Kalejta Lab Guidelines

Introduction.

Starting work in a virology research laboratory as a new graduate student or postdoc can be complex, intimidating, confusing, and stressful. From laboratory logistics to elemental expectations to scientific specifics, there is much to learn. To help new lab members adjust and excel, we have put together a series of guidelines for working and thriving in our laboratory. While these guidelines may be most helpful for new members, everyone is encouraged to refer to this document as a resource to maximize their time and efforts in the lab. Topics covered include safety, wellness, balance, teamwork, integrity, reading, research, writing, speaking, and timelines. Many thanks to Emily Albright, Donna Neumann, and Kinjal Majumder for their input and assistance in developing these guidelines.

Publications on how to be a scientist:

Gu, J., and Bourne, P.E. (2007) PLoS Comput. Biol. 3(11):e229

https://pubmed.ncbi.nlm.nih.gov/18052537/

Bourne, P.E., and Barbour, V. (2011) PLoS Comput. Biol. 7(6):e1002108

https://pubmed.ncbi.nlm.nih.gov/21738465/

Erren, T.C. et al. (2007) PLoS Comput. Biol. 3(10):e213

https://pubmed.ncbi.nlm.nih.gov/17967054/

Safety First.

Laboratories represent significant and specialized physical risks. Furthermore, working non-traditional hours (e.g., nights and weekends) introduces additional, different risks. The foremost concern for lab members is their safety. All lab members are given detailed instructions on how to mitigate the risks associated with lab work, and should ask the PI (Rob Kalejta; rfkalejta@wisc.edu) for further clarification if the instructions provided were not fully clear.

All lab members must understand and use proper biological and chemical safety precautions. The UW-Madison Office of Environmental Health and Safety (https://ehs.wisc.edu/) maintains separate offices of Biological Safety (https://ehs.wisc.edu/office-of-biosafety/), chemical safety (https://ehs.wisc.edu/office-of-chemical-safety), radiation safety (https://ehs.wisc.edu/radiation-safety/), and animal research safety (https://ehs.wisc.edu/animal-research-safety/). Lab members are directed to these web pages for further information regarding training, regulations, material disposal, personal protective equipment (PPE), and emergency reporting. Lab members will be required to complete various safety courses prior to working in the lab, and to renew those course approvals as needed. At a minimum you will have needed to successfully complete “Biosafety Required Training” and “Biosafety 102: Bloodborne Pathogens for Laboratory and Research" before beginning work in the laboratory. You can enroll in these courses at: https://ehs.wisc.edu/biosafety-training/.

In addition to this general laboratory safety information, the Kalejta lab maintains a separate, specific Biosafety Protocol. A printed copy of the protocol is available in room 641 of R.M. Bock Laboratories and an electronic copy is on the lab server. All lab members should read and be familiar with the Kalejta Lab Biosafety Protocol.

All lab members will receive PPE and individual training from experienced lab members, especially for handling virus and virus-infected cells. Lab members should not perform experiments alone until properly equipped and trained. If for any reason a lab member does not feel comfortable and confident in knowing and mitigating the biological and chemical safety hazards of their experiments, or how to report accidents or spills, contact the PI immediately. Furthermore, if a lab member observes any conduct in the lab that they feel does not meet the precautions described in the Kalejta Lab Biosafety Protocol, they should promptly express these concerns to the PI.

Issues of personal safety while on campus are addressed on the website of the UW-Madison Police Department (https://uwpd.wisc.edu/). The Office of International Students also lists campus safety resources (https://iss.wisc.edu/resources/campus-safety/). These include electronic emergency and crime warnings, free walk and ride escorts, as well as lists of lighted paths and emergency telephones. Lab members are instructed to familiarize themselves with these resources and to use them when appropriate. Specific news updates regarding campus safety are regularly released (https://news.wisc.edu/tag/campus-safety/).

In addition to normal safety considerations, there are situations where additional or alternative safety precautions may need to be enacted. A prime example is the COVID-19 pandemic. When such situations arise, look for additional university resources. For COVID-19 they can be found at www.covidresponse.wisc.edu and https://news.wisc.edu/covid-19-campus-response/ .

Wellness Always.

