

# Guide to the Skrabalak Laboratory: Introduction

## **Why I am a professor:**

I started college as an art history/archeology major; however, I had also enrolled in general chemistry because of my interest in science. My introductory chemistry courses were fascinating, and I quickly became engrossed with all the possibilities. I began undergraduate research my sophomore year and my interest in chemistry continued to grow. By the end of my senior year, I declared that I wanted to be a professor so that I could share my excitement for the field with other curious minds. Graduate school continued to foster my excitement, particularly for cutting-edge research.

At the most basic level, my job is to teach the fundamentals of chemistry and the process of research. I hope to instill in my students the necessary tools to look at the scientific world critically, yet with curiosity, and to develop problem-solving strategies and effective communication skills. I am excited to create an environment conducive to conducting great research and learning as well as to train a group of students to be individual researchers.

## **Philosophy of the Skrabalak lab:**

Respect. Treat others the way you would like to be treated. This philosophy extends to you and me, your lab mates, your science, equipment, common areas, the department, and the university and its staff.

## **Scientific Ethics:**

Scientific integrity is essential. If at any point you are unsure of whether you are making the appropriate choices about how to design an experiment, interpret data, keep your notebook, etc. please come to me immediately. Also see "Scientific Integrity" by F. L. Macrina for further details. A copy of this book has been provided for the lab.

# Guide to the Skrabalak Laboratory: Group Meetings

A *tentative* schedule will be provided at the beginning of the fall and spring semesters as well as at the beginning of the summer. Assume the schedule is “as-posted” unless an email is sent out stating otherwise.

## ***Wednesday/4-6pm/Room 500***

Students are in charge of preparing the room for the meeting; i.e., if a projector or computer is needed, please get it and have it set up by the meeting’s start time.

All group meetings will begin with a brief discussion of group needs/problems. For example:

- (1) Does anybody know a group with a Raman microscope (or X) that I could use?
- (2) Can we buy a microcentrifuge (or X)? Here is the cost of and model I am interested in.
- (3) The GC (or X) is broken and I don’t know how to...

Afterwards, the group meeting will assume either one or a combination of the formats listed below. Come prepared appropriately.

## **Formats**

### *Subgroup or Roundtable Discussions*

These group meetings are meant to be informal roundtable discussions of research progress made in the last few weeks. Each student should bring relevant data to share (electron micrographs, spectra, etc.). This time can be used to ask questions about interpreting results, decide where to go with the results, or to discuss ways of troubleshooting problems. If you haven’t been making much progress, come prepared to discuss why/what you are trying to do. We will come up with ideas!

### *Literature Talks/Tutorials*

These group meetings are meant to keep us up to date on research within the broad field of materials chemistry as well as to give new group members practice presenting. Topics may be decided on by the presenter or by me and will generally involve summarizing 3-4 recent and related publications. Alternatively, one may provide a tutorial talk on a subject relevant to our research; i.e., it might be useful to present background relevant to a particular type of materials characterization. Regardless of the format, the presentation should be 20-30 minutes using PowerPoint. Please provide me with a printout of each manuscript covered and provide group members with a reference list. It will be useful to email the reference list to group members a few days prior to our meeting so that they may look over them. Tutorial talks should be stored in the group document folder.

### *Research Talks*

These group meetings are meant to be semi-formal PowerPoint presentations summarizing your research progress since the last time you presented a research talk. These can range from 30 to 50 minutes. Please provide the group with slide handouts.

### *Individual Meetings*

Signup for individual meetings through the [skrablab@gmail.com](mailto:skrablab@gmail.com) calendar. The password can be obtained from labmates. These meetings are meant to be a frank discussion about your research progress and goals. Please come prepared with a handout (3-hole-punched, 2 copies) summarizing (1) research accomplishments since last individual meeting, (2) research plans for the next month, and (3) all relevant data. This time is also good for discussing graduate school requirements, writing papers, discussing conference attendance, career goals, etc.

