DUKE NUS
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From Stead to Singapore:
Building a new way to learn

C. Frank Starmer
Duke-NUS Graduate Medical School Singapore &
Duke University

Our Objective: To embed Stead themes throughout Duke-NUS

- Everyone is a learner
- Learn through doing and explaining
- Know what you don't know
- Reinforce learning with repetition
- Visual thinking / communication
- Identify patterns and deviations from patterns
- Team-based problem solving
- Extend brain memory with Internet memory

Gene's marching orders.

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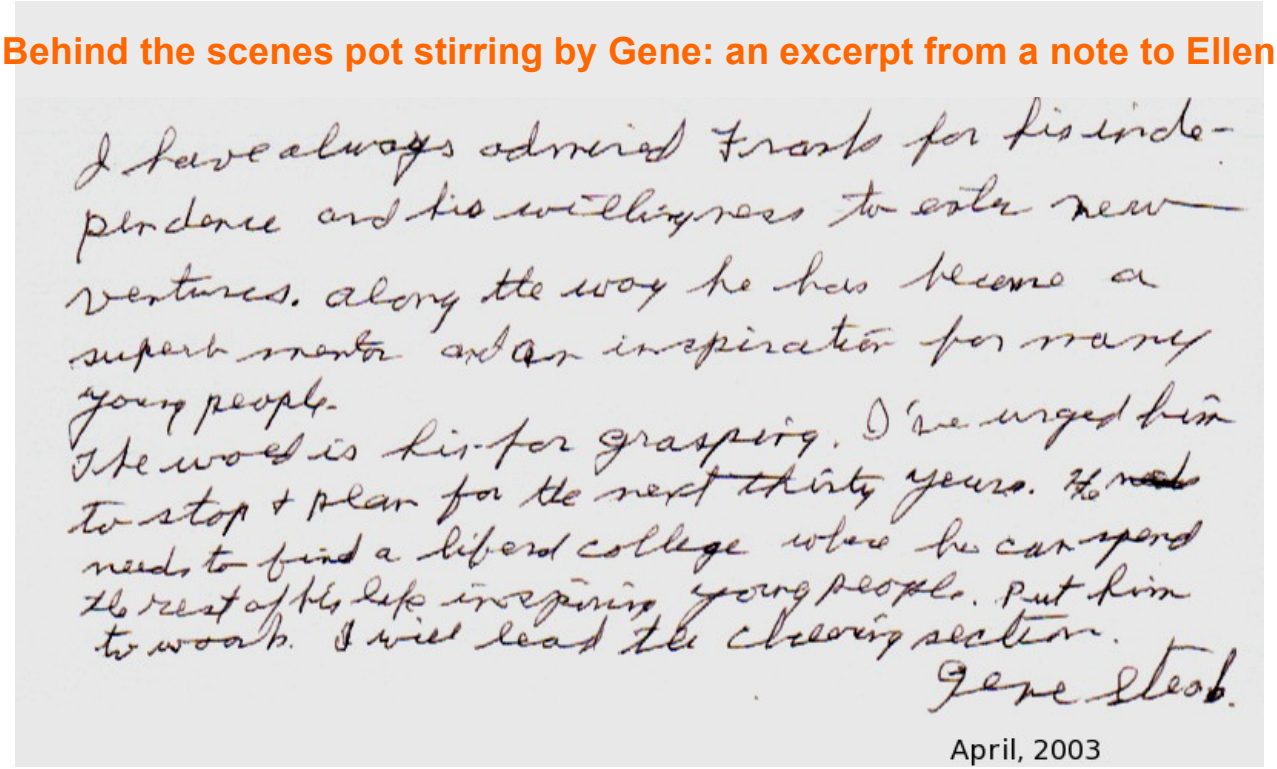
Behind the scenes pot stirring by Gene: an excerpt from a note to Ellen



I have always admired Frank for his independence and his willingness to take new ventures. along the way he has become a super mentor and an inspiration for many young people.
The word is his for grasping. I've urged him to stop + plan for the next thirty years. He needs to find a liberal college where he can spend the rest of his life inspiring young people. Put him to work. I will lead the cheering section.
Gene Sleab.

April, 2003

Fortunately, Sandy Williams provided something better than a liberal arts college: Duke- NUS GMS

Transforming Medicine, Improving Lives

An engineer in a clinical dept:

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The 30+ year Stead, Wyngaarden and Greenfield STP

- 1959-1965: Undergraduate and MS EE student, worked for TelCom in Duke South
- 1961: Henry McIntosh, Tommy Thompson, Bob Whalen and Jim Morris (Cardiac Cath Lab)
- 1963: John Moore exposes me to quantitative neurobiology (Basic Science)
- 1965: Gene "encouraged" me to leave. If I was "any good", he would invite me back
- 1967: Stead "People Chemistry" experiment, 1st PhD in the Dept of Medicine
- 1969: Grizzle, Starmer Koch. Biometrics 25:489-504, 1969 (Biostatistics)
- 1969: Harley, Starmer, Greenfield. J Clin Invest. 48: 895–905 (Clinical Science)
- 1969-1980: Built the IT infrastructure for the Cardiology Databank
- 1970: Gene gave Ellen the keys to his place at Kerr Lake (Life Balance)
- 1971: Established the Computer Science Dept (Computer Science)
- 1972-1977: Learning medicine: Physical Diagnosis (Galen) + Osler rounds (Gene)
- 1973: Sperling, Wyngaarden, Starmer: J Clin Invest. 52:2468–2485 (Translational Medicine)
- 1975: McNeer, Wallace, Wagner, Starmer, Rosati Circulation 51:410-413 (EBM)
- 1981-2005: Joe Greenfield sent me to work with Gus Grant: Antiarrhythmic drugs
- 1985: Starmer and Grant: Mol. Pharm 28, 348-356 (Basic Science)
- 1987-2002: Collaborative research in USSR / Russia (Multiculture Lessons)
- 1993-94: Visiting Prof at Indian Institute of Technology, Madras, India (Multiculture Lessons)
- 1997: Completed Singapore Training Program
- 1998: Fulbright – Univ Patras, Greece (Multicultural Lessons)
- 2006 - ?: Unretired from Duke to execute Gene's and Sandy's marching orders

The Challenge

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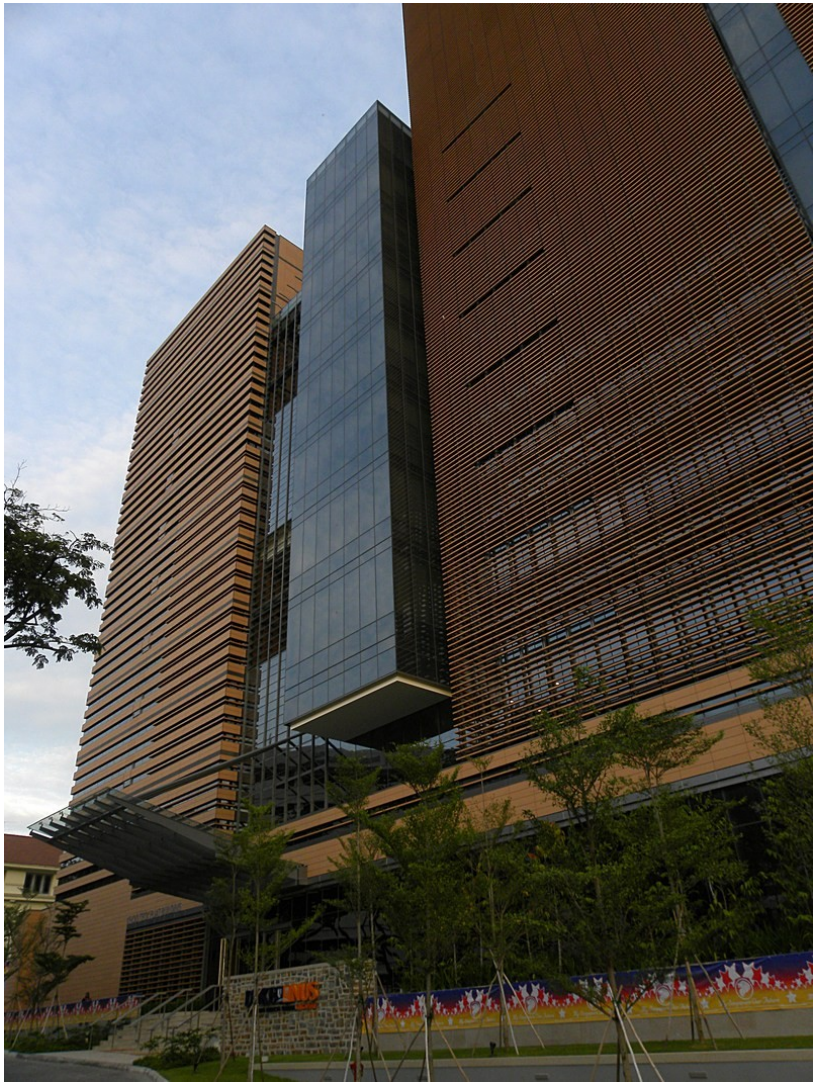
From March 2006

