - Let the students vote on the outcome of a problem (“Who thinks it is possible to levitate a frog with a magnet?”) and then work your way to the answer (works particularly well if the answer is surprising)
  - Have students design and/or play a game that tests their knowledge. You can base it on a game you know like Trivial Pursuit or Jeopardy.
- Assign a small task to each student before section by e-mail.
- Use food bribes if necessary – a bag of candy goes a long way.
Lesson planning - sample form

<table>
<thead>
<tr>
<th>Date:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Section #:</td>
<td>Section topic(s):</td>
</tr>
</tbody>
</table>

**Instructional goal (essential questions or points of unit/section)**

**Performance objective (What will students *do* to demonstrate understanding of goals?):**

**Rationale:**

**Section content/agenda:**

**Section activities:**

**Beginning:** Introduction/warm-up/brief review:

**Middle:** Section activities

*How will you get students to participate?*

*How will you check for understanding?*

**Closure:**

**Assessment procedures (how will you know if students understand goals?)**

**Materials and aids (what will you need in order to teach this lesson?)**