# Guide to the Skrabalak Laboratory: Summer Reading

While you should be reading journal articles daily, in the summer months, literature summaries will be expected and evaluated on a 2-week basis. There are several goals associated with this summer reading. They are to (1) increase your “skimming” of journals/broaden your scope of reading, (2) increase your critical analysis of research, and (3) improve your writing skills. Depending on your year in the Skrablab, your role in summer reading will vary.

## **Students who have completed their 1<sup>st</sup> year only**

(1) Select a paper from the past **2 years** that is (1) in a well-respected journal and (2) contains research loosely relevant to the work being done in our laboratory. If you have questions about selecting a suitable article, please consult with me.

(2) Read the article.

(3) Summarize the article in **1-2 paragraphs**, making sure to discuss (1) what they did, (2) why it is important, (3) what they learned, and (4) what questions are still unanswered. You may need to consult other manuscripts to really be able to answer these questions. If there is a flaw or short coming in the article, please make sure to discuss that observation as well.

(4) These summaries as well as a pdf copy of the article are to be emailed to me by midnight on the date listed on the summer group meeting schedule. I will send back comments on your summary ASAP.

## **Students who have completed their 2<sup>nd</sup> year and are preparing for their 5<sup>th</sup> semester exam**

(1) By May 15<sup>th</sup>, compile a comprehensive list of topics you intend to study (or have been studying) in preparation for your 5<sup>th</sup> semester exam and email it to me. Based on your topic list, I will email you a general question a week in advance of your literature summary due date.

(2) Survey the literature for manuscripts relevant to the question posed and select one of those papers for your summary.

(3) Write your literature summary following the guidelines above.

(4) Add **an additional paragraph** answering the posed question and relate your answer to the manuscript you summarized.

## **Students who have passed their 5<sup>th</sup> semester exam/Post-doctoral researchers.**

(1) You are excused from preparing summer literature summaries (unless you would like to participate); however, I will select one of the literature summaries that I receive from a 1<sup>st</sup> or 2<sup>nd</sup> year student and have you analyze the quality and provide feedback to the student.

(2) After you have analyzed the work, please send your comments to me. I will then edit/add in any additional perspectives I have on the work and send it back to you and the student.

# Guide to the Skrabalak Laboratory: Some More Useful Stuff

**1. Group Computer(s):** The group computer is to supply students without a laptop with Internet access and the necessary software to do paper work in lab. Do not download games and junk on to the computer. Do not store your data on the group computer; that is just waiting for it to be deleted. Also available on the computer are group documents that may be of interest. The same policies apply for the group laptop; however, it needs to be signed out when it is taken from the student office so we know its location. A backup system is being developed with ITG.

**2. Group Calendar:** The group calendar can be accessed at [skrablab@gmail.com](mailto:skrablab@gmail.com) using the password available from labmates. The calendar is to be used for (1) individual meeting signup and (2) instrument signup (BET, long-duration UV-vis, catalysis line/GC-TCD). Also, multi-day vacations must be uploaded 3 weeks in advance, so we may plan accordingly.

**3. Chemical Inventory:** On the group computer is an excel spreadsheet that lists all chemicals available in the lab and their approximate location. The list is also printed and posted throughout the laboratory. When you purchase a new chemical, please add it to the list. If you use up a chemical and do not replace it, remove it from the list. If a chemical is on the list but you can't find it, email the group before placing an order for it. We will do a formal inventory update each semester, but this task will be much less painful if you just get in the habit of keeping it up to date.

**4. Equipment:** Most major research equipment comes with a manual. If you buy something with a manual, add it to the group filing cabinet with a well-marked folder.

**5. Your Notebook:** Your notebook is your research career. Develop a strategy to keep it up-to-date and organized. Make photocopies or digital copies of your notebook regularly and keep them at home should something happen to the laboratory. Also, burn CD/DVD copies of your digital data and keep them both at home and at work. Some tips to keeping a good, ethical notebook:

- Keep it well organized, neat, and written in permanent ink.
- Several pages should be reserved at the beginning of the book for a Table of Contents.
- Each experiment should include a title, purpose statement, literature reference if applicable, reference to other applicable notebook pages, chemical equations, procedure and observations, and reference to file names for data and experimental conclusions.
- Research samples, products, and data files should be coded in the following way: initials of investigator, notebook number, page number and an additional number and/or letter if more than one sample or spectra is described on a given page; for example, SES-I-12a.