To March 2009



Transforming Medicine, Improving Lives

The surface agenda: Sandy's marching orders

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Pat Casey, Bob Kamei, Sandy Cook, Ed Buckley and you have 16 months to build a successful and competitive learning program from the ground up

We had to:

- Build learning spaces (large learning room, clinical practice rooms, laboratory, lounge)
- Implement the Duke curriculum: Adapting the Duke curriculum to the Singapore context: Team-based learning modeled on teaching rounds with Dr. Stead on Osler
- Recruit a faculty
- Become known to potential students
- Deal with uncertainty: Will there be applicants? Will there be completed applications. Will we recruit a world-class faculty? Can we build a learning strategy reflecting the way we would like to have learned? And finally, what about Naomi?
- Maintain balance: address the requirements of Ministries of Health, Education, Finance and Trade and Industry, A*STAR (Agency for Science, Technology and Research) and Duke
- Build a partnership with SingHealth (Singapore General Hospital and KK Women's and Children's Hospital)
- With SingHealth, develop the Outram academic campus
- Design, construct and debug our new building

The Stead themes: our hidden agenda:

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- A flat structure: Everyone is a learner. Traditional students are junior learners, faculty are senior learners
- A learner-centric pecking order:
  - 1st Students
  - 2nd Everyone else
- Internet-centric learning
- Crescendo-like transition from university to medical school to housestaff to professional life
  - First weeks of school = Foundations, not Orientation
  - Developing young people, neither educating nor teaching
  - Team-based administration (Ranga's influence, balanced score card)
  - Promote and enable flexible individual learning styles
    - Laptop neutral (Windows, Mac, Linux)
    - Open learning resources (Internet accessible)
    - Embrace portable media (USB disk, iPhone and iPod touch)
- Mastering MFU concepts (reduce exposure to the forgetting process)
- Our internal objective: To out-Duke Duke

MFU: Most Frequently Used

Foundations of our program:

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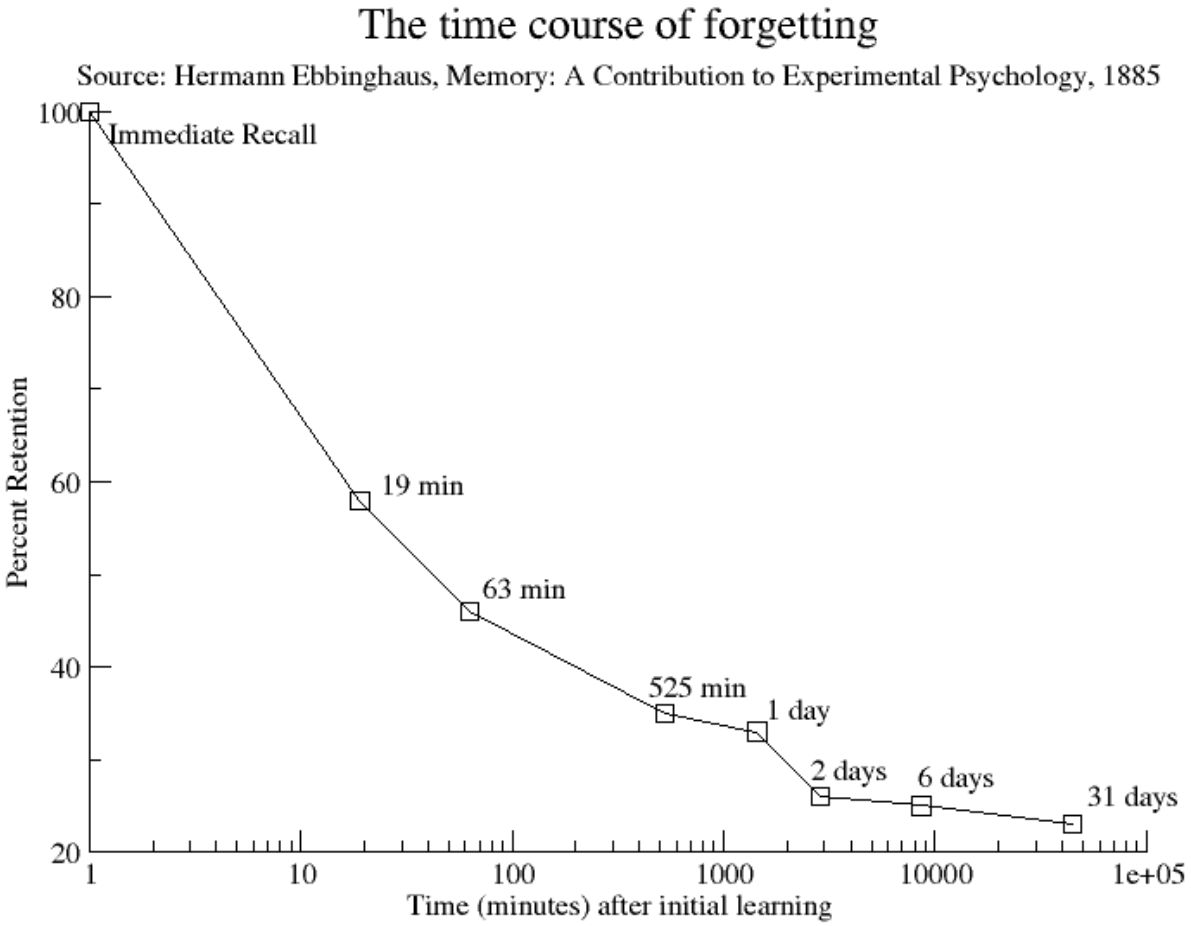
- Culture matters – encourage respectful questioning
- Team-based learning
- Ignite curiosity: a major driver of learning
- Engineering approach to problem solving
- Awareness of the neurobiology of learning and forgetting:
- Drive the curricular content by a what-we-do model: Mastery of the 80% concepts and information we use daily – exposure to other 20%
- Use Google and Internet resources as a memory extension
- Learning episodes designed to avoid the forgetting curve

Characterizing forgetting



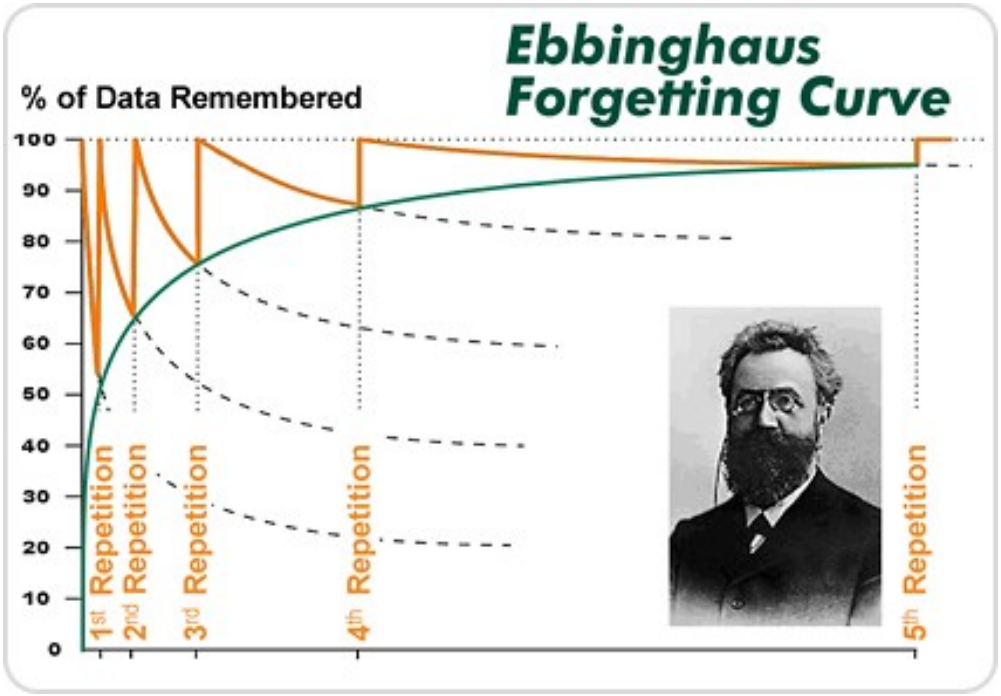
Studies of Learning and Forgetting

Ebbinghaus, *Über das Gedächtnis (About memory)*, 1885

Repetition: reinforcing accurate recall of learned material

Retention is exponentially related to time, t, and strength, S:

$$R = e^{-\frac{t}{S}}$$



Learning with Gus:

Cardiac Cells can learn and forget

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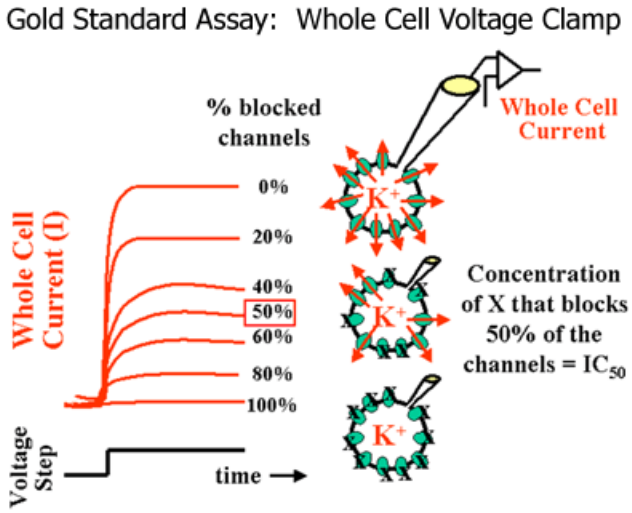
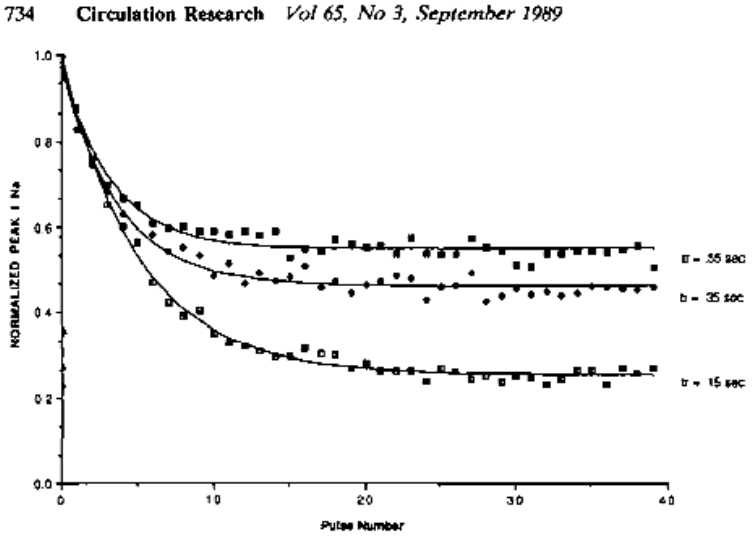
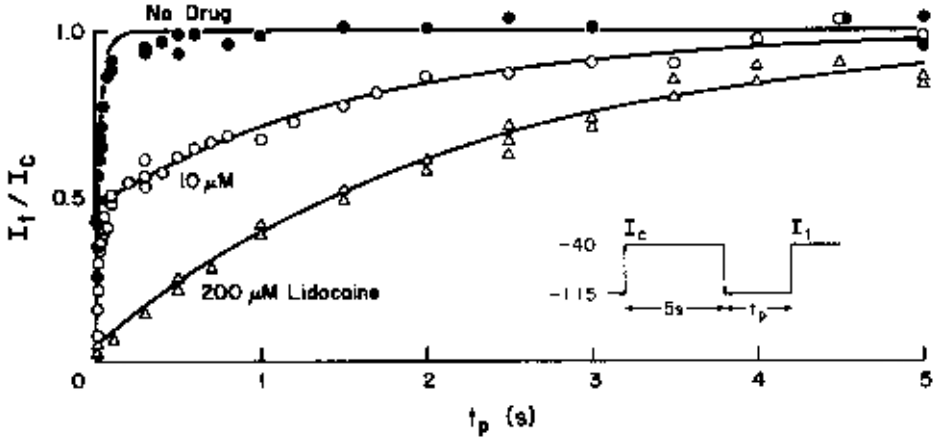




Cardiac Learning



Cardiac Forgetting

From Gilliam, Starmer, Grant, Circ Res, 65:734, 1987
and Bean, Cohen, Tsien J. Gen Physiol 81:613, 1985

Our Program: Team LEAD (Learn, Engage And Develop)

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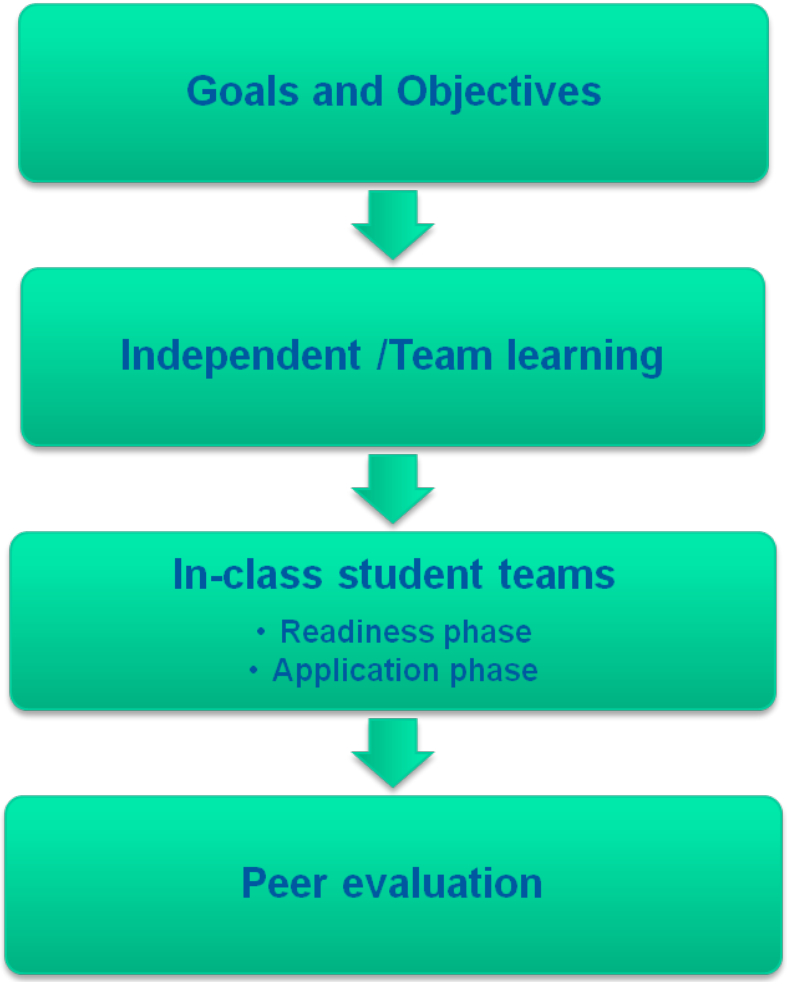

Overview

Initial Learning

Repeats 1 and 2

Feedback among team members

First year goals:

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Fact and Concept Acquisition (memory)

- Traditional emphasis for medical schools
- Guided Independent learning
- Individual learning style

Information Processing (thinking)

- Making conceptual connections, solving problems, explaining to others, knowing what you don't know
- TeamLEAD

Osler Rounds = Team-based learning

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	Osler Rounds	TeamLEAD
Prework	Patient assigned, perform Hx + PE. Books and journals to identify differential and prepare for Dr. Stead	Review faculty developed goals / objectives. Learning focused by module learning resources
Readiness Phase	IRA: Questions around the bedside. GRA: Discussion in the resident's office (maybe a nickel on the blackboard)	IRA: Multiple choice questions GRA: Team reviews questions and submits consensus answers
Application Phase	Developing patient care plans	Applying learned concepts and material to questions derived from a clinical problem