Laboratory work is demanding and stressful, and can adversely affect ones physical, mental, and emotional health and wellness. As wellness represents a dynamic process of growth and change toward the goal of a healthy, productive, and rewarding life, issues that subtract from an individual's wellness can become impediments and obstacles to success and fulfillment both inside and outside the laboratory. Kalejta lab members should be aware of, and are encouraged to use, the multiple wellness resources offered by UW-Madison. These resources can be found on the web pages for UW Human Resources (https://hr.wisc.edu/well-being/), the UWell Initiative (https://uwell.wisc.edu/), Student Affairs (https://students.wisc.edu/health-and-wellness/), the Dean of Students Office (https://doso.students.wisc.edu/), University Health Services, Mental Health and Wellness (https://www.uhs.wisc.edu/wellness/), and UW Health (https://www.uwhealth.org/health-wellness/main/10433). UW-Madison also has a dedicated news feed for health and wellness issues (https://news.wisc.edu/health-wellness/), as well as an annual Wellness Symposium (https://hr.wisc.edu/wellness-symposium/).

Lab members seeking guidance for wellness issues are encouraged to openly discuss their situation with the PI. If the problem is with the PI, or if the lab member desires outside or anonymous assistance, they are encouraged to consult the UW Madison Ombuds office (https://ombuds.wisc.edu/), whose mission is to provide free and confidential guidance regarding workplace concerns.

Publications on wellness:

Stoewen, D.L. (2017) Can. Vet. J. 58(8):861

https://pubmed.ncbi.nlm.nih.gov/28761196/

Stoewen, D.L. (2016) Can. Vet. J. 57(11):1188

https://pubmed.ncbi.nlm.nih.gov/27807385/

Balance for Achievement.

Scientific research takes considerable time and effort. Normal work weeks are considered as 8 hours a day (e.g., 9:00 AM to 5:00 PM), 5 days a week (e.g., Monday – Friday). New lab members are required to be present during normal work hours so that their techniques can be monitored for safety and effectiveness, and to promote interactions with other lab members and the PI. More experienced and well-trained lab members have additional work hour options (evenings and nights) that can accommodate different schedules, although there will be times and reasons (lab meetings, seminars, etc.) where lab attendance during normal hours is mandatory.

Often, laboratory personnel will work nights and weekends in addition to normal work times. Working more than the customary 40 hours per week is not mandatory but generally encouraged, because it accelerates both the pace of discovery and advancements to measurable benchmarks (e.g., publications, degrees, job offers). Working at night can significantly shorten the time in which experiments can be completed. For example, setting up an overnight Western blot transfer in the evening or plating cells for infection tomorrow can shave a full day off the length of an experiment. Working on the weekend allows for novel ideas or techniques to be tried at a leisurely pace and in the absence of interrupting meetings, classes, or seminars.

The motivation to work additional hours should come from within, from the innate desire to better understand the biological problem being investigated, and the practical ambition to learn, achieve, and advance one's career. Laboratory personnel should not feel pressured to work nights and weekends by the PI or other lab members, and should discuss any feelings of coercion with relevant University resources (see "Wellness" section above).

Laboratory personnel are allotted 2 weeks of vacation per year, 10 sick days per year, and 6 weeks maternity/paternity leave, all with full pay and benefits, and in addition to normal university holidays. Please note that the university does not have stipulated policies regarding leave for graduate students and postdocs, but these numbers are based on the leave lengths available to faculty and staff. Lab members are encouraged to discuss any questions regarding leave with the PI.

Publication on laboratory balance:

Maestre, F.T. (2019) PLoS Comput. Biol. 15(4):e1006914
https://pubmed.ncbi.nlm.nih.gov/30973866/

Teamwork for Advancement.

Our lab will be at its best when we all provide our individual commitment to the group's effort. When we work together toward a shared, common vision, our group accomplishments will far exceed what any one of us can do on our own. Remember, none of us is as smart as all of us, and that there are no self-made people, but that we can all reach our goals with the help of others.

Teamwork can be exemplified in many ways. First and foremost, be aware of what others are doing. Encourage their pursuits, applaud their efforts, support their struggles, and acknowledge their success. Silence is the enemy of teamwork. Our communications with each other must be free, honest, constructive, timely, and designed to build up, not tear down. It is important to remember, when giving or receiving, that people are not criticized, but experiments, data, and conclusions are criticized to make them better.

