Get the most out of your Research

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Collegiate Science and Technology Entry Program Workshop

February 18, 2011

University at Buffalo The State University of New York

Motivation for this Presentation

- Increase your familiarity
- Improve your understanding
- Add to your longevity

What does getting the most out of your research mean to

YOU

University at Buffalo *The State University of New York*

Grade Yourself :

Future research aim is to become highly proficient on the

RUBRIC

Getting ideas from the best

“

To steal ideas from one person is plagiarism, to steal ideas fro

”

- Humorous quote w/real connotations

Exercise : Who should you know

Write down your major

What are 3 active areas of research

Name 10 highly reputable researchers in your field.

First try this w/o using resources, then use resource like the internet for assistance

Priorities of a Researcher

- Creating new Knowledge
- Grant Money
- Publications
- Reputation
- Good researchers in the lab
- Teaching

- Science
- Presenting
- Travel
- Invited Talks
- Tenure

Getting the most out of your research

1. Understanding research from a perspective of :
   - Accomplishments
   - Abilities
   - Culture
   - Character
   - Skill Set
1. Then applying the knowledge obtained

   to gain a competitive advantage that enhances collaborations and easily allows you to navigate paths of anticipated complexity

Abilities

Getting the most out of your research

ABILITIES

Speaking
Reading
Writing
Designing
Funding

Good scientists talk talk talk

The ability to talk well is the single most important ability of a researcher

Research talk includes

- Selling your research
- Effective Presentations
- Elevator speech
- Story telling
- Chalk Talk

Selling your research

Name your topic

- I am studying …….

Imply your question

- Because I want to find out who/how/why……..

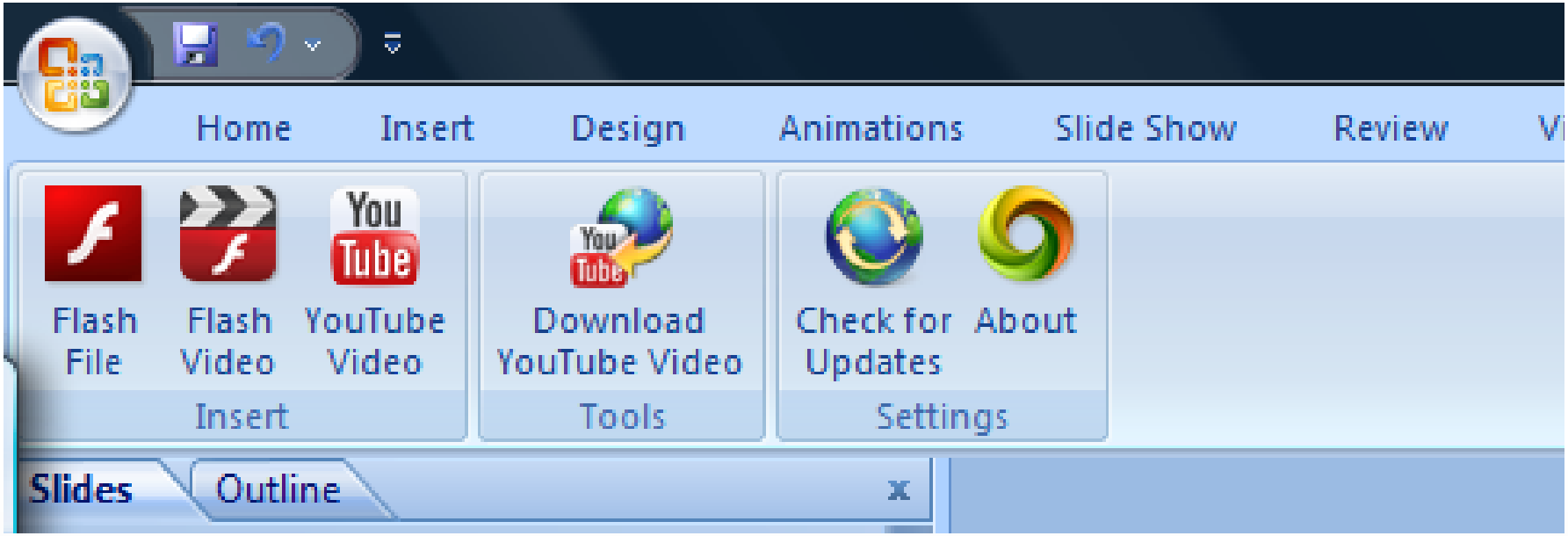
Set the rational for the question and the project:

- In order to understand how/why what ……

For an effective talk

- Be optimistic about whatever you are talking about
- Take your time
- Keep your audience in mind
- Connect to real life issue
- Attend Talks
- Look up You Tube Videos
- Look up press releases

MULTIMEDIA



http://www.globfx.com/downloads/showroom/formerly_swfpoint.php

Show room
Swish

RESEARCH RELATED FLASH

Depiction of micelle encapsulation

YOUTUBE VIDEO - CSTEP

Getting the most out of your research

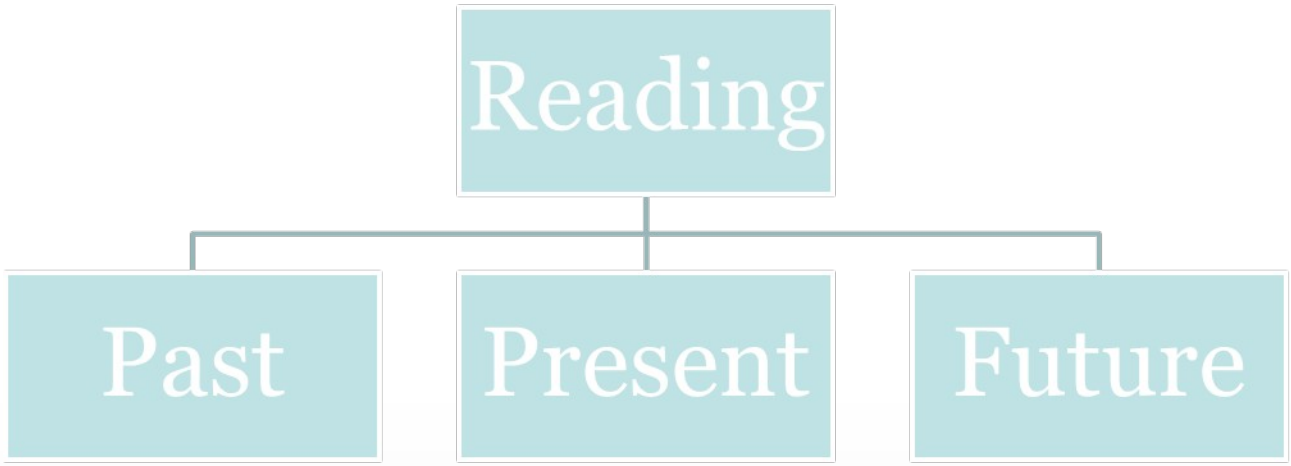
MAXIMUM
Give memorable talks at National meetings

MINIMUM
Listen to good talks

To do : Talk with family, friends and acquaintances about your work in a way that gets them excited.