Curriculum Overview

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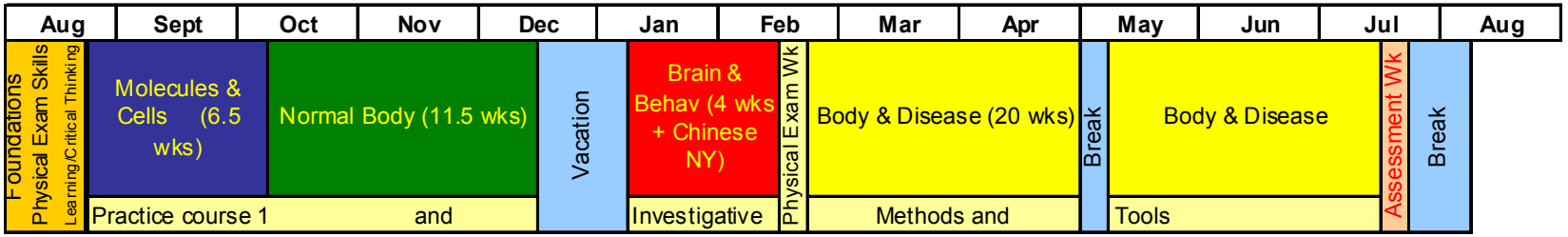

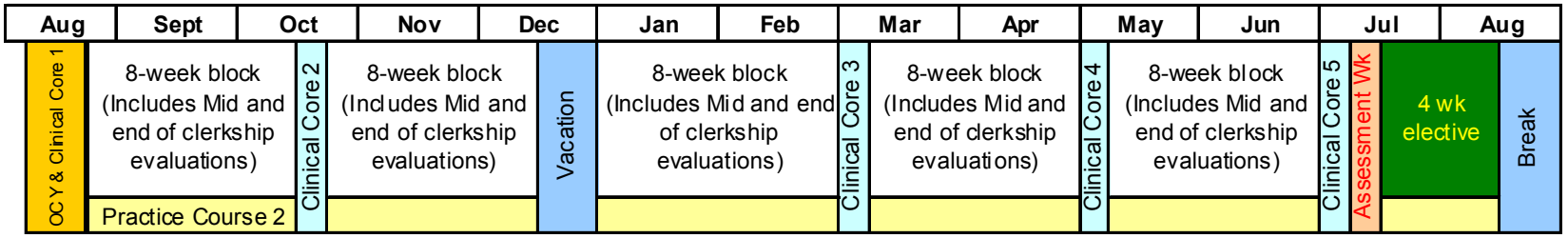

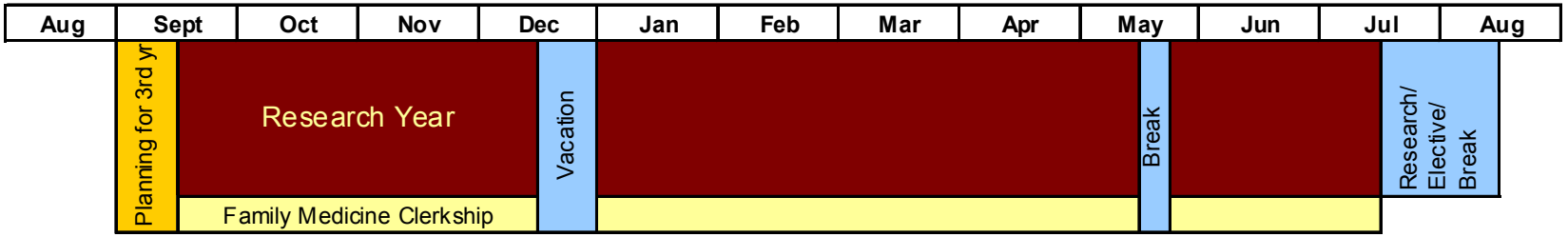

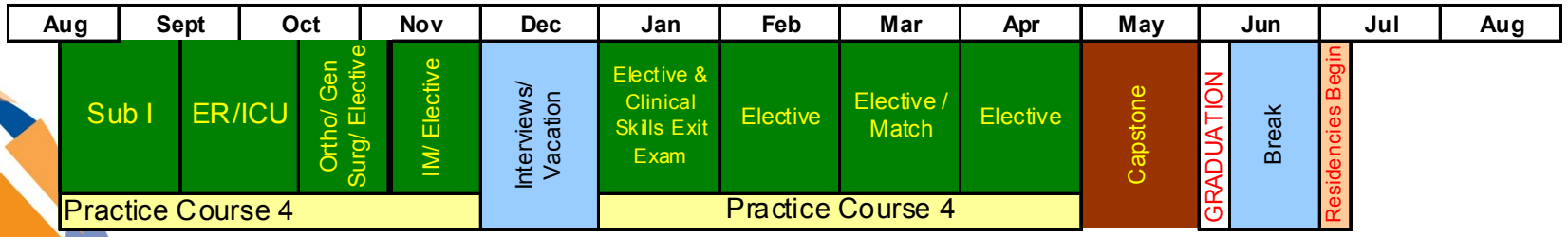

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Internet-centric learning

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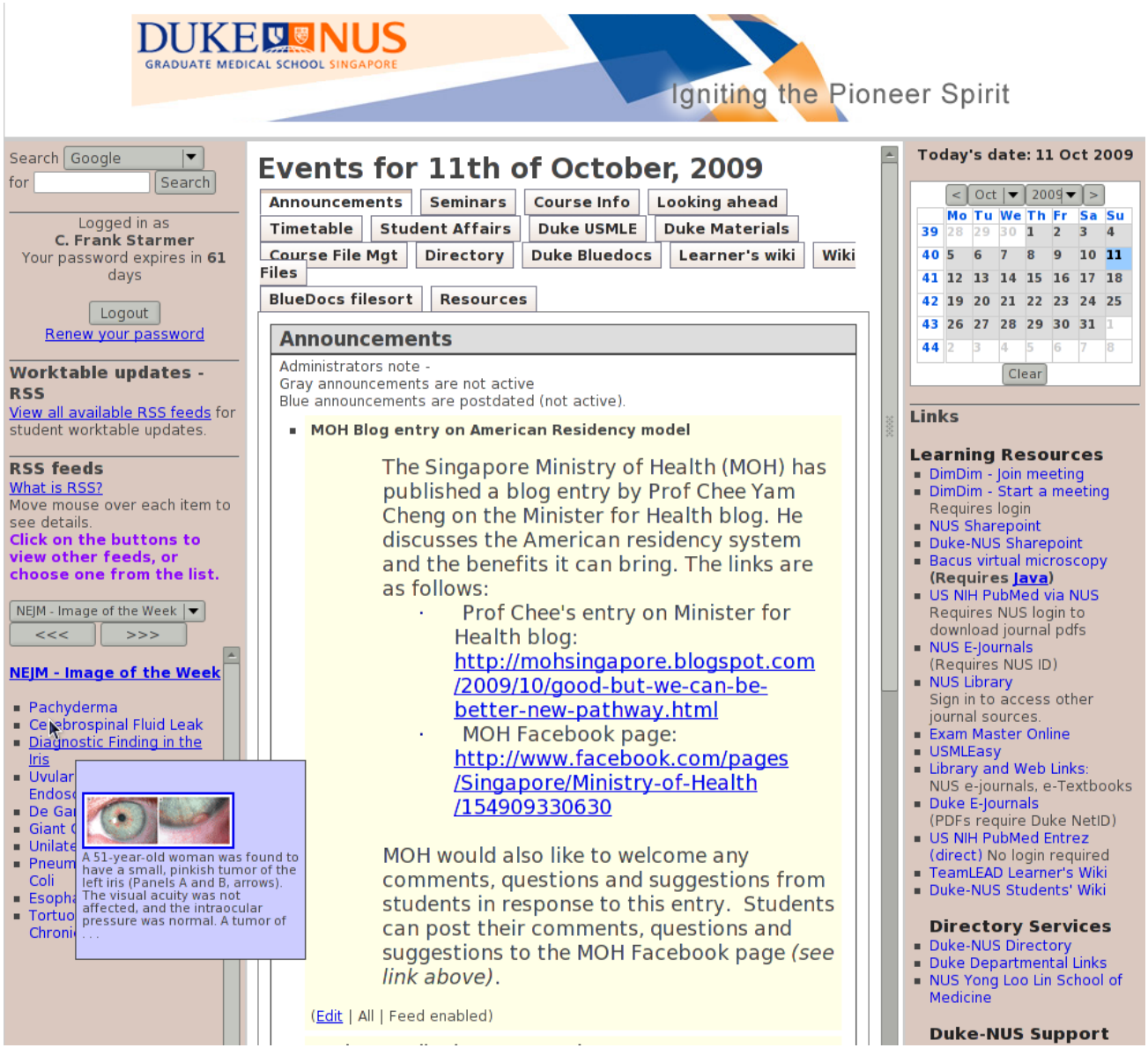