Treat others with respect, and contribute to an inclusive laboratory environment. Know that everyone is welcome in our laboratory. We actively maintain a diverse and inclusive workplace where we want all to feel empowered to be their authentic, whole selves. We value the visible and invisible qualities that make individuals who they are. Our commitment to inclusion across diverse backgrounds, citizenship, economics, ethnicity, gender, genetic disposition, ideas, identity, military service, national origin, perspective, physical ability, race, religion, or any other aspect that makes people unique is inextricably linked to our creativity and productivity. We put effort into recruiting and retaining laboratory members from historically marginalized and underrepresented groups because inclusivity is our innate identity, and insist that all incoming lab members embrace our vision of equity and inclusion. More information about equity, diversity, and inclusion at UW-Madison can be found at www.diversity.wisc.edu.

Be a good lab citizen by returning reagents to their proper places, keeping common areas clean, doing your lab job faithfully, actively participating in lab meeting, and ordering supplies before they completely run out. Respect other people's experiments, and their use or reservation of common equipment (e.g., don't change the temperature if an incubator is occupied). Finally, inform the PI or proper authorities of any misconduct you witness – if you see something, say something. For research misconduct, inform the PI (Rob Kalejta; rfkalejta@wisc.edu) or the department chair (IMV: Paul Friesen, pfriesen@wisc.edu ; McArdle: Paul Lambert, plambert@wisc.edu). For criminal activity, inform the UW-Madison police department at https://uwpd.wisc.edu/. Hate or bias incidents can be reported at https://doso.students.wisc.edu/report-an-issue/bias-or-hate-reporting/ .

Emily Albright has generated an "Onboarding" document available on the lab server with many of the details you will need when starting out in the laboratory. Topics covered include building and laboratory access, payroll and benefits, safety training, laboratory citizenship, laboratory notebooks, ordering supplies, meetings and seminars, and COVID-19 guidelines. You should refer to that document, as well as this one, not just as you enter the lab, but throughout your time in the lab as well.

Integrity of purpose.

Experiments and data never prove a model; they test a hypothesis. Always remember that the goal of our research is to understand biological truths, not to show that our ideas are correct. To reveal biological truths, all lab members must work with honesty and integrity. Scientific misconduct of any kind is never tolerated and will result in immediate dismissal from the lab. Research misconduct does not include honest errors or differences of opinion, but represents purposeful manipulation of the scientific record such that it no longer reflects observed truths.

Research misconduct is officially defined by the US Department of Health and Human Services Office of Research integrity (https://ori.hhs.gov/definition-misconduct) as fabrication, falsification, or plagiarism in proposing, performing, or reviewing research, or in reporting research results. Fabrication is making up data or results and recording or reporting them. Falsification is manipulating research materials, equipment, or processes, or changing or omitting data or results such that the research is not accurately represented in the research record. Plagiarism is the appropriation of another person's ideas, processes, results, or words without giving appropriate credit.

Examples of fabrication include generating line or bar graphs from data that does not exist. Examples of falsification include image manipulations (splicing together different images to represent a single experiment; changing brightness or contrast in only part of an image; any modification that conceals information) removing outlying data points, and selecting data points or images that are not representative of the experiment or experimental series. Examples of plagiarism include copying word-for-word from a previous publication, and failing to reference prior relevant work (note that references, when possible, should cite the primary source of the information (the original research paper containing the data), not secondary sources (e.g., review articles)).

Scientific misconduct is often reported to be motivated by career pressure. Careers advance upon publishing high-profile papers, which can lead to external or internal pressure to fabricate or falsify results. If such pressures tempt you towards scientific misconduct, talk with your PI or department chair (if the pressure is coming from your PI; IMV: Paul Friesen, pfriesen@wisc.edu ; McArdle: Paul Lambert, plambert@wisc.edu). Know that most journals now routinely screen submitted images for evidence of manipulation, and many require all primary data associated with a paper to be publicly available in a data repository. The motivation to work with honesty and integrity should be the love of science and the desire to seek the truth, but know that, with the ever-evolving forensic tools and increased scrutiny on scientific research, it is now inevitable that if you cheat, you will get caught, and it will end your career.