Google good and bad presentations

READING is key to intelligence



Papers
Patents

Conference
Proceedings

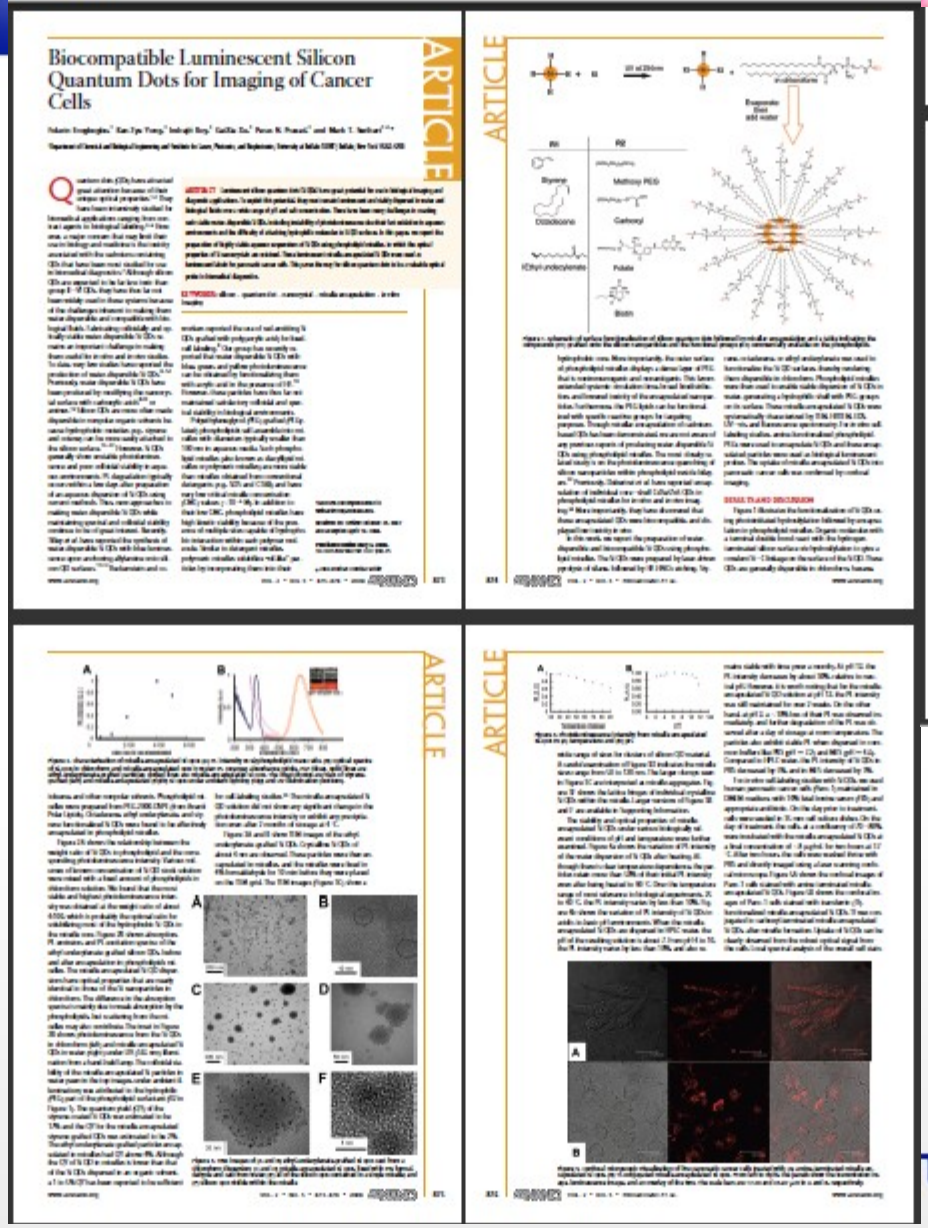
Grants

READING

For Scientific papers :

- Select relevant article (Author, journal)
- Read abstract
- View Figures and read caption
- Read conclusion
- Read paper / check references
- Critique paper/get ideas

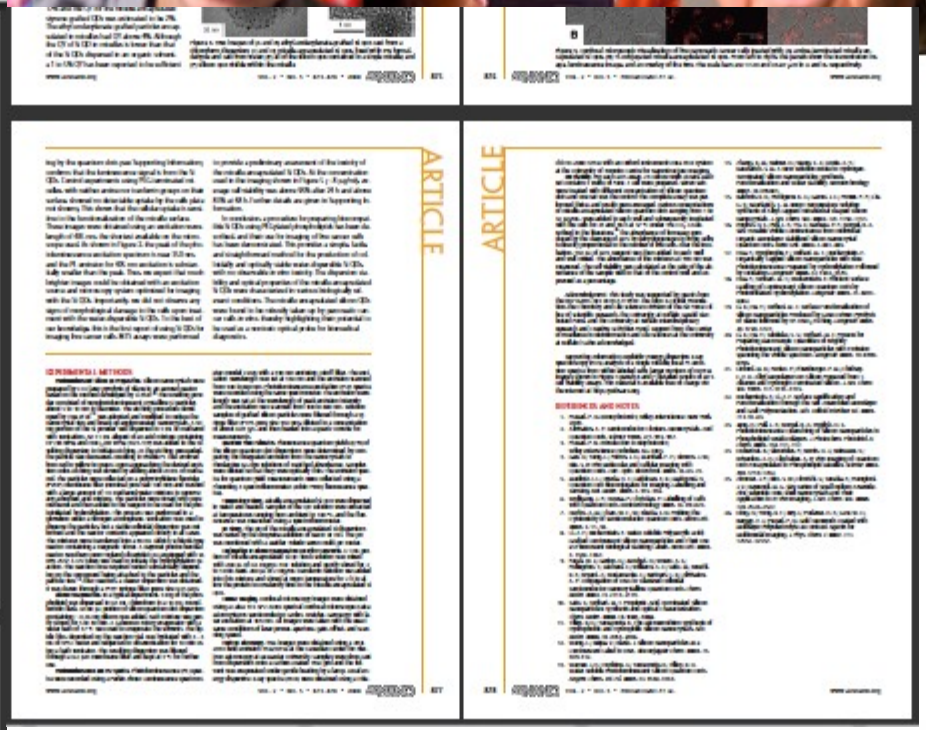
Nature Precedings : doi:10.1038/npre.2011.5702.1 : Posted 18 Feb 2011