Anywhere – anytime access

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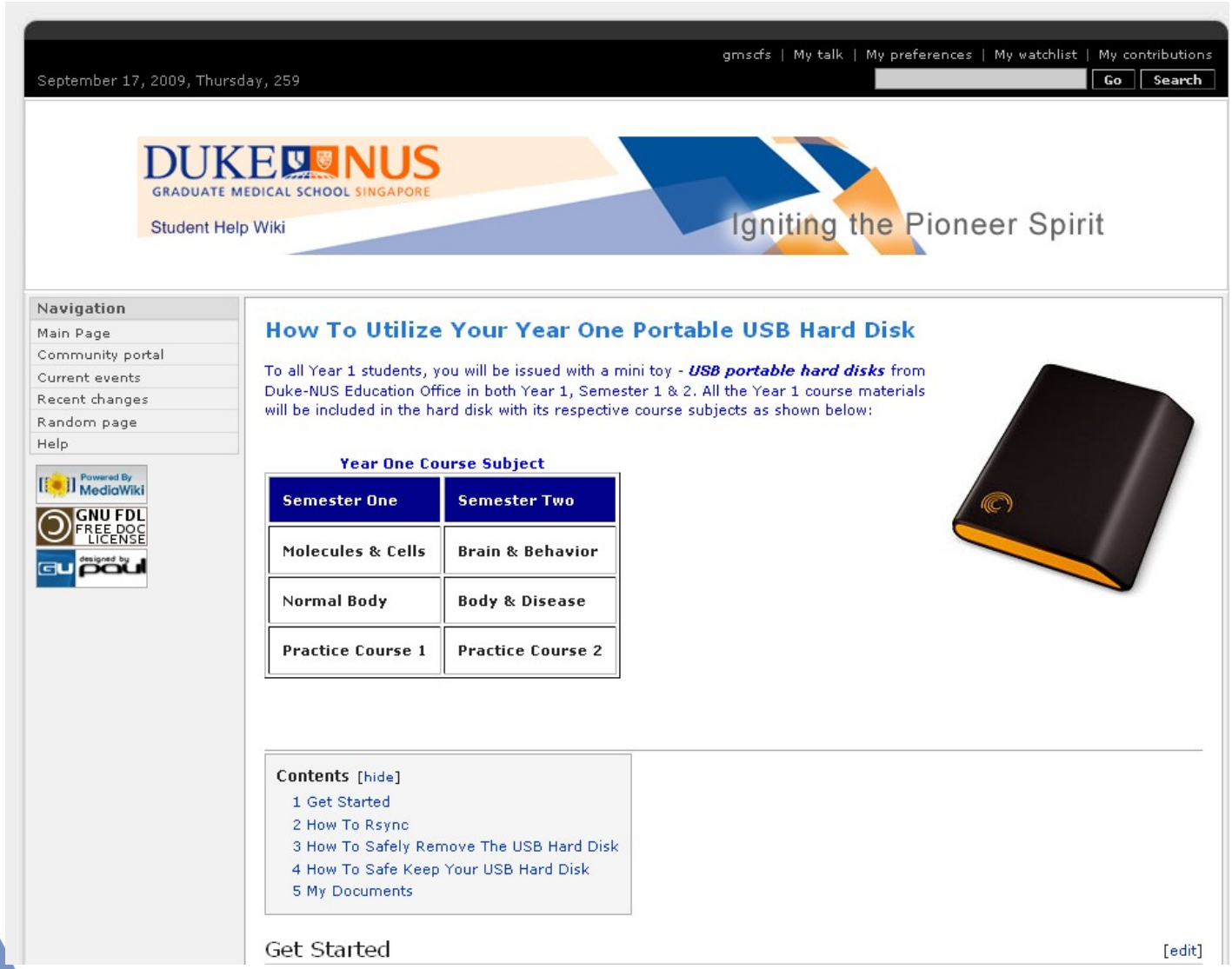

Weekly TeamLEAD Schedule

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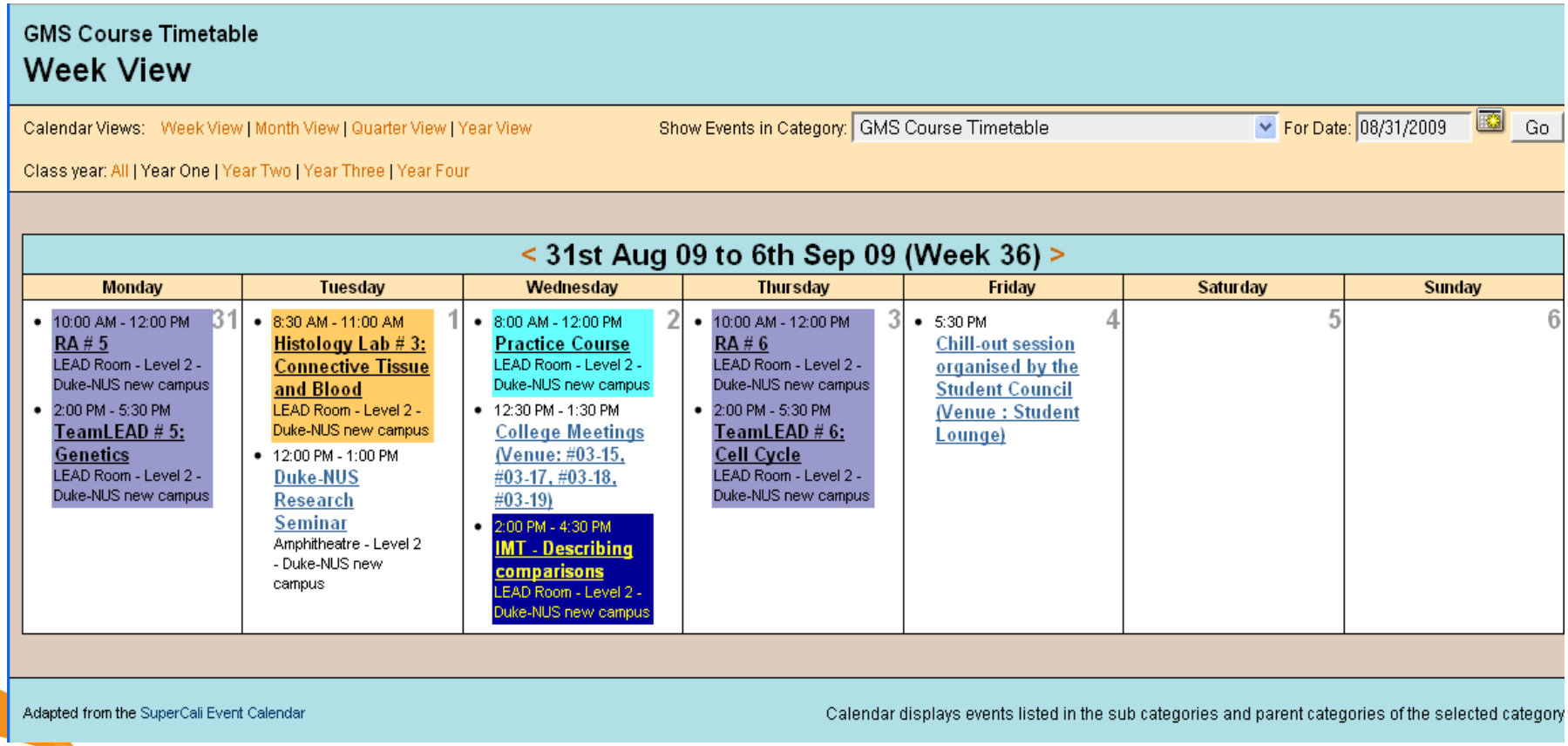