Scientific misconduct is often detected by colleagues (fellow trainees or supervisors) with knowledge of experimental protocols and access to primary data. Colleagues who suspect scientific misconduct are encouraged to report their concerns to the PI, or if it involves the PI, to the department chair (IMV: Paul Friesen, pfriesen@wisc.edu ; McArdle: Paul Lambert, plambert@wisc.edu). All suspected instances of scientific misconduct will be taken seriously, investigated thoroughly, and confirmed cases will be handled appropriately (education and training for mistakes in good faith; dismissal for knowing acts of misconduct).

Advances in science depend on the reliability of the research record. Sustained public trust in the research enterprise also requires confidence in the research record and in the processes through which it is generated. Any conduct that erodes public trust or contaminates the research record diminishes us all. Our laboratory insists that all members conduct their research with honesty and integrity, and to avoid any and all instances of scientific misconduct. Furthermore, while not addressed under the auspices of research misconduct, any and all other improprieties (bullying, discrimination, sexual harassment, etc.) are strictly forbidden, and all lab members must adhere to our laboratory's accepted code of conduct. Finally, all lab members are required to receive official instruction in research ethics. Acceptable courses include: Oncology 715 Ethics in Science, Microbiology 811 Current Issues in Microbiology, and Biochemistry 729 Responsible Conduct of Research.

Publication on scientific misconduct:

Gross, C. (2016) Annu. Rev. Psychol. 67:693

https://pubmed.ncbi.nlm.nih.gov/26273897/

Read Deeply and Broadly.

Reading the scientific literature is critical for developing hypotheses, learning new techniques and approaches, and expanding your scientific thinking. It should start with the literature generated by your own laboratory, then expand on to collaborators, colleagues, and competitors. One should read deeply about their own specific projects and closely related fields. Review articles are good introductions, but primary research articles must be read and critiqued. Reading deeply in one's field is required, but one should also read broadly to learn about new areas, generate new ideas, and to view your own project from a new perspective.

There are many ways to identify papers to read. For example, you can arrange to have prominent, broad-spectrum high impact journals, as well as specialty journals within your field email you when a new table of contents is published. Similarly, you can arrange to get updates from Pubmed or Google Scholar based on submitted keywords. Periodic, manual searches of Pubmed also work, and unlike other methods, can be initiated when you actually have time to devote to tracking down and reading the papers. Finally, social media is becoming an increasingly viable way to identify new and noteworthy papers.

When reading a paper, start with the title and abstract to get an idea of what the authors are reporting to have shown. Then read the introduction to make sure you have the background to understand the authors' hypotheses and approaches. Spend the most time on the results section, with most of that time spent examining the figures. Read the text of the results so you know what was done and what the authors' conclusions are, but be sure to look at the data yourself, make up your own mind, and draw your own conclusions. Read the discussion, but know that it will mostly be speculation. Look at the materials and methods (or the figure legends) if you need specific information (viral strain, primer sequences, etc.). Keep notes on the papers you read, indicating hypotheses, methods, and conclusions. Share outstanding or controversial papers with your colleagues. Establish journal clubs to stimulate your reading, and hone your critiquing skills. Finally, make sure you apply what you have learned from reading the literature to your own project.

Publication on reading the scientific literature:

Méndez, M. (2018) PLoS Comput. Biol. 14(10):e1006467

https://pubmed.ncbi.nlm.nih.gov/30307941/

Research Design and Methods.

Laboratory experiments must be designed to test a hypothesis, not to prove a specific model (yours or your PI's). They must always have proper positive controls (something that you know will work) and negative controls (something that you know will not work). The best experiments are quantitative and analyzed for statistical significance. Experiments must be repeatable; generally, at least three independent experiments are required (three biological replicates – a completely separate experiment performed on a different day). Whenever possible, perform more than one type of experiment so that hypotheses can be tested in more than one way, providing a robust approach.

