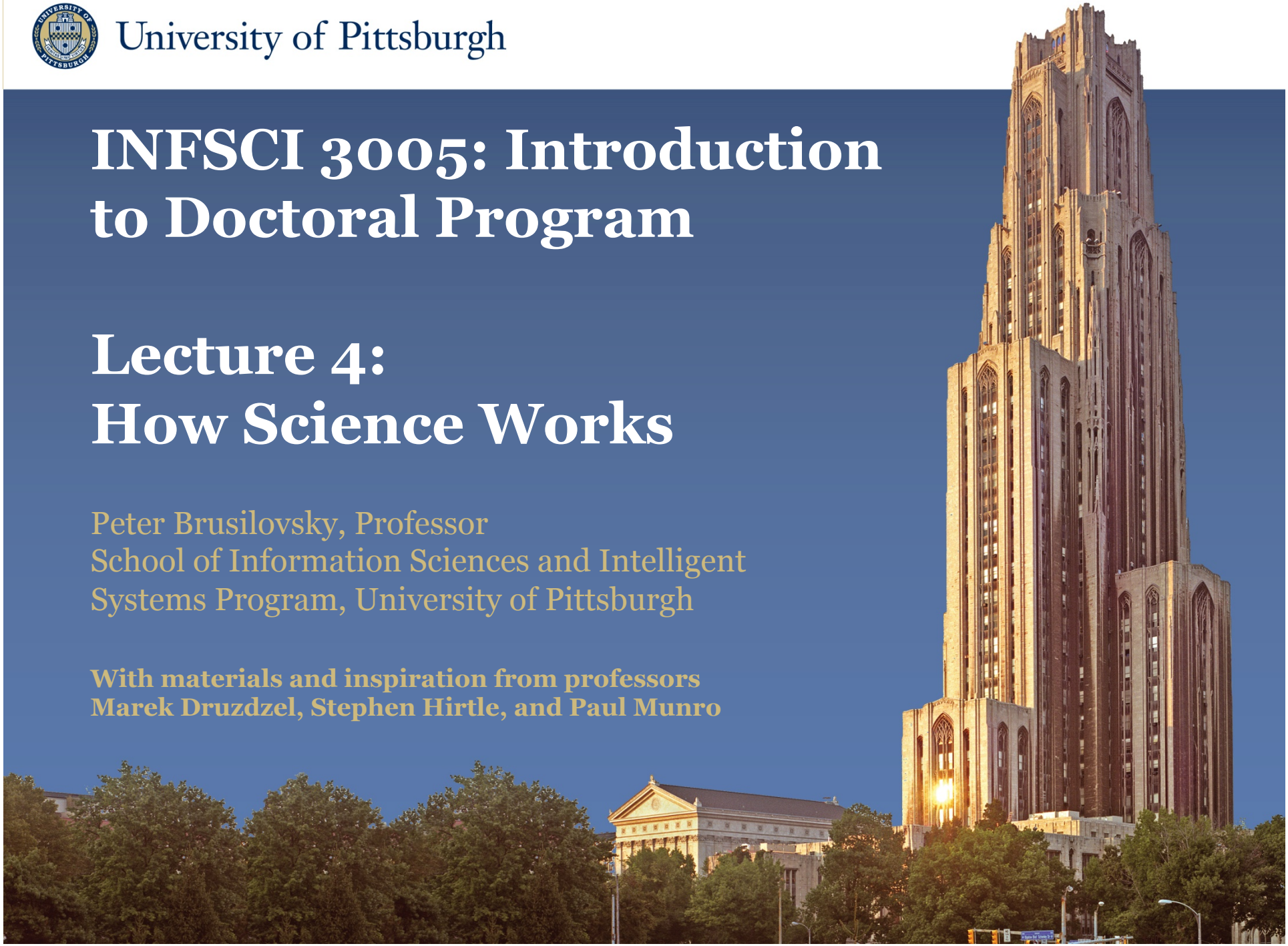


University of Pittsburgh

INFSCI 3005: Introduction to Doctoral Program

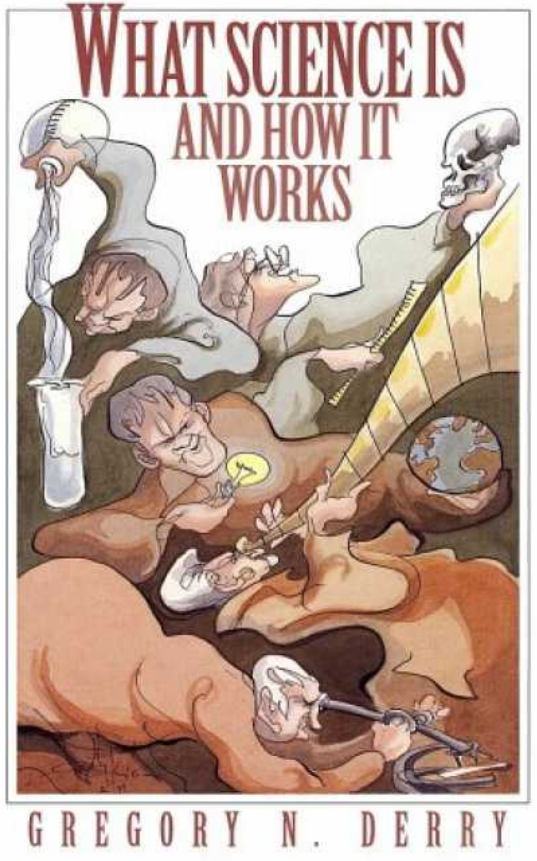
Lecture 4: How Science Works

Peter Brusilovsky, Professor
School of Information Sciences and Intelligent Systems Program, University of Pittsburgh