**6. Courtesy:** If something isn't yours, ask before you take it or use it. If you make a mess, clean it up. If you break something (or find something broken), have it fixed. If you are the last to leave the lab, make sure to lock the doors (and always take your keys with you). Don't waste group money on excess office supplies and use printers judiciously and appropriately (e.g., there are resources available for TA assignments). We are a team-- pull your weight to keep the lab organized and to assist others with group tasks. As we get larger, I will assign responsibilities to divide up these tasks evenly.

**7. Safety:** Accidents in lab are nearly inevitable; however, we must do everything possible to decrease the frequency and severity of such events. The best way to prevent an accident is to ALWAYS know the dangers associated with the chemicals/techniques you are working with.

- It is generally good to work when others are around, especially when trying new techniques.
- No eating in the lab.
- No chewing gum in the lab.
- Music is fine, as are headphones, **BUT you must be able to hear each other at all times!** I typically will wear only one earpiece.
- Wear safety glasses.
- No open-toed shoes or shorts.

- Wear laboratory jackets when handling dangerous chemicals
- Wear gloves when handling dangerous chemicals.
- Do not wear your gloves into the office, hallways, or elevators.
- No bench should have more than 10 solvent bottles and 10 chemical solids stored on or above it.
- All purchased chemicals should be dated and initialed by the person who bought them. Label anything you put in common areas (e.g., refrigerators) with your name, date, and contents.
- All ethers must be disposed of within six months of being opened. Older bottles may contain explosive peroxides (which must be removed prior to disposal by adding CuI).
- Never return any liquid to a bottle after removing it from the bottle (if you add a tablespoon of wine to a barrel of sewage, you have a barrel of sewage; if you add a tablespoon of sewage to a barrel of wine, you have a barrel of sewage).
- Never store fuels and oxidizers together. Organic liquids and solids are potential fuels. Oxidizers include gases (halogens and oxygen), oxidizing liquids (hydrogen peroxide, organic peroxides, acids), and oxidizing solids (nitrate, perchlorate, permanganates, and chromates).
- Waste solvent containers cannot be left open and you cannot have a funnel in an open container, even in a hood – there are serious fines for such actions.
- Dispose of chemicals and waste properly and often.

When in doubt, consult <http://www.ehs.indiana.edu/>

## Things I Have Learned and What Graduate School is all about...

**What is the goal of graduate school?** The answer to this question can take many forms depending on the student and his or her career aspirations, but below are some of my expectations. It is my goal that every student in my group becomes a successful and independent scientist. Feel free to talk to me about what you want your experience to be and how to get the most out of graduate school!

**What is a thesis?** A thesis is body of work (not time). As a general guide, the first chapter should be a comprehensive review of literature relevant to the general theme of your thesis, and it would be great if we could turn it into a review article for peer-review in *Chemistry of Materials*, *Advanced Materials*, *Accounts of Chemical Research*, *Chemical Reviews*, among others. The best theses then consist of 4 to 6 additional chapters of original research results, which correspond with 4 to 6 first author manuscripts. Of course, given the diversity and success of research projects, there are no hard and fast numbers regarding thesis chapters or papers. It is also okay to include unpublished results, just make sure the work is of high-quality. Don't dilute your good work just to make your thesis appear longer—your committee members will know what you are doing!

**What about manuscripts?** In general, the more the better... but of course, quality matters as well (and is becoming more and more important as some P.I.'s have publication "diarrhea")! The more, higher quality manuscripts you achieve as a graduate student, the more easily you will be able to achieve your career goals... no matter what they may be! In general, it will be very difficult to find a good post-doctoral position without three good manuscripts. As a general guide of graduate progress, a manuscript submission should roughly correspond with each graduate school milestone.