Biocompatible Luminescent Silicon Quantum Dots for Imaging of Cancer Cells

ARTICLE

ARTICLE



ARTICLE

ARTICLE

ARTICLE

Read patents for more details

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READING – Conference Proceedings

Ex. ABRCMS, CSTEP, MCNair

-Will be more specified the longer you stay in research

Grants

- NIH
- http://projectreporter.nih.gov/reporter.cfm
- NSF
- http://www.nsf.gov/awardsearch/index.jsp

Getting the most out of your research

MAXIMUM

Read multiple papers, critique and review relevant literature

MINIMUM

Read a paper

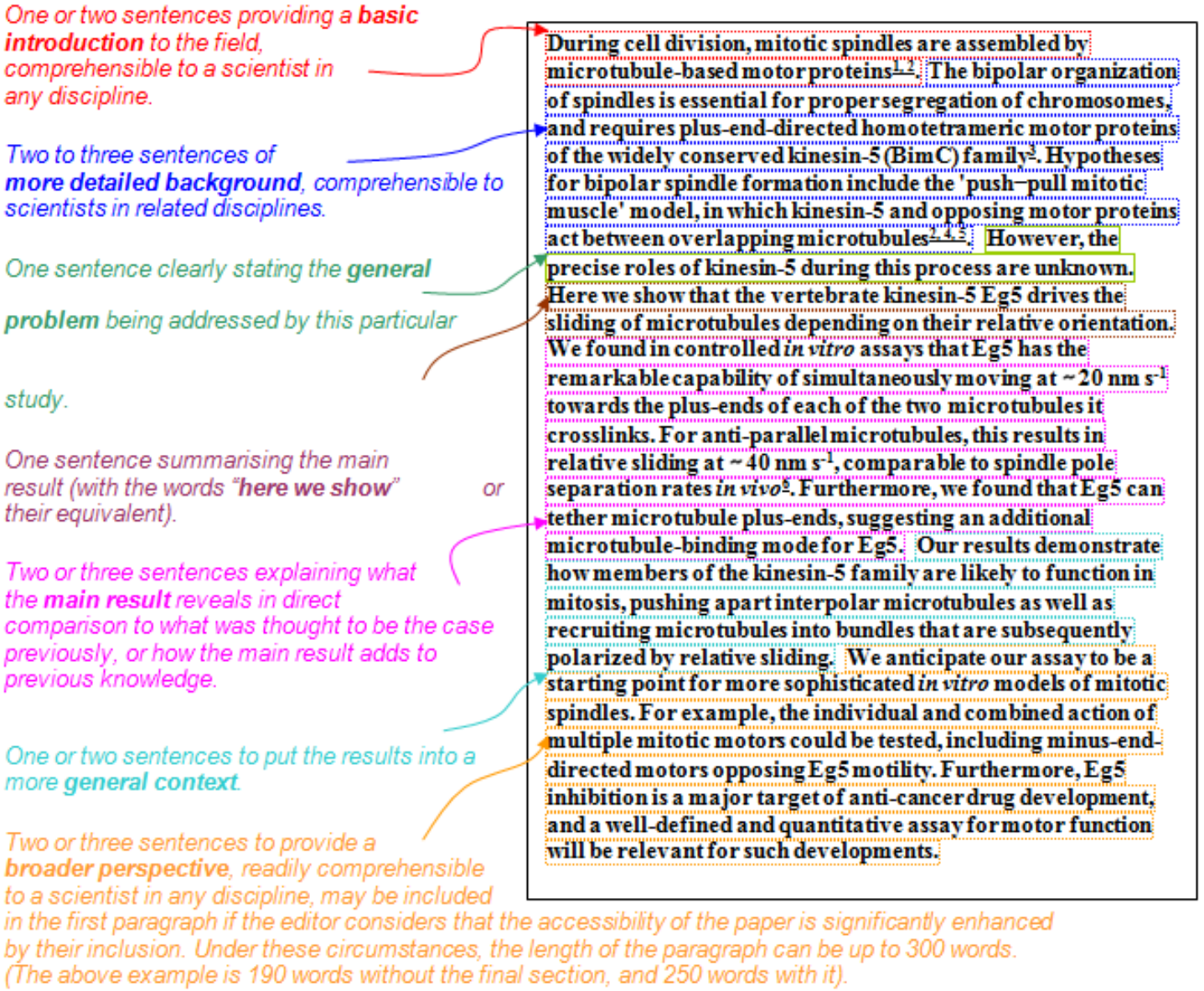
To do : Read literature that is pertinent to your work, critique it

Writing abstract

An abstract is a short summary of your completed research. If done well, it makes the reader want to learn more about your research

For an abstract – write :

- Motivation/problem statement
- Methods/procedure/approach
- Results/findings/product
- Conclusion/implications



Getting the most out of your research

MAXIMUM

Write abstract for a top quality research journal conveys the work and it's broader impact

MINIMUM

Write what you did

To do : Read abstract templates e.g. nature abstract, rewrite someone else's abstract

WRITING : Picking templates

Templates are used for just about everything one produces

NEVER WORK WITHOUT A TEMPLATE

Finding Templates

Get Paper Templates – Journal websites

Templates

- Download
- Recreate

Modify old templates

Recycle

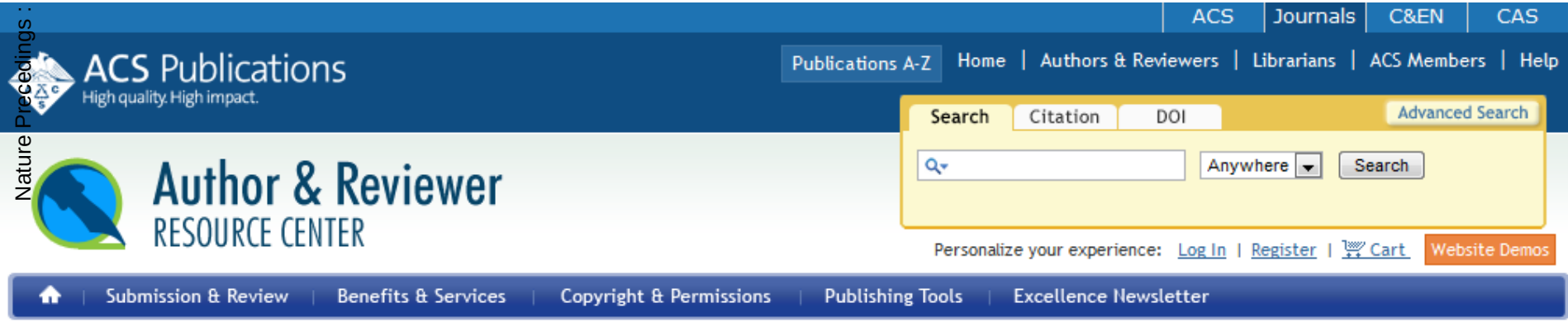
Journal websites

Look for Authors Link

Go to submission and review

You may have to create account

Look for manuscript information



WRITING: getting a grant

Grants are the largest source of science funding
They come from the government, Industry and Academia