With materials and inspiration from professors Marek Druzdzel, Stephen Hirtle, and Paul Munro

How Science Works

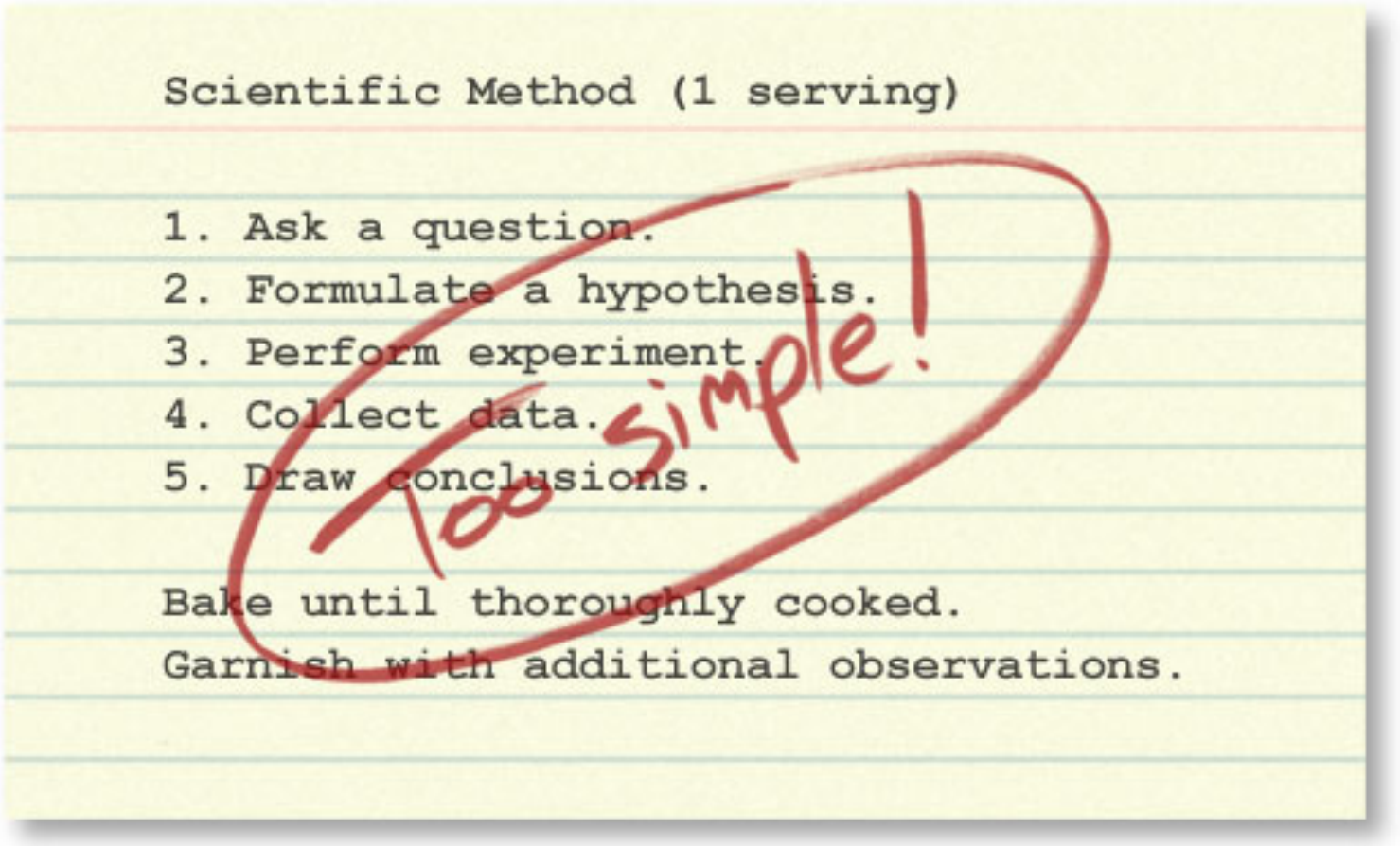
- What you should have learned in School
- History of the Scientific Method
  - Aristotle
  - al-Haytham
  - Galilei
  - Bacon
  - Descartes
- Structure of the Scientific Method