GMS Course Timetable

Week View

Calendar Views: Week View | Month View | Quarter View | Year View

Show Events in Category: GMS Course Timetable For Date: 08/31/2009 Go

Class year: All | Year One | Year Two | Year Three | Year Four

< 31st Aug 09 to 6th Sep 09 (Week 36) >

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
31 • 10:00 AM - 12:00 PM **RA # 5** LEAD Room - Level 2 - Duke-NUS new campus • 2:00 PM - 5:30 PM **TeamLEAD # 5: Genetics** LEAD Room - Level 2 - Duke-NUS new campus	1 • 8:30 AM - 11:00 AM **Histology Lab # 3: Connective Tissue and Blood** LEAD Room - Level 2 - Duke-NUS new campus • 12:00 PM - 1:00 PM Duke-NUS Research Seminar Amphitheatre - Level 2 - Duke-NUS new campus	2 • 8:00 AM - 12:00 PM **Practice Course** LEAD Room - Level 2 - Duke-NUS new campus • 12:30 PM - 1:30 PM College Meetings (Venue: #03-15, #03-17, #03-18, #03-19) • 2:00 PM - 4:30 PM **IMT - Describing comparisons** LEAD Room - Level 2 - Duke-NUS new campus	3 • 10:00 AM - 12:00 PM **RA # 6** LEAD Room - Level 2 - Duke-NUS new campus • 2:00 PM - 5:30 PM **TeamLEAD # 6: Cell Cycle** LEAD Room - Level 2 - Duke-NUS new campus	4 • 5:30 PM Chill-out session organised by the Student Council (Venue : Student Lounge)	5	6

Adapted from the SuperCali Event Calendar

Calendar displays events listed in the sub categories and parent categories of the selected category

Prework:

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TeamLEAD # 2: Getting around the cell - Time and Space Close Window

Category: **TeamLEAD**
Venue/Location: **LEAD Room - Level 2 - Duke-NUS new campus**
Faculty members: **David NG** () - Primary instructor
Marc FIVAZ () - Primary instructor
Date: **Thursday, August 20, 2009 - 1:30 PM - 5:00 PM**
Description: Learning Objectives

Protein folding
1.Proficiency to describe principles that determine the three-dimensional fold of a protein.
2.Critically evaluate different models of how proteins fold.
3.Compare and contrast the different molecular mechanisms for how misfolded proteins can cause certain diseases.

Translocation and quality control
1.Describe the biophysical and biochemical basis for protein misfolding.
2.Appreciate the different fates and cellular consequences of misfolded proteins.
3.Understand the cellular response to misfolded proteins and the mechanisms use by cells to cope with protein misfolding.

Event materials **TLEAD 02**

- Cytoskeleton

- 0808131300in100b9d02700009064194.mov
- 0808131300in100b9d02700009064194.mp3
- 16_1.mov
- 16_1.mp3
- 16_1.wmv
- EndowCBI200Cytosk2008.V1(2).ppt
- EndowCBI200Cytosk2008.V1.ppt

- Cytoskeleton in health and disease

- 0808221000in100b9b02700009144194.mov
- 0808221000in100b9b02700009144194.mp3
- VBennett_2008.ppt

- Davis Ng Compulsory Readings

- Clerc_et_al.pdf
- Quan_et_al.pdf

Learning resources and readings
Mandatory
1.In preparation for the TeamLEAD session, please review the video lectures & power point slides under the following topics:
-Cytoskeleton in health and disease
-Cytoskeleton
-Motor proteins in non-muscle disease
-mRNA export and trafficking
-Protein synthesis and protein degradation
-Molecular mechanisms of protein folding and misfolding
-Protein translocation Protein quality control-ERAD
-Protein trafficking Protein sorting
-Exocytosis and endocytosis

2.Research Articles: These are the studies that the applications section will focus on. Please read these papers carefully in advance of class and bring along a copy of each.

-Clerc, S., Hirsch, C., Oggier, D.M., Deprez, P., Jakob, C., Sommer, T., and Aebi, M. (2009). Htm1 protein generates the N-glycan signal for glycoprotein degradation in the endoplasmic reticulum. J Cell Biol 184, 159-172.

-Quan, E.M., Kamiya, Y., Kamiya, D., Denic, V., Weibezahn, J., Kato, K., and Weissman, J.S. (2008). Defining the glycan destruction signal for endoplasmic reticulum-associated degradation. Mol Cell 32, 870-877.

USB disk access

TeamLEAD Module: Readiness

Individual Assessment

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Individual assessment: Answers entered with an audience response unit

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Individual assessment: Review responses

Green = correct, red = incorrect

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TeamLEAD Module: Readiness

Team assessment

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Team readiness: Record answers
Scratch-off answer pad

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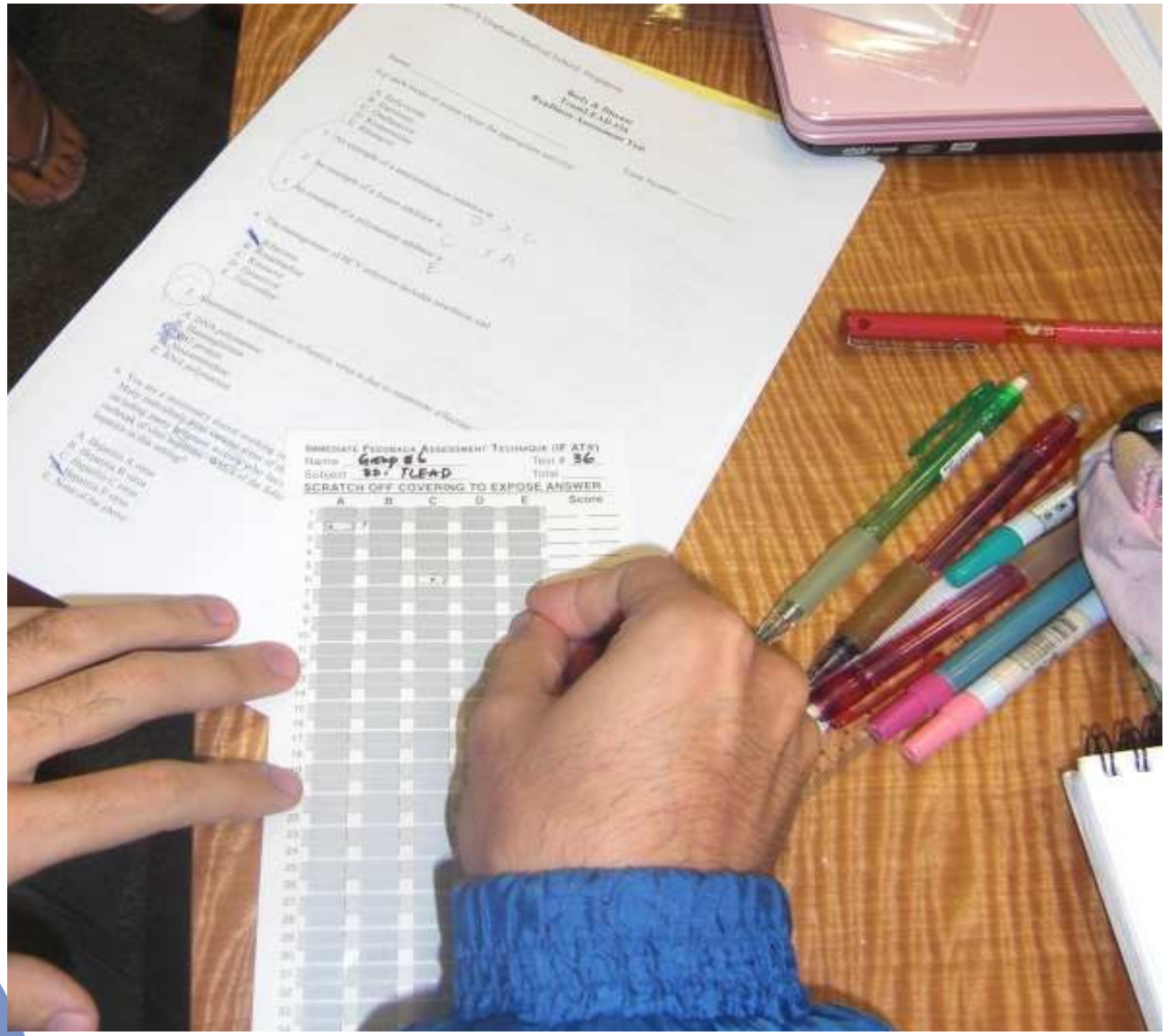