I personally like to submit communications, followed by full-length papers, both with supporting information.

**How do I get manuscripts and material for a thesis?** Through hard work and creativity in research.

**How Hard Should a Graduate Student Work?** The quality of the job you end up with immediately after graduate school, in large part, will be determined by your level of effort and success in graduate school. It is important to realize that **you are not working for me, but with me. Graduate school is an investment in yourself.** Also, a Ph.D. is not a 9-to-5, 40 hr/week regular job. You have to put in as many hours as are needed to get the job done. If you are efficient and have good lab skills, then ~40 hr/week may be possible, but I seriously doubt it. That said, I will treat you like an adult – **you set your own hours, but I ask that you spend at least four of your working hours between 9-5 to ensure sufficient face time with me. If things aren't going well, do not make the mistake of reducing your efforts!** Keep working hard and seek help with research and with stress management. The average chemistry Ph.D. takes ~5 years, although I am fine with it taking less time if you have the necessary results. I also realize that extenuating circumstances can cause it to take longer, but do you really want to be in graduate school for 10 years?!?!

**What about vacation time?** According to school guidelines, you are allowed 3 weeks of vacation per year. You do not need my permission to go on vacation, but please notify me at least one week in advance (the earlier the better) if you will be gone for 5 or more days.

## Tips to Research

- **Always know why you are doing something and be able to tell people why!**
- Get started. In year one: read, get trained on instruments, set up your hood, and begin experiments.
- Hard work and time well spent cannot be overstated; sometimes you just have to get your hands dirty!
- Time management—make a list of your daily/weekly goals. It's ok to not always reach them, but it's amazing how much time you can waste if you don't have a plan. Here is an example of a good day:
  - (1) Prepare solutions for preplanned experiment and begin heating furnace for experiment
  - (2) Have coffee and look through *ASAP* and *RSS* feeds for manuscripts
  - (3) Check furnace temperature... good, start experiment(s) and begin to work up experiment from previous night
  - (4) Read *ASAP* and *RSS* articles and monitor experiment(s) progress
  - (5) Lunch
  - (6) Stop experiment and work up experiment/prepare for second experiment(s)
  - (7) Start second experiment/finish work up on first experiment
  - (8) Seminar/read/service activities
  - (9) Check on second experiment
  - (10) To the gym and then dinner
  - (11) Analyze experiment from previous day and this morning (e.g., imaging by SEM)
  - (12) Stop evening experiment and make list for next day (including experimental details)
  - (13) Relax/go out with friends and always sleep

Here is an example of weekly goals (keep flexible because results typically direct research plans)

- (1) Run experiments with precursor concentrations of X, Y, and Z at temperatures A, B, and C
  - (2) Repeat with precursor B
  - (3) Repeat with precursor C
  - (4) Image and analyze results from (1-3) and devise experiments for later in the week.
  - (5) Do later week experiments
  - (6) Read papers on X from the Y group
  - (7) Find good book on interpreting electron diffraction patterns and begin to read (exam prep)
  - (8) Attend two weekly seminars
  - (9) Sign up for training on the XRD
  - (10) Organize data for group meeting and make plan for following week
- Make good and adequate observations; many of sciences' great accomplishments occur by accident and are only known because of good observations (e.g., carbon nanotubes).
  - Develop ways to run multiple experiments and work up experiments simultaneously.
  - Read, read, and read some more! Keep a notebook from your readings.
  - Attend talks and discuss problems. Keep a notebook and jot down your ideas... no matter how crazy!
  - Try the extremes... Rather than sticking to *typical* reaction concentrations, try something out of the norm. Don't be afraid to test your ideas... worst-case scenario, you lost a day... best-case scenario, you have a thesis chapter and a manuscript. Regardless, you will have learned something about your system!
  - Don't be afraid to ask for help from me, your lab mates, your friends, other professors, and staff.
  - Stay organized. I highly recommend keeping a good table of contents.
  - Don't change too many parameters between experiments; otherwise, you won't know what factor influenced the outcome.
  - When trying to make comparisons between samples, obtain electron micrographs at the same magnification. Doing so will make for much nicer figures and easier interpretation of data.
  - Browse catalogues to see what is available (it can be more exciting than holiday shopping-- I swear!).
  - Read about analytical techniques and what information they can provide.