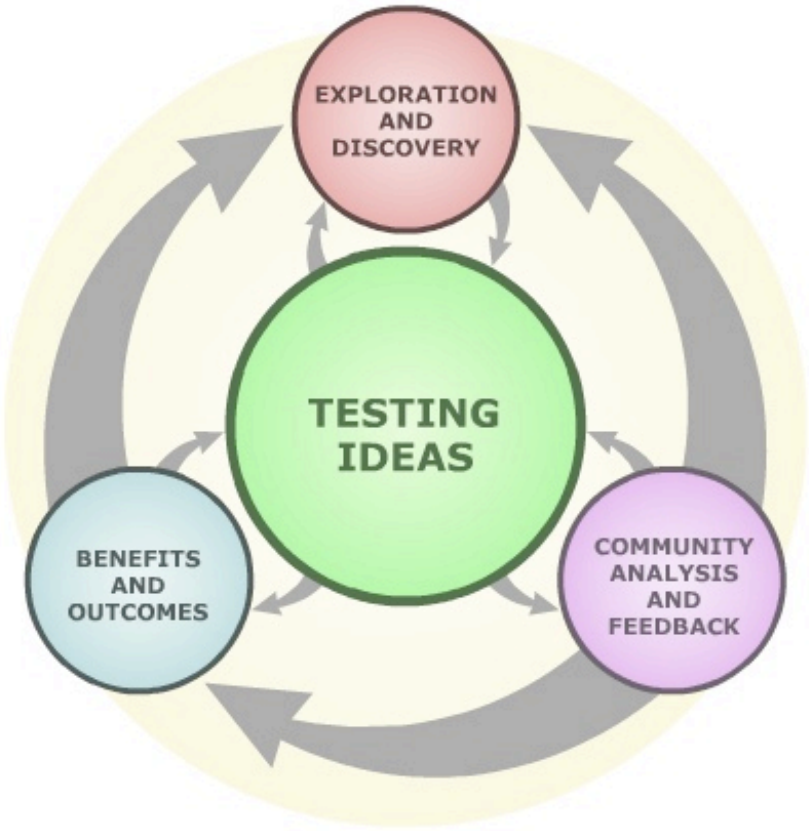
The Scientific Method

1. Define the question
2. Gather information and resources (observe)
3. Form hypothesis
4. Perform experiment and collect data
5. Analyze data
6. Interpret data and draw conclusions that serve as a starting point for new hypothesis
7. Publish results
8. Retest your work (frequently done by others)

Too Simple?


Scientific Method (1 serving)
1. Ask a question.
2. Formulate a hypothesis.
3. Perform experiment.
4. Collect data.
5. Draw conclusions.
Too simple!
Bake until thoroughly cooked.
Garnish with additional observations.