TeamLEAD Module: Application

Team problem solving

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Application (1 – 2 hour problem)

Consensus answers to application questions

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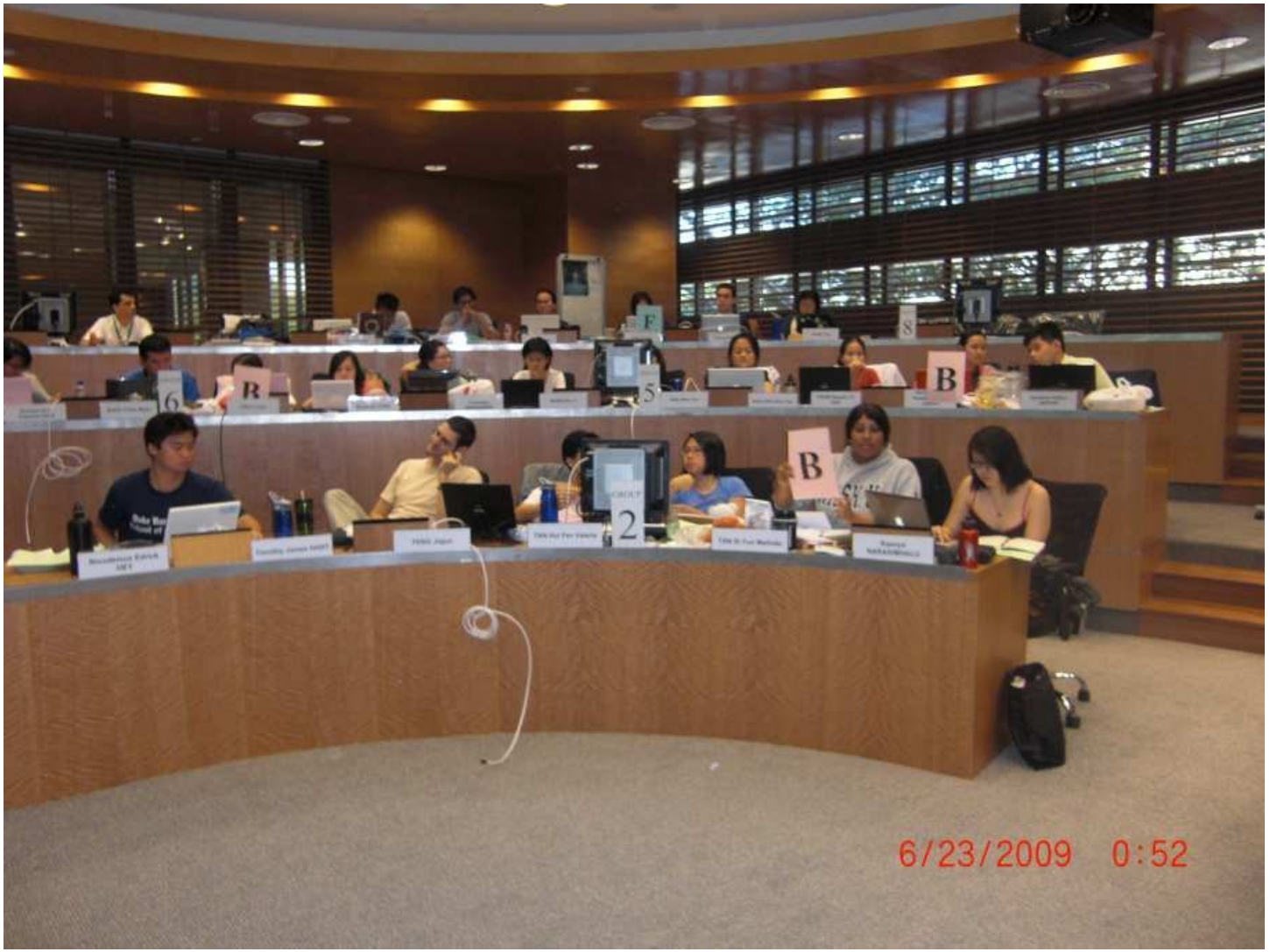

Body and Disease: Application

learning with Doyle Graham

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How are we doing?

Stead-inspired TeamLEAD vs the world?

Entrance Background Comparisons (Two Measures)

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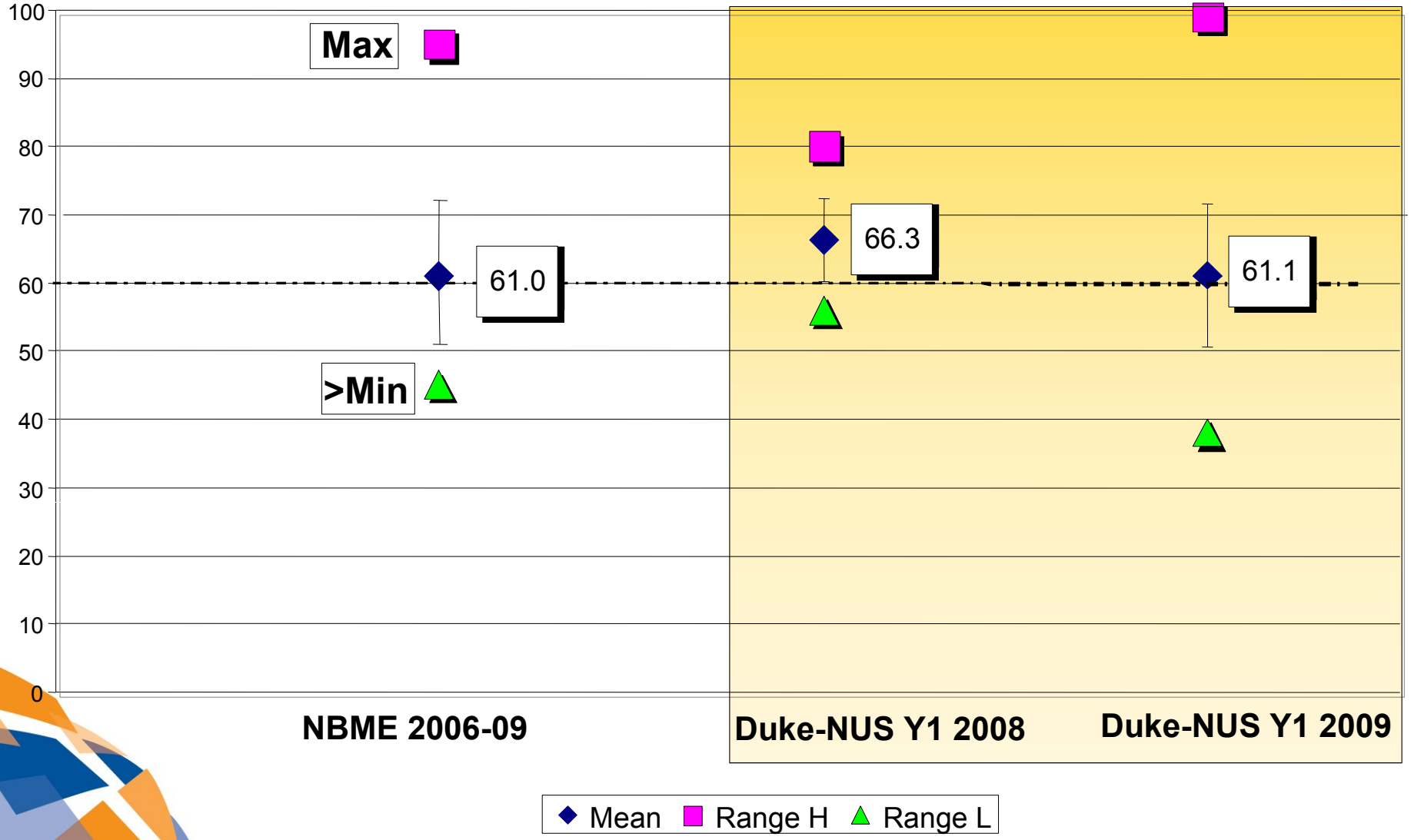
Rank	School	Biology	Physical Sciences	Verbal Reason	MCAT Total	GPA
1	Johns Hopkins	12	12	11	35	3.86
2	Washington U	13	13	11	37	3.89
3	Univ of Penn	12	12	11	35	3.82
4	Duke Univ	12	12	11	35	3.81
5	U of Michigan	12	12	11	35	3.81
6	Yale Univ	12	12	11	35	3.75
7	UC SF	12	11	11	34	3.80
8	Baylor College	12	12	11	35	3.80
9	UT SW - Dallas	12	12	11	35	3.85
10	Vanderbilt Univ	12	12	11	35	3.77
	Duke-NUS	*11*	*11*	*9*	*31*	*3.5*
95	Albany Med Col	10	10	10	30	3.52