Experimental write-ups should be generated in advance, so that you understand not only what you are doing but why you are doing it, and so that you can be sure all the reagents are available, that the proper controls are included, and that obstacles, potential results, and future directions can be anticipated. They should state the general hypothesis, the purpose of the experiment, and the expected outcomes. The rationale for the experimental design (virus strain, multiplicity of infection, cell type, drug concentrations, etc.) and the supporting precedent or literature needs to be listed. The reagents needed (primers, antibodies, etc.) with identifiers where appropriate (manufacturer, catalog number, etc.) and methods used (qPCR, Western blot, etc.) should be listed. Make sure that you understand why every step of the protocol is necessary, and the purpose of every agent that you use. This type of understanding is critical both for interpreting results and troubleshooting when things go wrong. If you do not understand everything about your experiment, ask someone who does. The positive and negative controls should be specified. Sample tubes should be labeled with the date and a specific identifier (not 1, 2, 3, etc.). Finally, the outcome of the experiment should be listed, along with any conclusions, future directions, and troubleshooting comments.

Your laboratory notebook must be detailed, accurate, and current. All lab book entries should be dated and written in English. Consider numbering experiments in sequential order. This record will be used by you to repeat experiments and to generate figures as well as materials and methods sections for papers. Include not only what you did but why you did it (the thinking, rationale, and hypothesis behind the experiment). Presenting representative data accurately is extremely important, so having a meticulous record of your experiments is necessary. It will be used by others in the laboratory to repeat your experiments and to model their own new experiments after yours. An accurate record will also help you and others troubleshoot experiments that don't work. At regular intervals (e.g., monthly), copy files to the shared laboratory server. Organize these files in such a way that someone other than you can understand them. Make sure you not only list the reagents that you used, but where they can be found (-80^{o} freezer, refrigerator, etc.).

Many journals are now requiring that all primary data associated with a paper be deposited in a data repository and be freely available to the scientific community and the general public. Therefore, saving data from all biological replicates in an annotated format is critical.

Publications on error bars and statistics:

Cumming, G. et al. (2007) J. Cell. Biol. 177(1) 7-11
https://pubmed.ncbi.nlm.nih.gov/17420288/

Kass, R.E. et al. (2016) PLoS Comput. Biol. 12(6): e1004961
https://pubmed.ncbi.nlm.nih.gov/27281180/

Writing is Forever.

Write accurately, succinctly, and boldly. Accuracy is required because a major goal of scientific writing is to allow others to understand exactly what you did, so that they can repeat your work and debate your conclusions. Therefore, your write-ups of results, figure legends, and materials and methods should leave absolutely no ambiguity or confusion as to what you did, how many times you did it, and what results you obtained. Your writing is an eternal record of your research that must stand on its own without you there to defend it, and you only have one chance to get it right. Your writing must be sufficiently detailed, complete, and correct. Brevity is required to showcase the most important parts of your work, so they don't get lost in lengthy prose. Writing succinctly is difficult and takes practice. Whenever you write something, go back the next day and cut it by 30% without sacrificing accuracy or appeal. Boldness is required to make your work interesting, provocative, and memorable, and your writing style personal and unique. Bold writing is eloquent and articulate, not arrogant or vain, and for the reader should be intellectually challenging, persuasive, and even inspirational. Lastly, write in the active voice. For example, write “virus X kills cell Y” instead of “cell Y is killed by virus X”.

Titles must grab the reader’s attention and make them want to explore further. Are they going to attend your talk/poster or go get a coffee? Will they click on the link to your paper or keep scrolling through the journal’s table of contents? From your title, people will decide (rightly or wrongly) whether your work is a complete story or a work in progress, mechanistic or descriptive, important or mundane, groundbreaking or incremental, novel or derivative, and ultimately, worth their time or not.

Abstracts need to quickly convince readers of the importance of your work. You have 30 seconds of their undivided attention. Give them enough background and detail so they understand what you did and why you did it, but also convey why you are excited about the work. The emotion generated by your abstract will define whether you are giving a talk or a poster at a meeting, whether an editor will send your paper out for review or reject it on the spot, whether a reviewer is enthusiastic or apprehensive about reading the rest of your work, and whether conference attendees or study section members will view your work with an open mind (or at all).

Grants need to make sure that the reviewers know exactly what you are doing, convince them that you can do it, and most importantly, persuade them that what you are proposing absolutely, positively needs to be done (and that you are the perfect person to do it, or better yet, the only person that can do it). The “why” is much more important than the “what” and the “how”, although those things are certainly necessary. Provide reviewers with the context they need by telling them what is known, what are the gaps in our knowledge, why it is important to fill those gaps, and how you are uniquely qualified to do exactly that. Grants test hypotheses. Make sure the reviewer can locate and understands your hypothesis, why testing it is important, and how you will test it. Tell the reviewers what you will do if your hypothesis is correct, and what you will do if your hypothesis is wrong. Finally, make sure reviewers see the paradigm-shifting potential of your proposed work, and how someday the outcomes will be described in a science textbook. Sell your ideas, your vision, and your abilities.