How Science Really Works



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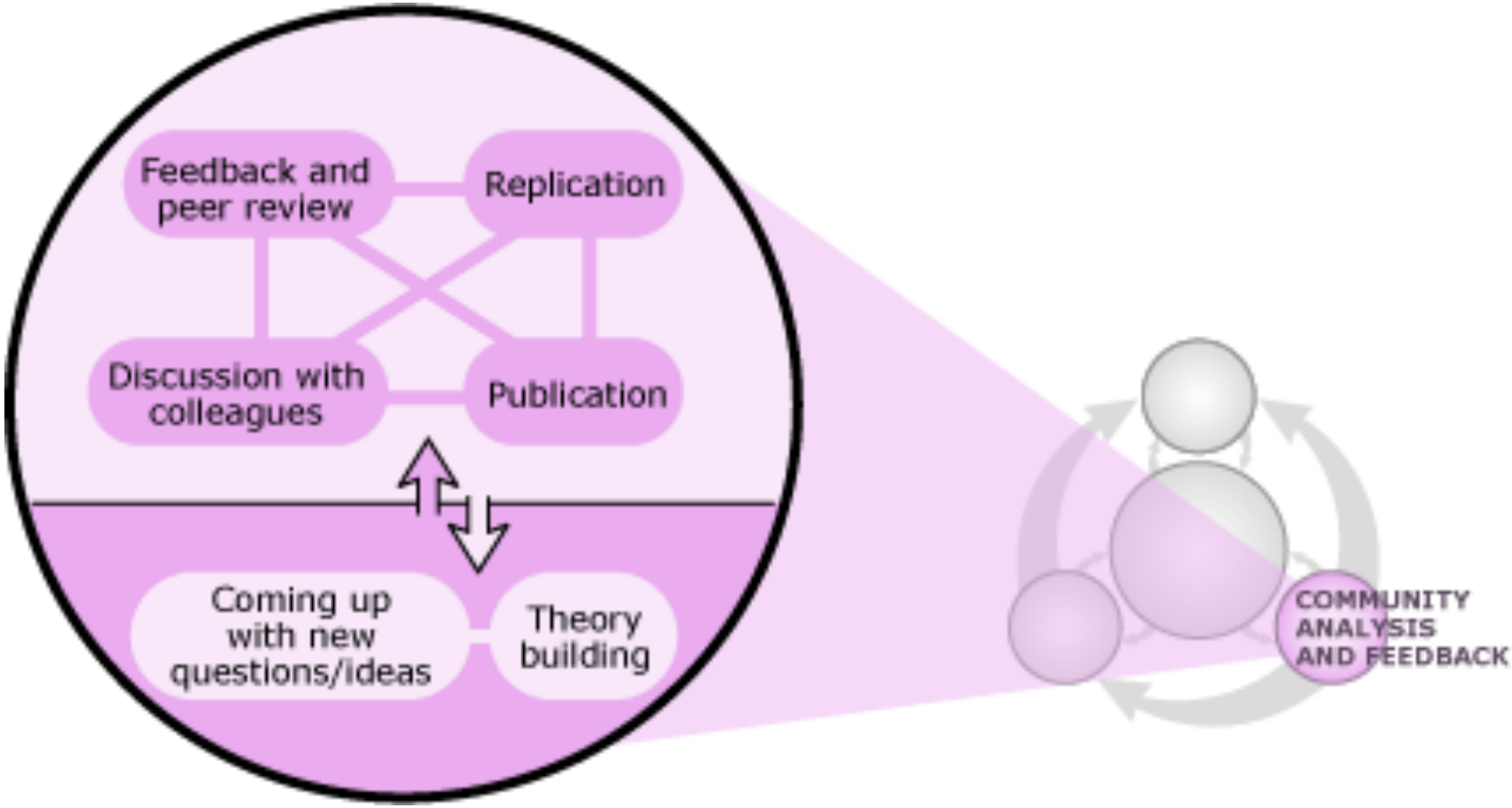
The Social Side of Science



The Community is…

- Source of ideas
- Place to discuss and test ideas
  - Colleagues, presentations, workshops, conferences
- Place to report results
  - Publishing, conference talks, research colloquia
- The mechanism to evaluate quality of ideas, results, contributions
  - Peer review
  - Replication
- The mechanism to propagate ideas
  - Citation
  - Publicity
  - Impact

