Al-Mustaqbal University

College of Science

# Scientific Thinking and Research Skills

**Third Year Students / 1st Semester**

**Research skills, continued**

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***Biochemistry Department***

*By*

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# Skill 7: Problem solving and adaptability

- Find suitable tools to answer a question or to solve a well-posed problem
- Be able to **adapt** yourself to the context
  - Turn a problematic situation into an interesting research problem
- Read, read, read
- Don’t get discouraged, a solution can always be found


“We look for people who can quickly adapt to changes in the workplace.”

# Skill 8: Self-critical eye

- If you are too sure of your research results, you will never notice the flaws
- If you are too unsure, you will never start
- Flaws should be considered and noted, they may be useful later to modify the theory to make space for them
  - This can be a source of great results
- Have your work read by others and listen to the comments and suggestions
  - Humbleness: there is always something you can learn from others

# Skill 9: Being able to learn lessons

- A system or a tool may be a useful object, and experiments may be good, but what is most important is the general lesson learnt by developing it
  - Others (or yourself) can use this lesson to build different tools or to define other experiments
- Same also for a theorem, but less crucial since a theorem is already a way to abstract and generalize what has been seen in a specific case
- Learn also from failures (or from rejected papers)
- Work locally, think globally
  - Work hard on your specific propagator, but think about the general consequences of your results

# Skill 10: Independence and courage

- Independent thoughts
  - Not just following others' ideas
- Courage to pursue your ideas
  - Self-confidence
  - Also courage to know when to stop
- Don't worry to state your ideas and to be criticised
- Better to be criticised than to be ignored
- No need for people who follow others

# Skill 11: Communicating your results

- A paper
- A talk
- A Ph.D. thesis
- General advice:
  - The idea and motivation is important, not just the technical details
  - The simpler your way to present your idea, the more chances people will pay attention

# Skill 12: Participate in the academic system

- Write a review
  - Reviewers are there to help science go forward, just like authors
  - … not to help their papers by killing others!
- Ethics
  - The most important asset of a researcher is his reputation
  - Freedom in what to do, but we need to have high ethical standards
  - Honesty
- Have a good attitute!
  - The advancement of science is a distributed collaborative effort

# General advice 1: Work hard

- Given two people with equal abilities, the one who works 10% more will produce twice as much
- The more you know, the more (and faster) you learn, the more you can do

# General advice 2: Drive and commitment

- You should be committed to your research
- This is not a 9 to 5 job
- It should not be a sacrifice, but an opportunity to do something you enjoy

# General advice 3: Openess to other people

- Be open to others and to others' work
- Read a lot
- Talk a lot with other people
- Open vs. closed office doors
  - People who work with a closed door produce more in the short term but obtain less, and less interesting results, in the long term

# General advice 4: Collaboration

- Most great work comes out of collaborations with others
- More than one point of view
- Faster definition of the problem
- Solving eased by resorting to more available techniques
- More fun

# General advice 5: Be open to many diverse experiences

- Take different courses
- Go to summer schools and conferences
- Spend periods in industry or other labs
- One never knows what can come out
- Never a waste of time!


Google
Summer of Code 2008

# Summary

- Many research skills
- You can learn/improve your research skills
- You can produce sustained great research results if you are committed, open, enthusiastic, honest
- Work hard and enjoy what you do

# Some useful sources

- **You and your research**, R. Hamming
- **Technology and courage**, I. Sutherland
- **Basic research skills in computing science**, C. Johnson
- **What is research in computing science?**, C. Johnson
- **How to give a good research talk**, S. L. Peyton Jones, J. Hughes, J. Launchbury
- **How to write a good research paper**, S. Peyton Jones
- **How to organize your thesis**, J. W. Chinnek
- **How to have a bad career in research/academia**, D.A. Patterson
- **Ethical constraints**, Toby Walsh