Publication on grant writing:

Bourne, P.E., and Chalupa, L.M. (2006). PLoS Comput. Biol. 2(2): e12
https://pubmed.ncbi.nlm.nih.gov/16501664/

Tips for writing graduate and postdoctoral fellowships:

1. Why you are doing an experiment is more important than how you will do it.
2. Give reviewers the ammunition they need to defend your proposal using catch phrases and bolding.
3. All reviewers scores count the same; your writing must reach both experts and novices.
4. Most reviewers will only see your Specific Aims page: make it the best page of the grant.
5. Don’t overload reviewers with Background; use the available space for more important things.
6. Just because you want to do an experiment doesn’t mean you should propose it.
7. Just because you propose an experiment, doesn’t mean you have to do it.
8. Experimentally, never ask “if”; always ask “how”.

9. Make sure reviewers understand how this work will someday be a line in a textbook.
10. At the end of each section, include the line "These experiments will show…."
11. Always have alternative plans; show them you are adaptable.
12. Always have future directions; show them where you are going.
13. Describe the quality of the training environment.

Papers are permanent, everlasting proof that you existed, and excelled as a scientist. Writing papers is arguably the most important thing a scientist does. If the data you generate is not viewed or appreciated by others, then it never really existed. When writing a paper, develop the figure set first. Define the narrative or story that your figure set tells. Write the results section succinctly and accurately. Decide if you need additional experiments to complete the story. Tell readers exactly what you did, and exactly your results, because these two things will always be correct and unassailable. Then tell them what you conclude from the data. The conclusions other people make from your data may be different than yours, and your conclusions may change over time based on new data or an evolved understanding, but you need to state your current conclusions with conviction. Next write the introduction. Tell readers what they will need to know to understand the importance and the significance of your work. Write the discussion succinctly but boldly, looking both backwards and forwards. Describe the issues that your work solved (without simply retelling the results), and the exciting new questions it revealed. Admit limitations but focus on strengths and potential. Finally, write the title and abstract, accurately, succinctly, and boldly. Make people want to read what follows.

Publications on how to write papers:

Bourne, P.E. (2005) PLoS Comput. Biol. 1(5):e57
https://pubmed.ncbi.nlm.nih.gov/16261197/

Mensh, B. and Kording, K. (2017) PLoS Comput. Biol. 13(9):e1005619
https://pubmed.ncbi.nlm.nih.gov/28957311/

Ecarnot, F. et al. (2015) European Geriatric Medicine 6(6) p573
https://www.sciencedirect.com/science/article/pii/S1878764915001606?via%3Dihub

Speaking to Inspire.

Presentations are your time to shine, your time to show people the fruits of your hard work. Initially, they are daunting and cause anxiety, but the more talks you give, the more comfortable you will become with telling your story. And be sure to present to your audience a story, not just a collection of experiments and cartoons. You must tailor your talk to the specific audience based on their previous knowledge. Are they virologists, molecular biologists, or high school students? Do they work on something similar to you or something completely different? Are they considering you for a job, or just there to hear great science? As you speak, engage your audience with eye contact, voice inflection, and movement. Speakers who stare at their notes or the screen, talk in low monotones, and hide behind the podium rarely convey their messages effectively. The best talks are based on high quality data. Remember, a slick presentation will never make bad data look good (so spend most of your time at the bench generating great data), but a poor presentation can make good data look bad. Show mostly primary data and save cartoons for models, summaries, and conclusions. Make sure your images and text are visible from the back of the room (by the eyes of an emeritus professor, not a second-year graduate student!). If you can, go to the room, project your slides, walk to the back, and see for yourself. Stick with one major concept per slide, and don't make slides too busy with crammed figures or jammed text. Slide headings should be declarative statements (X needs Y to accomplish Z) not descriptive (Analysis of X and Y during process Z) and not questions to be answered (Does X need Y to accomplish Z?). Impress your audience with the quality of your work, not the quantity. In a talk, less is usually more. Always adhere to your time limit. Nothing is worse than a scientific talk that never ends. Leave them wanting more. Good talks start by telling the audience what you are going to tell them, continue by telling it to them, and end by telling them what you told them. Be personable. Make them feel smart. Make them like you. At the end, they should walk out thinking to themselves "I knew a lot of that stuff, but I did learn something new today. I'm interested to see how their stuff turns out".