To get grants
Use a single solid idea
Follow guidelines to the T

Get inside knowledge

- Write conservatively for Government
- Write risky for private
- Write about fundamentals for large co-operations

NIH Undergraduate Scholarship Program for Individuals from Disadvantaged Backgrounds

INFORMATION AT A GLANCE

The National Institutes of Health (NIH) Undergraduate Scholarship Program offers scholarship awar students from disadvantaged backgrounds who are committed to careers in biomedical, behavioral an social science health-related research. The program is sponsored by the NIH, one of the world's fore centers for biomedical research and research training.

The scholarships pay for tuition and reasonable educational and living expenses up to $20,000 per academic year. In return, recipients are obligated to serve as paid employees in NIH research laborat during the summer and after graduation. In addition to financial assistance, the scholarship program offers invaluable training and mentoring, as well as practical experience in a state-of-the-art research setting.

Getting the most out of your research

MAXIMUM

Life (Career) time funding from a single source such as the National Institute of Health (NIH)

MINIMUM

(Don't) Apply

To do : look up grants.gov, NIH grants, NSF grants that are suited to you.

Abilities : design experiments

Planned experiments let you and everyone know where you're going

Allows you to know the feasibility

- To Design experiments
- Start from paper idea that is publishable
- Sketch required figures
- Understand available equipment
- Watch out for unexpected results

Design Process

• Follow a design process to develop an idea in steps from coarse to fine:

First Step: ***Evaluate the resources that are available***

Second Step: ***Carefully study the problem and make sure you have a clear understanding of what needs to be done and what are the constraints (rules, limits)***

- • Steps 1 & 2 are often interchangeable

Third Step: ***Start by creating possible strategies using words, analysis, and simple diagrams***

Imagine possible motions, data flows, and energy flows from start to finish or from finish back to start!
Continually ask “Who?”, “What?”, “Why?”, “Where”, “How?”
Simple exploratory analysis and experiments can be most enlightening!
Whatever you think of, others will too, so think about how to defeat that about which you think!

Fourth Step: ***Create concepts to implement the best strategies, using words, analysis, and sketches***

Use same methods as for ***strategies, but now start to sketch ideas***
Often simple experiments or analysis are done to investigate effectiveness or feasibility
Select and detail the best ***concept…***

Fifth Step: ***Develop modules, using words, analysis, sketches, and solid models***

Sixth step: ***Develop components, using words, detailed analysis, sketches, and solid models***

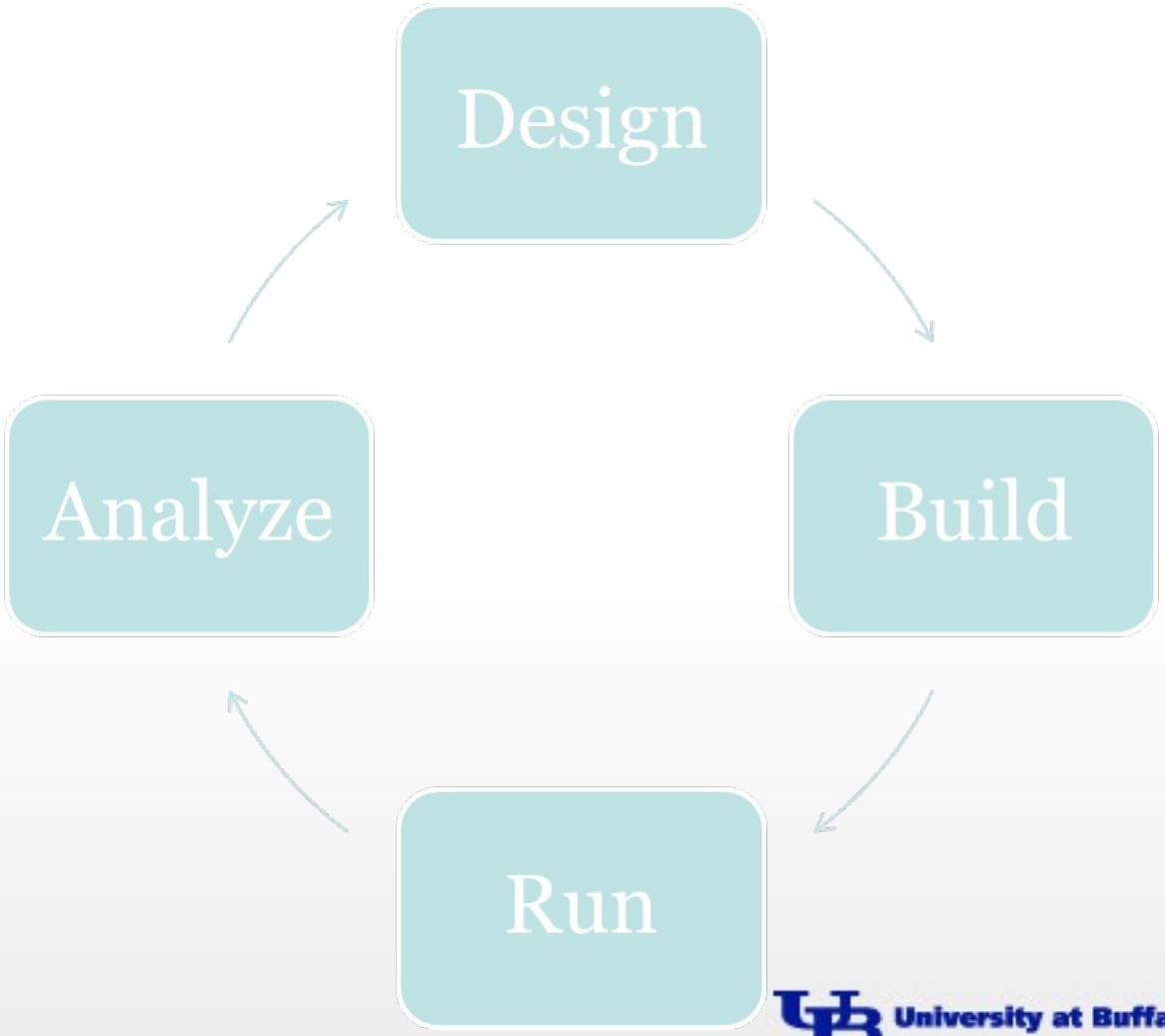
Seventh Step: ***Detailed engineering & manufacturing review***