The Community Judges

- Whether your paper should be published, whether you should get money, tenure, research space, etc., is judged by your peers
- Whether you should get a Ph.D. is judged by your peers
- Whether you have made a big contribution is judged by your peers (sometimes posthumously)
- *Science is not free of jerks, although there are more of them in other enterprises: The rewards for being a jerk are not that high in science (MD).*

Elements of the Scientific Enterprise

- Publications
- Grants
- Peer Review
- Networking
- Professional Societies
- Conferences

Publication: Sharing Ideas & Results

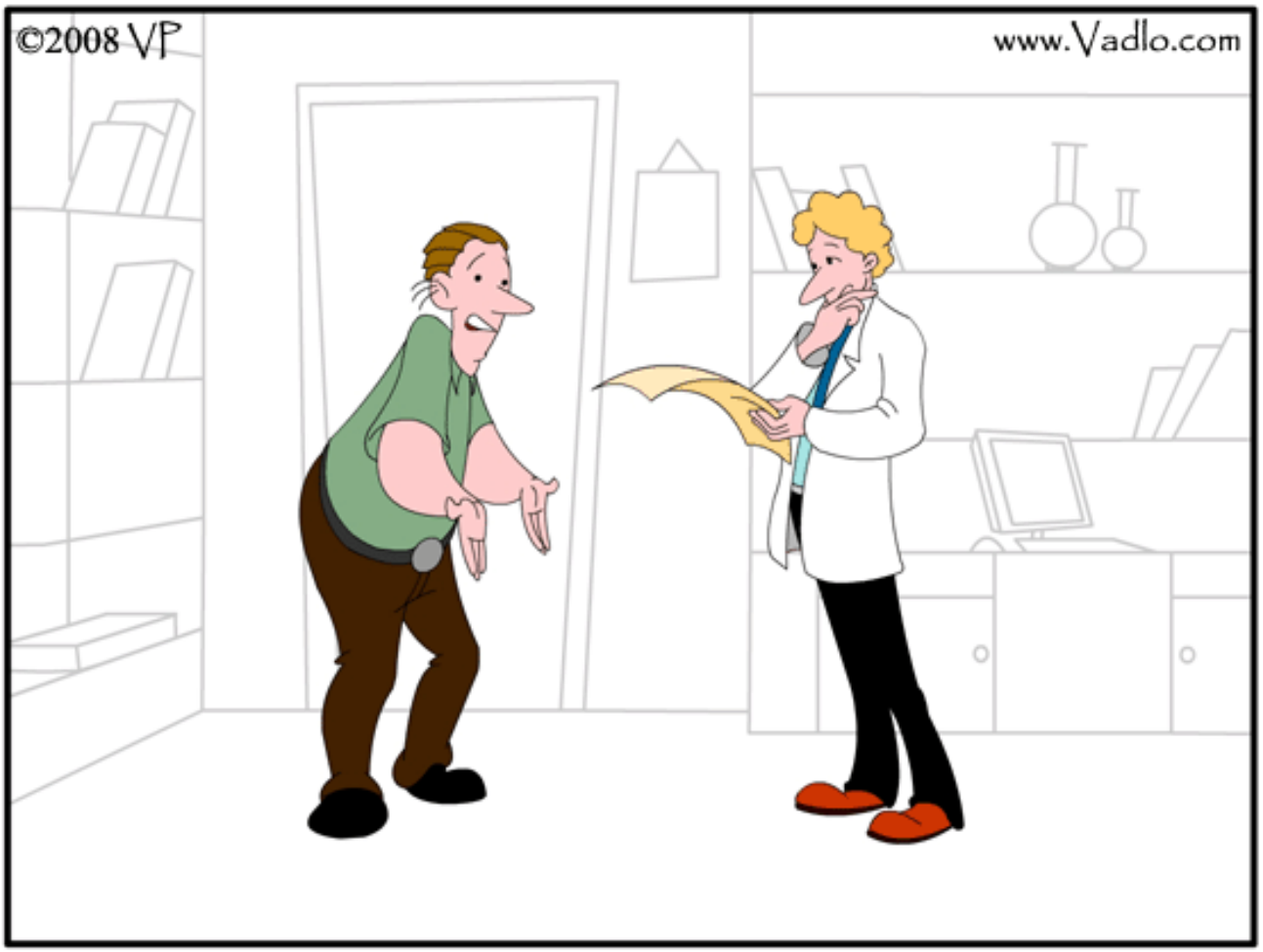
- *Oral presentations*
- Technical reports, web pages, no review.
- Workshops, symposia, annual meetings, non peer-reviewed conferences. Very fast, some review during the acceptance process and during the presentation. Good to share ideas, early results
- Peer reviewed conferences. Reasonably fast and can be reputable (in our field). Subject to "stupid reviewers"
- Magazines. Publicizing your research broadly. Some are competitive
- *Archival* Journals. Slow, reputable; archival purpose. Subject to "stupid reviewers," but you can argue with them
- Edited Books. Thematic collection of papers. Weak peer review.
- Monographs. Some are fundamental works that are meant to provoke, stir up, and disseminate a whole new view of a discipline. Sometimes summarize years of your work (published earlier)