Publications on how to give talks and posters:

Bourne, P.E. (2007) PLoS Comput. Biol. 3(4):e77

https://pubmed.ncbi.nlm.nih.gov/17500596/

Flemming, N. (2018) Nature Career Guide

https://www.nature.com/articles/d41586-018-07780-5

Erren, T.C., and Bourne, P.E. (2007) PLoS Comput. Biol. 3(5):e102

https://pubmed.ncbi.nlm.nih.gov/17530921/

Generalized Timelines:

Below are listed milestones that lab members should strive to achieve in the noted time frame. But please remember, everyone is different and every project / career is different, so use these as guidelines, not demands. Don't compare yourself with others, but ask yourself if you are giving your best effort and focus, and utilizing the training and guidance provided by the PI and other members of the laboratory.

Graduate Students:

Year 1:
- Learn and follow lab safety protocols
- Read, know, and understand all lab publications; keep notes
- Grow and titer all required viral and cellular stocks
- Attempt to repeat any necessary results achieved by former lab members

Independently confirm reagents given to you
Establish a mentoring committee and hold the first meeting
Begin formulating research plan and pre-doc fellowship application plan
Complete annual Individual Development Plan; discuss with PI

Year 2: Complete all required coursework including Oncology 640
Read, know and understand all literature relevant to research area
Become a more active participant in laboratory meetings
Generate preliminary data for candidacy exam research proposal
Submit pre-doc fellowship application
Write, defend and pass candidacy exam research proposal
Update annual Individual Development Plan

Year 3: Expand scope of literature reading
Actively participate in lab meetings and seminars by asking questions
Develop mentoring skills (train rotators or an undergraduate)
Generate data sufficient for submitting a meeting abstract
Explore the multiple career options in science beyond academia
Update annual Individual Development Plan

Year 4: Continue to expand the scope of literature reading
Assume leadership roles during lab meetings
Be a resource for junior lab members
Hone mentoring skills
Present data at an international conference
Write and submit a manuscript of primary data
Take full ownership of your project; drive it in new, interesting directions
Begin planning for after graduation
Update annual Individual Development Plan

Year 5: Read the literature broadly
Publish your primary data
Know more about your project than the PI
Generate a concrete plan for after graduation
Begin writing your thesis
Update annual Individual Development Plan

Year 6: Publish primary research and a review article
Successfully defend thesis
Leave behind laboratory records understandable to future lab members

Postdocs:

Months 0-6: Learn and follow lab safety protocols
Read, know, and understand all lab publications

Grow and titer all required viral and cellular stocks
Attempt to repeat any necessary results achieved by former lab members
Independently confirm reagents given to you
Begin formulating research plan

Months 6-12: Read, know and understand all literature relevant to research area
Generate data
Become a more active participant in laboratory meetings
Submit fellowship applications
Complete annual Individual Development Plan

Year 2: Expand scope of literature reading
Be a leader for lab meetings (organization; preparation; feedback)
Actively participate in lab meetings and seminars by asking questions
Develop mentoring skills (train rotators or an undergraduate)
Generate data sufficient for submitting a meeting abstract
Take full ownership of your project; drive it in new, interesting directions
Explore the multiple career options in science beyond academia
Update annual Individual Development Plan

Year 3: Continue to expand the scope of literature reading
Be a resource for junior lab members (prospectively and retrospectively)
Hone mentoring skills
Present data at an international conference
Write and submit a manuscript of primary data
Know more about your project than the PI
Begin planning for next stage of career
Update annual Individual Development Plan

Year 4: Read the literature broadly
Present new data at an international conference
Publish your primary data
Generate a concrete plan for next stage of career
Update annual Individual Development Plan

Year 5: Publish primary research and a review article
Find a job
Leave behind laboratory records understandable to future lab members