# What is this slide deck about?

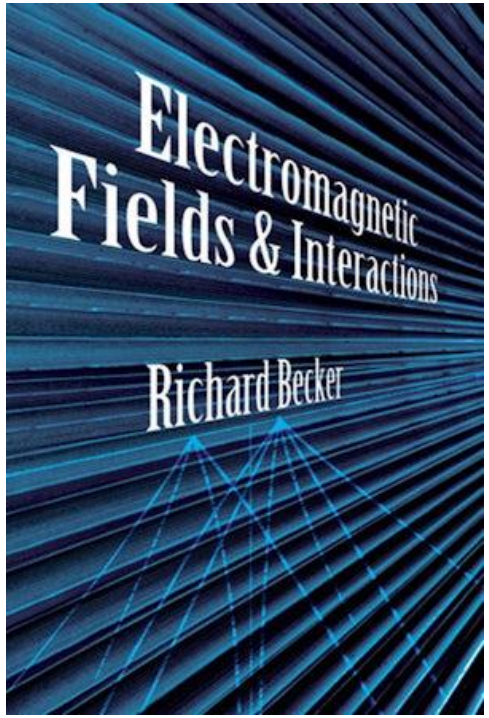
- Philosophical approach to *Education and Research* in the Reppert group.

- The goal is to lay out for all group members:
  - Who you should be/what you should know (scientifically) when you leave this group.
  - How we make sure that happens.

# Why does this matter?

Motivating example: *Richard Becker*, author of my favorite science text.

Not particularly well known as a researcher. But he very successfully passed on scientific excellence to his students.




## Early life [ edit ]

Becker was born in Hamburg. His studies in zoology started in 1906 at the Albert Ludwig University of Freiburg, where he earned his doctorate in 1909 under August Weismann. After hearing lectures by Arnold Sommerfeld at the Ludwig Maximilian University of Munich, Becker turned his professional interest to physics. He also studied physics under Max Born at the Georg-August University of Göttingen, and Max Planck and Albert Einstein at the Humboldt University of Berlin. Becker completed his Habilitation in 1922 under Planck.[1][2][3]

| Academic career | |
|---|---|
| **Doctoral advisor** | August Weismann |
| **Doctoral students** | Herbert Kroemer, Egon Orowan, Wilhelm Brenig, Peter Haasen |

During World War I, Becker worked in German industrial organizations, including the Kaiser-Wilhelm Institut für physikalische Chemie und Elektrochemie and the lighting manufacturer Osram.[1][2]

In 1919, Sommerfeld recommended three of his students as qualified to become physics assistant to the mathematician David Hilbert at Göttingen. The list included Adolf Kratzer, Becker, and Franz Pauer. Kratzer, first on the list, went to Göttingen.[4][5]

Becker's students included Eugene Wigner, who received the Nobel Prize in Physics in 1963, Rolf Hagedorn,[12] Wolfgang Paul and Hans Georg Dehmelt, who shared the Nobel Prize in Physics in 1989, and Herbert Kroemer, who received the Nobel Prize in Physics in 2000.[1]

https://en.wikipedia.org/wiki/Richard_Becker_(physicist)

**The point**: The greatest research impact is through the next generation. ***You*** are the primary deliverable of our research.

# Grad Students

# PhD Expectations: Scientific Knowledge

- **On your thesis topic**:
  - Be the world expert
- **In your Specialty** (e.g., protein vibrational spectroscopy):
  - Understand *thoroughly* what other people are doing.
  - Be ready to independently lead new projects.
- **In your discipline** (e.g., PChem):
  - Understand *generally* what other people are doing.
  - Be ready to participate in new projects (and, in time, lead them)

**In your field** (e.g., Chemistry):

- Be conversant with others about their work
- Learn to assess quality and significance of developments in the field
- Be able to recognize connections between fields ==> "creativity"

**In society**:

- Understand the broader impact (and limitations) of scientific research
- Have a mature sense of scientific ethics and responsible research conduct

# PhD Expectations: Management & Leadership

**Publication:**

- Publish at least one first-author paper before graduation
- Preferably more + co-authored publications

**Communication**:

- Written – formal & informal
- Oral – formal & informal
- Graphics
  - Design principles
  - Software/languages
- Story-telling:
  - Logical structure
  - Gap analysis
  - Transitional cues

**Management:**

- Learn to self-motivate
- Set ambitious but realistic goals
- Learn how to get "unstuck"
- Balance work and life
- Work and communicate effectively with others
- Develop a pay-it-forward mentality:
  - "Ask not what your lab can do for you; but what you can do for your lab."
- Develop your own sense of what research is "important" in science

# Undergrad Students

# Undergrad expectations

**First Semester**:

- Learn as much as you can
- Help as much as you can
- Be pro-active in communicating with your mentor and with the PI

**Second semester**:

- Choose (together with PI) a topic to focus on
- Assist mentor in that project
- Start thinking about an independent project

**Third semester & beyond**:

- Select (with PI) a publication target
- Begin independent work toward that target
- Become the world expert in that project

**Publication**:

- Depends on your goals
- If aiming for grad school, try to have at least 1 co-authored paper submitted before applying.

# Postdocs

# Postdoc expectations

- Lead by example – work ethic, responsible research conduct, collegiality, communication, etc.
- Be a world expert in *something* when you enter the group
- Become a world expert in *something else* while you're in the group
- Be proactive in driving your project forward
- Identify areas where you need to grow and get targeted help
- Help grad students and undergrads wherever possible

**Publication**:

- Aim to publish 1+ first-author paper per year.
  - Lag time! First paper likely won't be published in first year

# So how do we do this?

# How do you build scientific knowledge?

- **On your thesis topic**: Be proactive!
  - Mess around in the lab
  - Formalize & present your thinking
  - Read the literature
- **In your Specialty** (e.g., protein vibrational spectroscopy):
  - Read the literature
  - Attend conferences & ask questions
- **In your discipline** (e.g., PChem):
  - Read the literature
  - Prelim exams + Foundation courses
  - General course work
  - Group activities:
    - Core PChem

**In your field** (e.g., Chemistry):

- Attend seminars & conferences
- Teach!
- Read the literature

**In society**:

- Outreach & Education
- Read the literature
- Engage in constructive discussion
- Group activities:
  - Ethics discussions

# Group resources

- PyFAQs + Core PChem questions posted to group website
- Review 1 question/day at morning check-in
- More extensive coverage at periodic (voluntary) "review" sessions

- In development:
  - Put together a framework for Biochem Core Knowledge

# Group Meetings

Key functions:

- Communication
  - Keep goals/objectives in focus
  - Administrative updates
  - Regular practice in *formal* presentation + informal discussion/trouble-shooting
- Literature
  - Help entire group stay abreast of current literature
- Training – e.g., blackbody correction
  - Upon request/need.

- Format:
  - 10 minutes: Administration/goals
  - 10 minutes: Lit update from one group member
  - 10 minutes: Formal research update (one group member/5 slides)
  - 20 minutes: Discussion