Publish or Perish

- Your publication record is the most important information about your research
- Job Search
- Promotion and Tenure
- Quantity vs Quality
- Citations

"Surely you were aware when you accepted the position, Professor, that it was publish or perish."

Grants: Serious Work Needs Money



*With this much grant money, only experiment we can do is **"flip a coin"**!*

Grants

- Grant: allocating a piece of (limited) resources to you
- Gives you money to buy equipment, to travel, to fund doctoral students who will do the groundwork for you
- An indirect way of saying to you: This is a good piece of research. It is the right thing to do now
- A way to steer research to the priority directions

Funding Agencies

- National Science Foundation
- National Institute of Health
- US Department of Energy, Education
- Military agencies
  - DARPA, IARPA
  - Navy
  - Air Force
  - Army
- Foundations
- Industry

Peer Review

The basic mechanism of advancement in science

- Your work is judged by people working in the same area.
- Used in scientific publications and in allocating financial resources.
- Watch out conflicts of interest.
- The process is imperfect, but still good things will eventually get out to the world.
- Do it well - it is your moral responsibility.
- Treat others the way you would like to be treated.
- If you criticize somebody' s work, you should be able to show a superior approach.

Networking

- You need to know people and you need to be known
- Identify leading researchers and other interesting people in your area
- Find a chance to get know – meet, write
- Use presentations wisely: ask questions, talk with a speaker
- Attend professional conferences and use most of it
- Make connections from your work to the work of others, make yourself known
- Use address book and social linking tools to maintain contacts

Professional Societies

- Professional Societies are organized by researchers to help advancing their field
  - A group of like-minded researchers
  - Publish good quality journals
  - Organize professional conferences
  - Recognize leaders through awards
- A professional society can help you to advance your career
  - ACM (SIGART, SIGCHI, SIGWEB, SIGIR…)
  - IEEE Computer Society
  - ASIS&T
- Join as a student, take most of it

Conferences

- Publication venue
- Networking place
- Received the most up-to-date information about your field
  - Papers
  - Questions and discussion
- See the word
- Try to attend at least one conference per year

Which conference?

- Which factors are important when selecting a conference to attend?

Judging the Quality

- Conference quality
  - First tier, second tier, and weak and junk conferences
  - Judging the organizer
  - Judging program committee
  - Fighting bogus conferences, SciGen
- Journal Quality
  - Journal Board, Editor
  - Publisher
  - Indexing
- Book Publisher Quality

Making an Impact

- Quality first!
  - Publish good quality work well-positioned in context other research
  - Invest in good writing and proofreading
- Pick up good sources to publish your work
  - Topic-relevant, good quality conferences and journals where you work have a higher chance to be noticed
- Make yourself known
  - Participate in professional societies, conference organization, organize workshops
- Promote your work
  - Share papers on research networks (RG, Academia, Mendeley..)
  - Establish Google Scholar (Arnet, Semantic Scholar) profile
  - Use social media (LinkedIn, Twitter)
  - Introduce your work to peers at the conferences
  - Share with authors of similar work, offer comparisons
  - Do not spam! Use legitimate sources and reasons!