**In the End, Just Do It (and Have Fun)!**

# Tips to Giving a Presentation

Good presentation skills (orally and pictorially) are essential to success in graduate school requirements (or will at least make them less painful). They are also important when interviewing for any type of job. In the end, it doesn't matter how fantastic your science is if you cannot convey it to the community. The best way to develop good presentation skills is to give lots of presentations and accept criticism and suggestions. Thus, presentations (and critique of them) will be a general part of group meetings, and I strongly encourage students to present their research results at a regional meeting in their 2<sup>nd</sup> or 3<sup>rd</sup> year of graduate school and at one or two national meetings in their 3<sup>rd</sup> through 5<sup>th</sup> years of graduate school. National conferences are also a great means of networking and source of industrial interviews.

- Before you start on a presentation, look over the "Seminar on Seminars" at <http://www.scs.uiuc.edu/suslick/seminaronseminars.html>
- Public speaking on scientific topics is very difficult, especially when first starting out. Give yourself enough time for preparation and practice.
- Always know the point to your presentation and realize that most people will only learn one thing from your talk, so select the most important point and organize your talk around trying to convey it.
- Graphics and figures are better than a lot of words (your supposed to tell us about the results, not read them to us). Keep graphics and figures simple as well as labeled clearly.
- I have found it useful to put "tag-lines" at the end of slides: ~5 words that summarize the slide. This technique will help you remember the point of the slide should you get nervous and can provide a natural transition to your next slide. The title of your slides can then be used to help you remember what to say about your new, current slide.
- Keep slides simple and aim for a presentation pace of one slide per minute.
- Be consistent in format, use non-serif fonts, and avoid fonts below 20 pt., especially if non-bolded.
- Avoid Microsoft defaults, clipart, and templates and don't get *cutesy*!
- Never use yellow on a white background.
- Be careful about humor, especially with international audiences.
- Practice, practice, and practice some more, but don't memorize your talk.

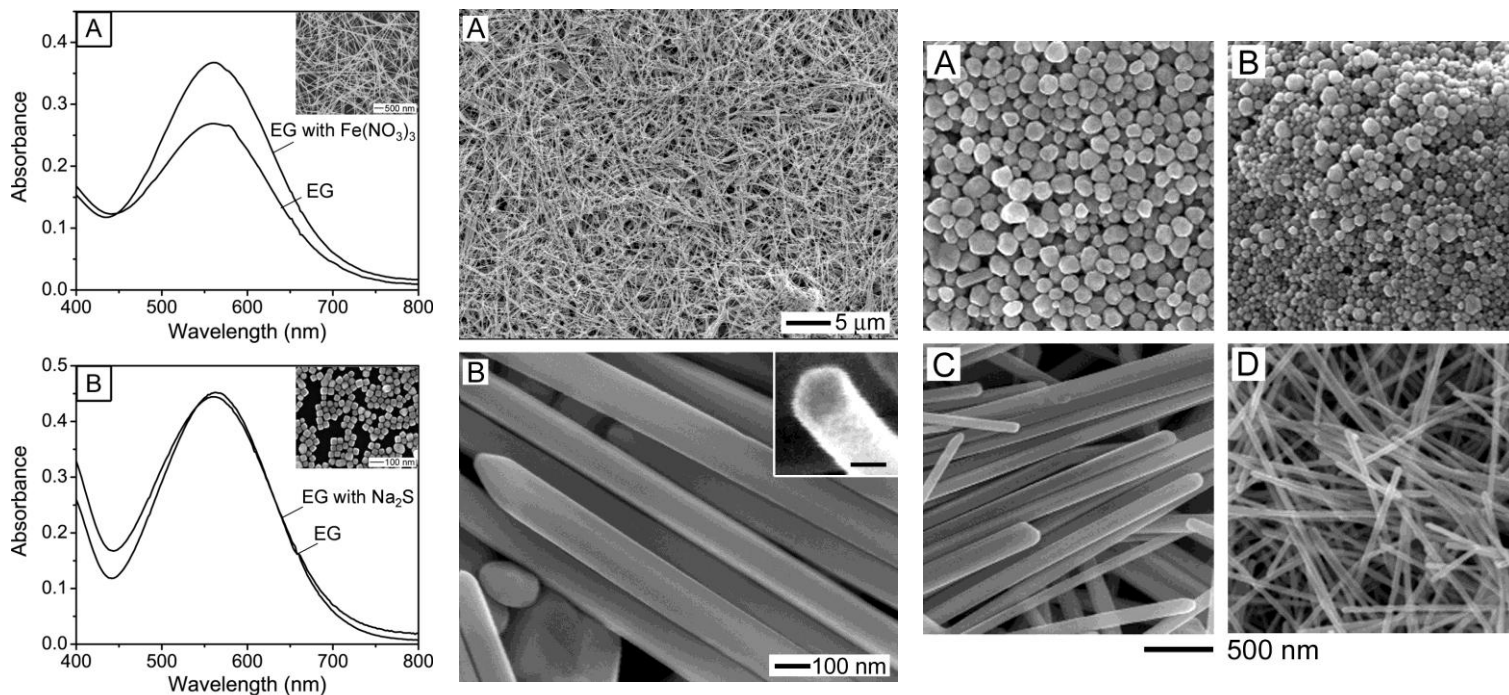
Chances are, I will have lots of suggestions after the first few times you give a group presentation. That's okay, just work to improve. Note that most job interviews require a research presentation.