Eighth Step: ***Detailed drawings***

Ninth Step: ***Build, test, modify… –***

 Tenth Step: ***Fully document process and create service manuals…***

GET TO KNOW DEBRA



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Abilities : analyze

- Because you follow a procedure - do not blindly expect it to work
- Use error margin
- Compare to literature and reference values
- View patents of the same publications

Getting the most out of your research

MAXIMUM
Design high quality experiments that others can execute and think is reasonable

MINIMUM
Look up figures in papers to understand experimental design

To do :put your experiments in the context of a design , design a new project, motivate someone

Ability : Scientist draw

A schematic indicating what you think a process is key.

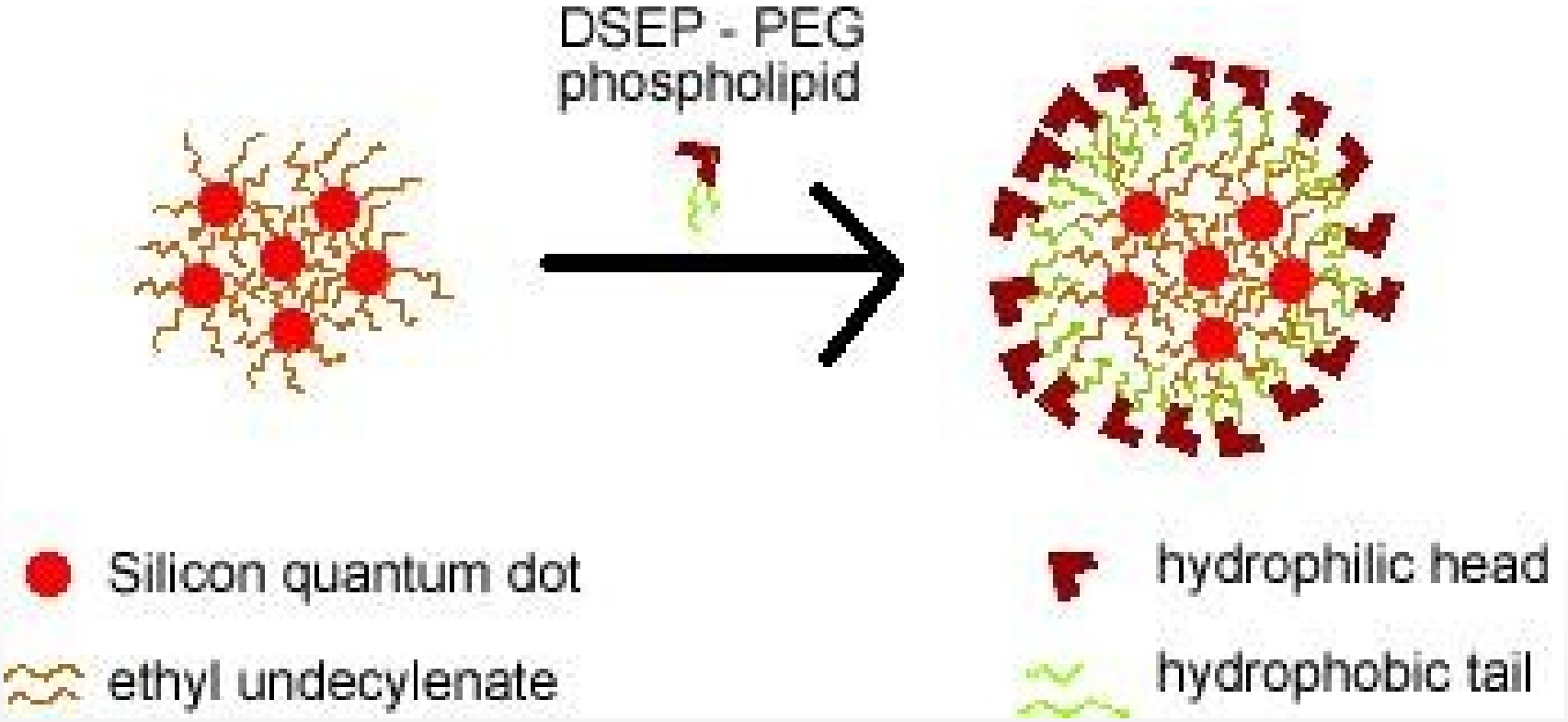
To draw schematics :

View previous images on the concept you want to convey
Notice details you can improve

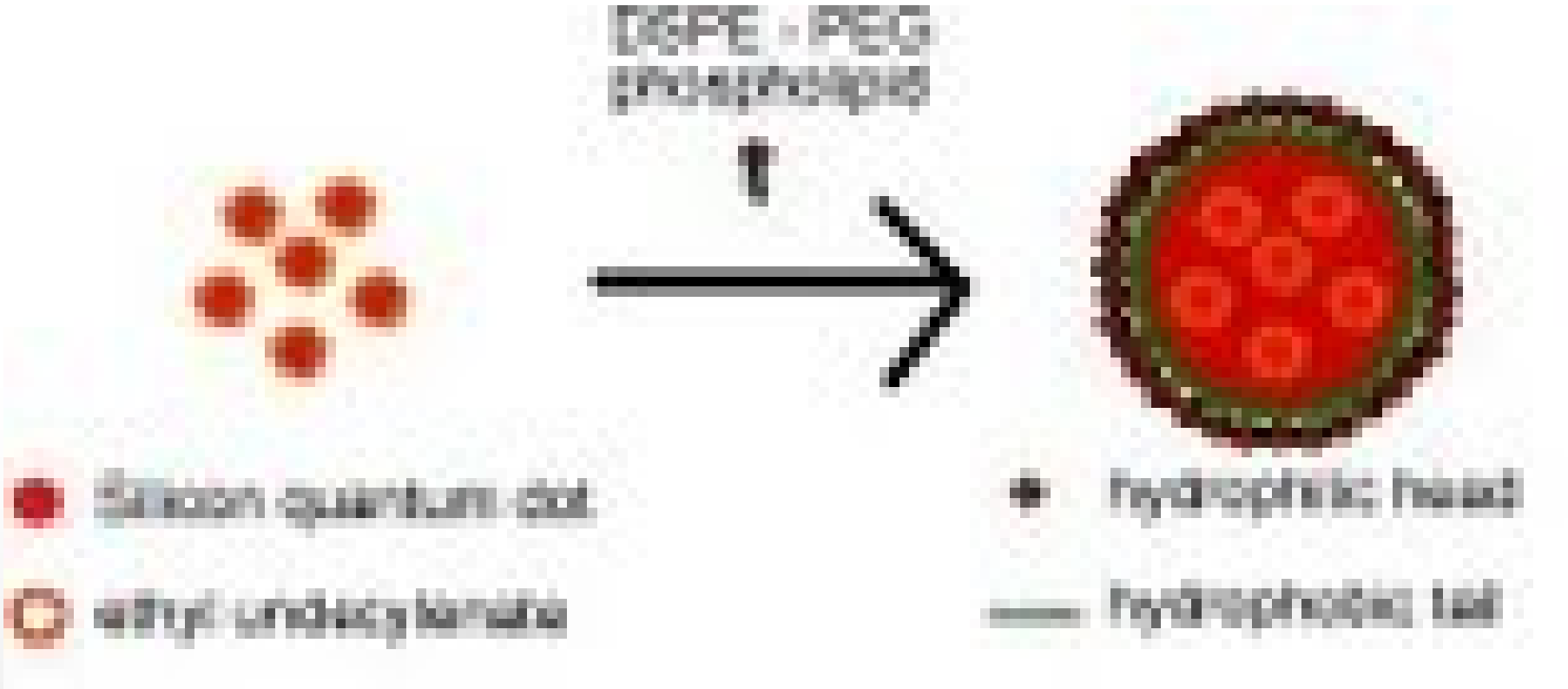
Tailor image to your preference based on understanding of your project
Draw large and reduce later
Use software like