## Tips to Getting your Manuscripts Submitted

-- Typically I will tell you that you are getting close to writing up your results; however, if I haven't said anything and you think its getting near time, then tell me. You should know your results better than anybody else, thus you may be a better judge of project completion than me.

-- We will select a target journal and format. If the results are good, let's aim high!

-- Next, prepare an outline of Figures (those necessary for the manuscript). Here are examples of well-designed Figures. Try to mimic these formats or those from my other manuscripts. Always be consistent within a Figure and within a manuscript. Note that many journals now charge for color so use it only when necessary. Get Figures ok'ed by me.



-- Write the paper (including any supporting information). As all manuscripts are submitted electronically, most journals have strict guidelines and provide a template. Use the template and get the manuscript as close to completion as possible, paying attention to formatting details. Consult the *ACS style guide*, *The Elements of Style* by Strunk and White, and *Common Errors in English Usage* by Paul Brians to assist you with writing. Use EndNote for references, making sure that citations are in their proper format *and* potential referees are cited (you don't dis a potential referee by not citing his or her work! I learned this the hard way by getting a good paper rejected without review). Typically, the first references are important reviews and the most important individual papers. Once you have gotten the manuscript in order, have a group member read it and give suggestions on how to improve it... make any changes, spell-check it, and then email it to me. The files should be named "shortpapername-yourlastname-date.doc" – For example, "Agwires-Skrabalak-03-12-08.doc"

-- Everybody has his or her writing pet peeves. Here are some of mine: (1) the word *this* should always be followed by a noun, (2) make sure to use commas and semicolons properly, (3) use active tense whenever possible, (4) do not overuse adverbs, (5) complete all comparisons, and (6) *owing to* is often better than *because*.

-- The quality of the first draft will determine the next step. Either I will revise the manuscript using track changes and send it back to you to finalize or we will have a meeting to discuss the manuscript and the necessary revisions. Most papers will go back and forth several times, especially if more experiments are necessary or the results are potentially controversial.

- Once I have given the okay for submission, prepare a TOC and cover letter, including a list of potential reviewers. Email the final manuscript, cover letter, and each figure (jpeg as well as photoshop layer version) to me; we will then submit the manuscript together.
- Then we wait for the referee reports, which will determine what we do next. Congratulations, you have just submitted your first manuscript!