- Adobe Products (Photoshop, Fireworks)
- Chem Draw

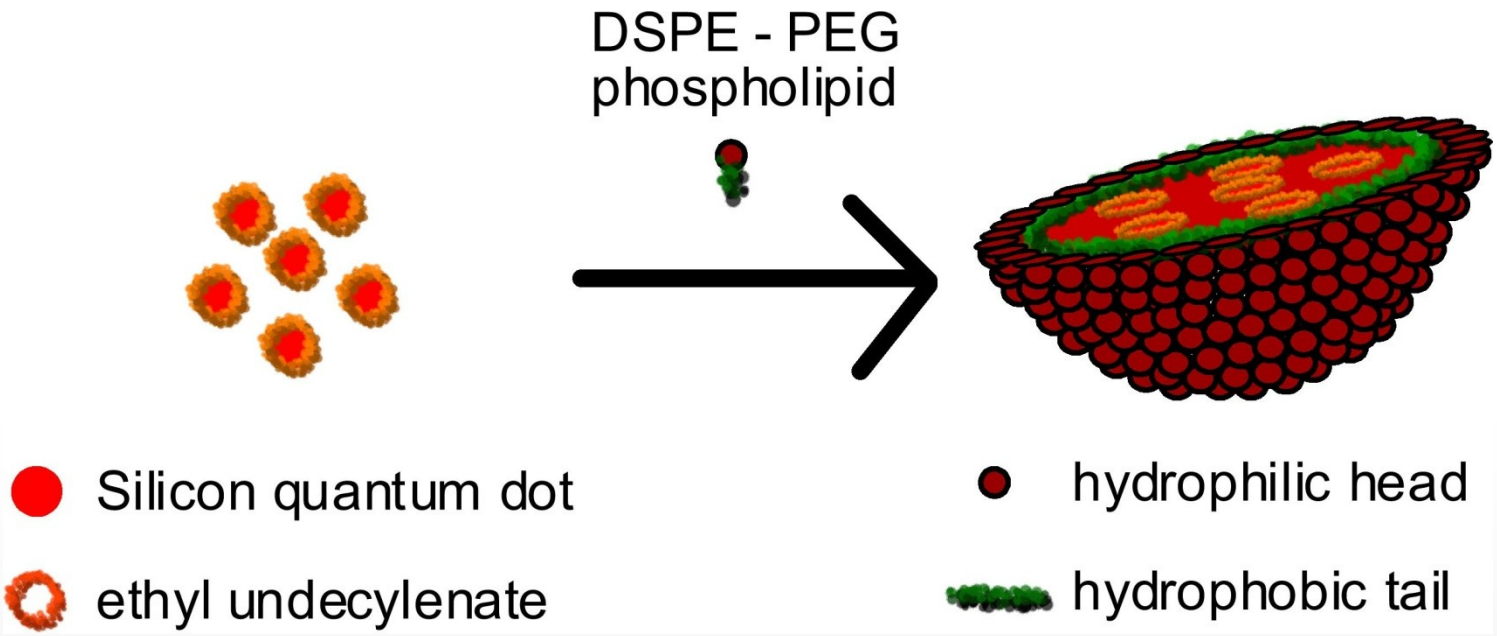
SCHEMATIC - development

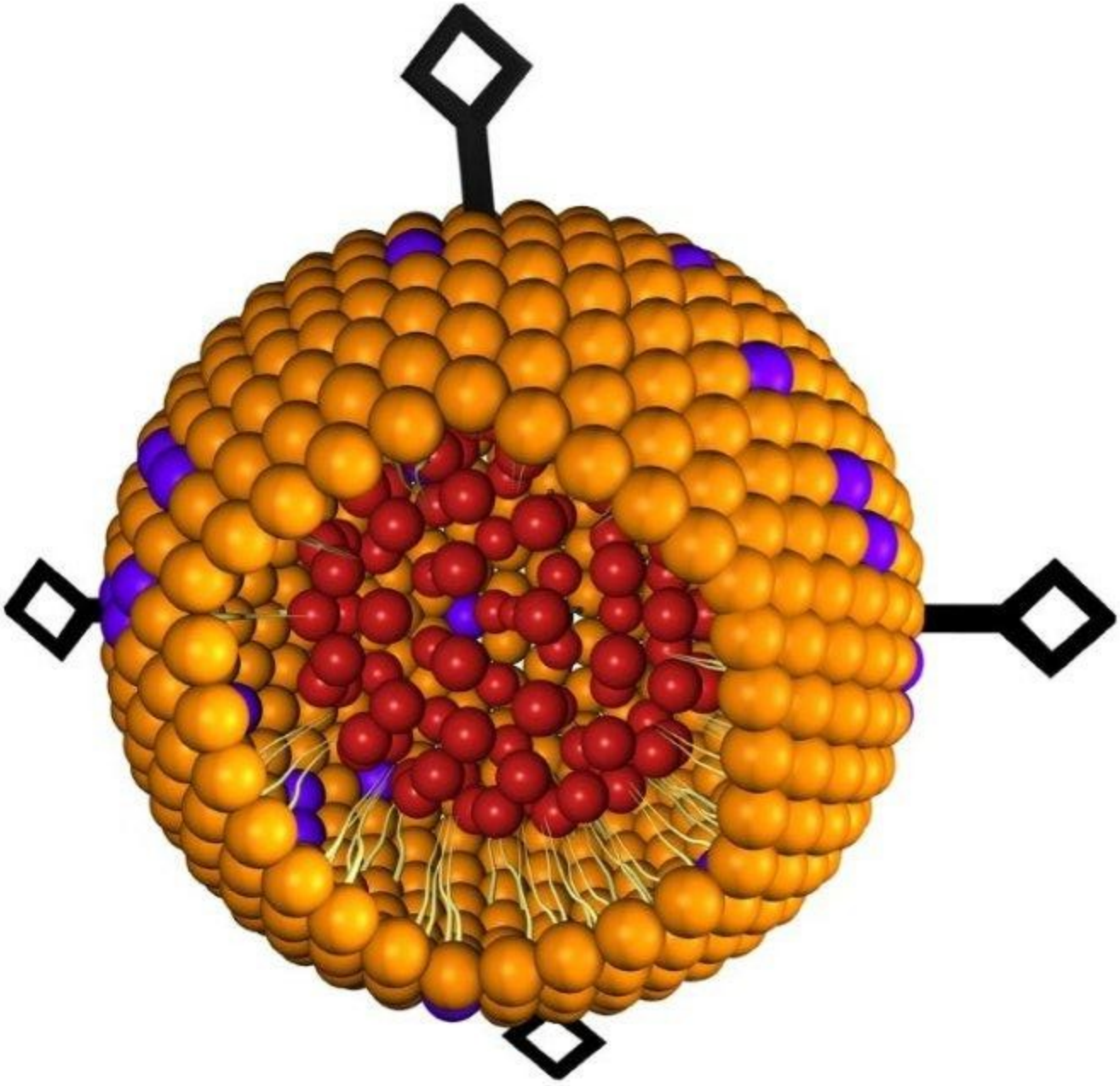


SCHEMATIC –blurry



SCHEMATIC - DEVELOPMENT





Getting the most out of your research

MAXIMUM

Use simulation software / graphic designer to create your graphic and flash animation

MINIMUM

Copy graphic from another

To do : learn how to illustrate concepts

Poster

- Follow the Judges Rubric
- Start by sketching it out
- Use graphics, arrows, and supporting text
- Include white space
- Significance of work, problems addressed and conclusions should be obvious
- Use active voice when writing the text.
- Delete all redundant references and filler phrases
- Self-explanatory graphics should dominate the poster.
- Use san-serif fonts

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In Vivo Targeted Cancer Imaging and Lymph Node Mapping with Silicon Nanocrystals

Nature Precedings : doi:10.1038/npre.2011:5702.1 : Posted 13 Jul 2011

Multidisciplinary Motivation

Silicon Nanocrystals

Safe, Cheap, Light emitting, particles
Problem :
How do you make them ?

Cancer

Very Deadly Disease
Problem :
How do you detect it ?

Tumor Targeting

Find the Tumor
Problem :
Can you do it non-invasively

Lymph Node Mapping

Cancer can spread via lymph
Problem :
Can you tell if it has spread?

Abstract

Quantum dots (QDs) have size-dependent optical properties that make them uniquely advantageous for *In vivo* targeted fluorescence imaging, traceable delivery, and therapy. The use of group II-VI QDs (e.g. CdSe) for these applications is advancing rapidly. However, group II-VI QDs contain toxic heavy metals that pose a threat to organs, and thus for *In vivo* applications, there is a need to replace these materials with a more biocompatible semiconductor, such as silicon. Here we demonstrate that, with proper preparation and encapsulation, biocompatible silicon QDs (SI QDs) can be used in multiple cancer-related *In vivo* applications, including tumor vasculature targeting, sentinel lymph node mapping, and multi-color NIR imaging in live mice. This work overcomes previously insurmountable challenges to *In vivo* imaging with, and efficient targeting of, SI QDs through a unique nanoparticle synthesis, surface functionalization, PEGylated micelle encapsulation, and bioconjugation process that produces bright, targeted nanospheres with stable luminescence and long (>40 hr) circulation times *In vivo*. With this demonstration, we anticipate that SI QDs will now be able to play an important role in more sophisticated *In vivo* models, by alleviating QD toxicity concerns, while maintaining the key advantages that have generated such intense interest in QD-based imaging methods.

Problem

In order to address the above problems, light emitting semiconductor nanocrystals have been investigated world wide. Most demonstrations contain toxic components (E.g.Cadmium) that prevent the adoption of these nanocrystals for clinical use.
Solution : Make non-toxic light emitting silicon nanocrystals (for cancer)

Applicable Methods (to make silicon nanocrystals)

Step 1 : Decompose Silane Gas

High-Temperature Laser Pyrolysis of Silane → SI Powders (nano-sizes / no PL)

Figure 1. a) Custom built laser reactor b) Silicon from reactor

Result 1 : Obtained dust-like particles

Step 2 : Treat Particles with acid

Controlled Etching to establish Luminescence → Luminescent SI Nanoparticles

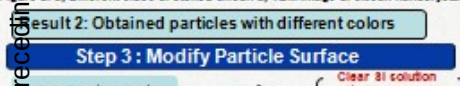


Figure 2. a) Different sizes of etched silicon b) TEM image of silicon nanocrystal

Result 2: Obtained particles with different colors

Step 3 : Modify Particle Surface

Surface Functionalization → Clear SI solution (with PL) nonpolar solvents

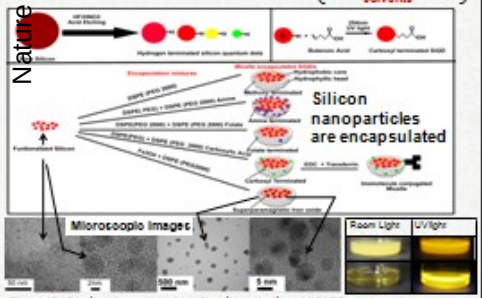


Figure 3. Synthesis and surface functionalization of SI QDs

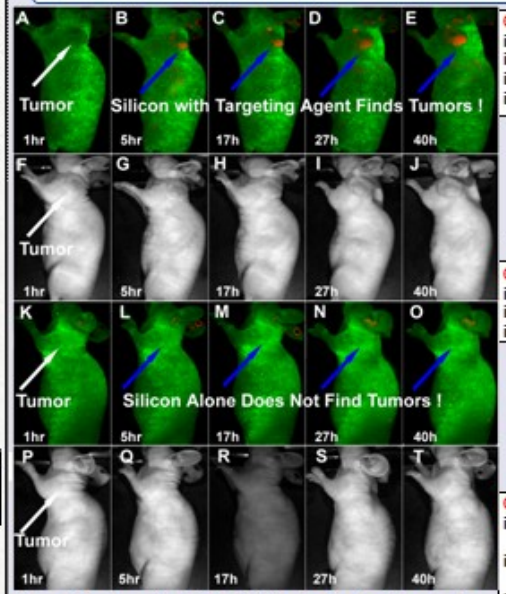
Result 3:Particles become quality imaging Agents

Can the particles be applied to live animals (mice)?

Data and Conclusions (Silicon can safely be used for Cancer Imaging applications)

VIDEO PRESENTATION

MAJOR RESULTS:TUMOR TARGETING. LYMPH NODE MAPPING & MULTI-COLOR IMAGING IN MICE



Conclusions
i. Silicon nanocrystals are useful for tumor detection
ii. They have long blood circulation time
iii. They are compatible with the immune system
iv. They are stable in the tumor environment

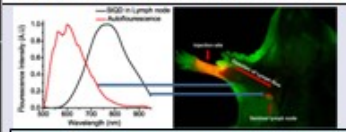


Figure 5. lymph node mapping

Conclusions
i. Can be Useful for finding out if cancer has spread
ii. Can identify the lymph node
iii. Can provide surgical image guidance

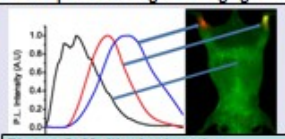
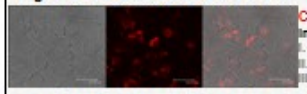


Figure 6. Multicolor Imaging

Conclusion
i. Near Infrared (invisible light) peaks from silicon are visible
ii. They are easily be distinguished in vivo after subcutaneous injection
iii. Useful Potential for distinguishing cancer molecules

In Vitro Imaging

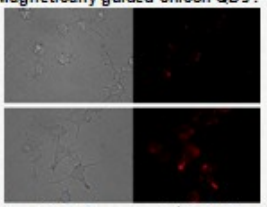
Targeted to Pancreatic cancer cells :



Conclusions:
Images show -
I. Robust optical signal
II. Targeted to cancer cells
III. No morphological damage

Figure 7. Targeted delivery of Silicon to cancer cells
the transmission image, luminescence image, and an overlay of the two

Magnetically guided Silicon QDs :



Conclusions :
I. Optical and magnetic
II. Increased particle uptake
III. Guided to cancer site
IV. MRI potential
V. Treatment potential

Figure 8.Micelle co-encapsulated SI QDs and superparamagnetic iron oxide. Top (No magnet), Bottom (Magnet)
left to right, the panels show : transmission and luminescence image.

Cellular and Live Mouse toxicity

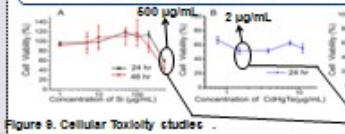


Figure 9. Cellular Toxicity studies .

SI toxicity at (500 µg/mL) is similar To that of CdHgTe at 10 µg/mL or CdTe at 30 µg/ml

Conclusions :
I. SI nanocrystals are 5-50 times less toxic than Cd based nanocrystals in cells
II. No Sign of adverse effects in the major organs over 8 weeks
III. Silicon has low toxicity and improves the chances of using semiconductor nanocrystals in

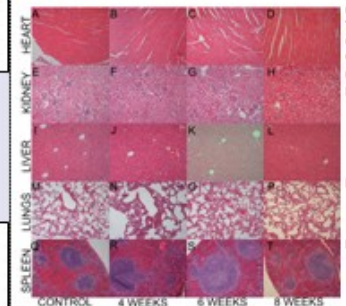
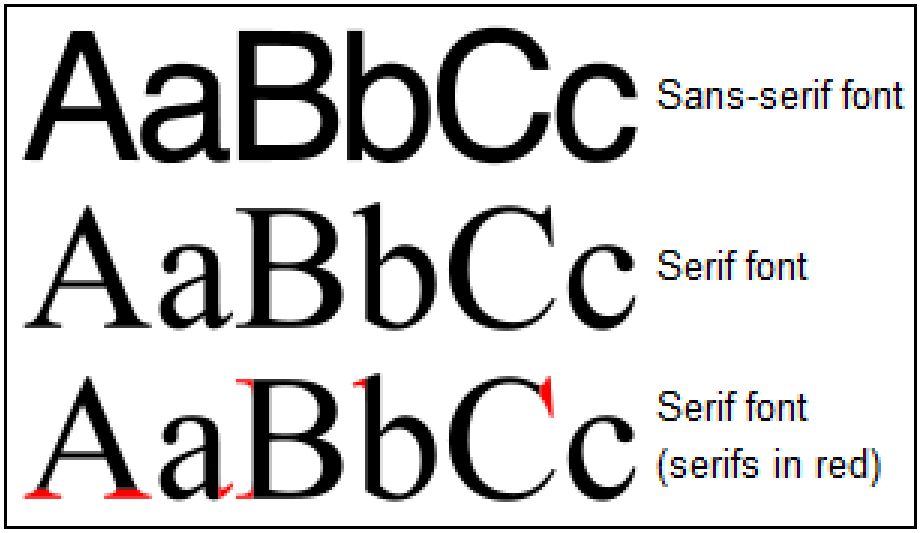


Figure 10. Microscopic images of major organs in mice

San-serif fonts



Getting the most out of your research

MAXIMUM

Create a great poster by taking advantages of your presenting good work and what you think is appealing

Insert your creativity

MINIMUM

Create a poster with all the basic components

To do : Look up posters on your department walls, create a good poster.

Getting the most out of your research

MAXIMUM

Write your paper in the best template, design high quality poster template

MINIMUM

Google and download templates

To do : Find templates relevant to your work for papers, poster

ABILITIES CONCLUDED

- Talking can lead to reputation suicide – do it well well
- Multimedia is like adding spices to bland food
- Reading contains golden nuggets of info
- Drawing is not only for art majors
- Designing research is key to credit
- Abstracts are your salesman
- Get creative and effective with posters
- Templates reduce work load

QUESTIONS