NBME Comprehensive Basic Science Exam (CBSE)
NBME Normed (2006-2008) and Duke-NUS (2008 & 2009)



NBME Comprehensive Basic Science Exam (CBSE)

NBME Normed (2006-2008) and Duke-NUS (Class 2011)

Taken at End of First and Second Year

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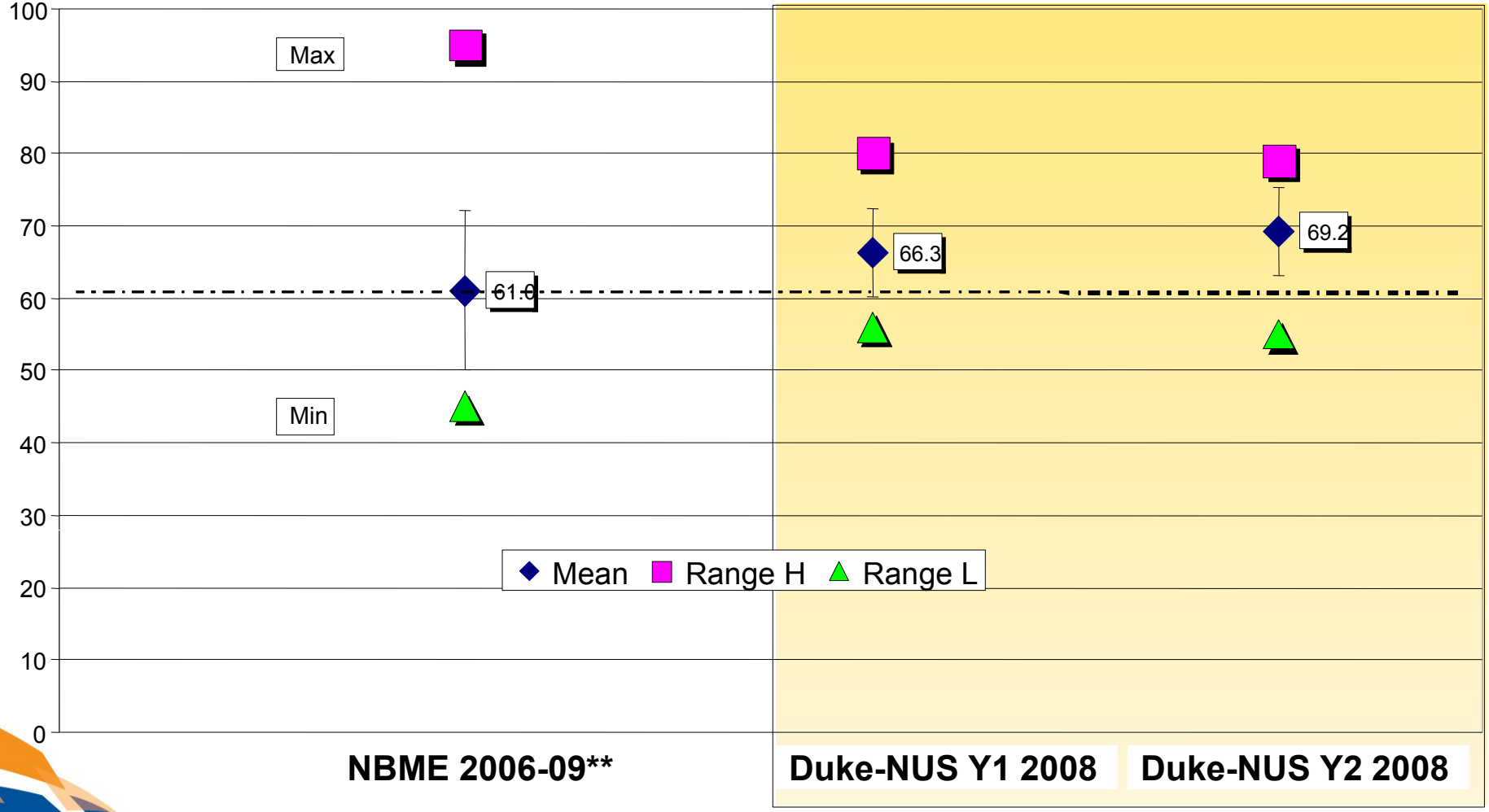
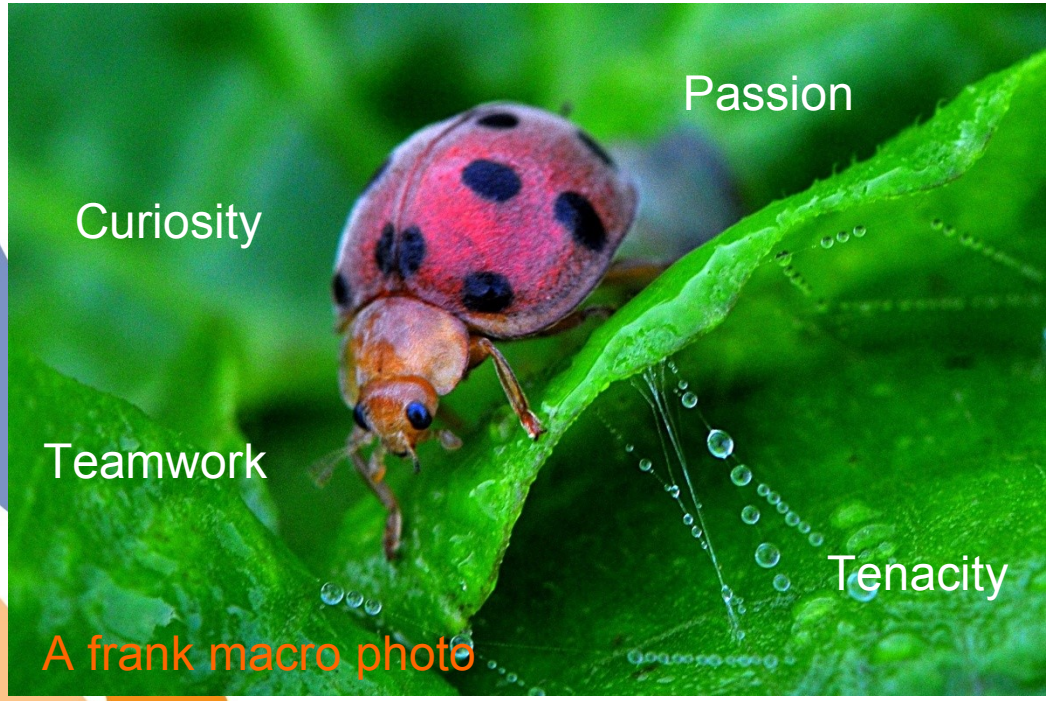


Thank you



Backup Slides

Academic Background

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Class of 2011	Class of 2012	Class of 2013
Undergraduate Degrees	**Undergraduate Degrees**	**Undergraduate Degrees**
Biology/Life Sciences (14)	Biology/Life Sciences (29)	Biology/Life Sciences (37)
Engineering (5)	Engineering (11)	Engineering (11)
Pharmacy/Pharmacology (4)	Pharmacy/Pharmacology (3)	Chemistry (3)
Computer Science (2)	Anthropology (2)	Psychology (1)
Chemistry (1)	Chemistry (1)	Kinesiology (1)
Higher Degrees	Biopsychology & Cognitive Science (1)	Dentistry (1)
Masters Degree (4)	Nutrition (1)	Statistics (1)
PhD (1)	**Higher Degrees**	Natural Sciences (1)
	Masters Degree (7)	**Higher Degrees**
	PhD (2)	Masters Degree (8)
		PhD (1)

Peer Evaluation (Approximately 10% Team Grade)

- Rating of team members: 1, 2, 3 (only 2 3s permitted) 3%

- Self evaluation of feedback (quality and quantity) 3%
  - 0 Zero feedback or not constructive
  - 1 Some feedback but not constructive
  - 2 Constructive feedback to some but not all
  - 3 Constructive feedback to all team members

- Self reflection on feedback received (given to advisors) – for submitting some reflection and on time. 4%

Greatest Challenge: Cross-cultural communication

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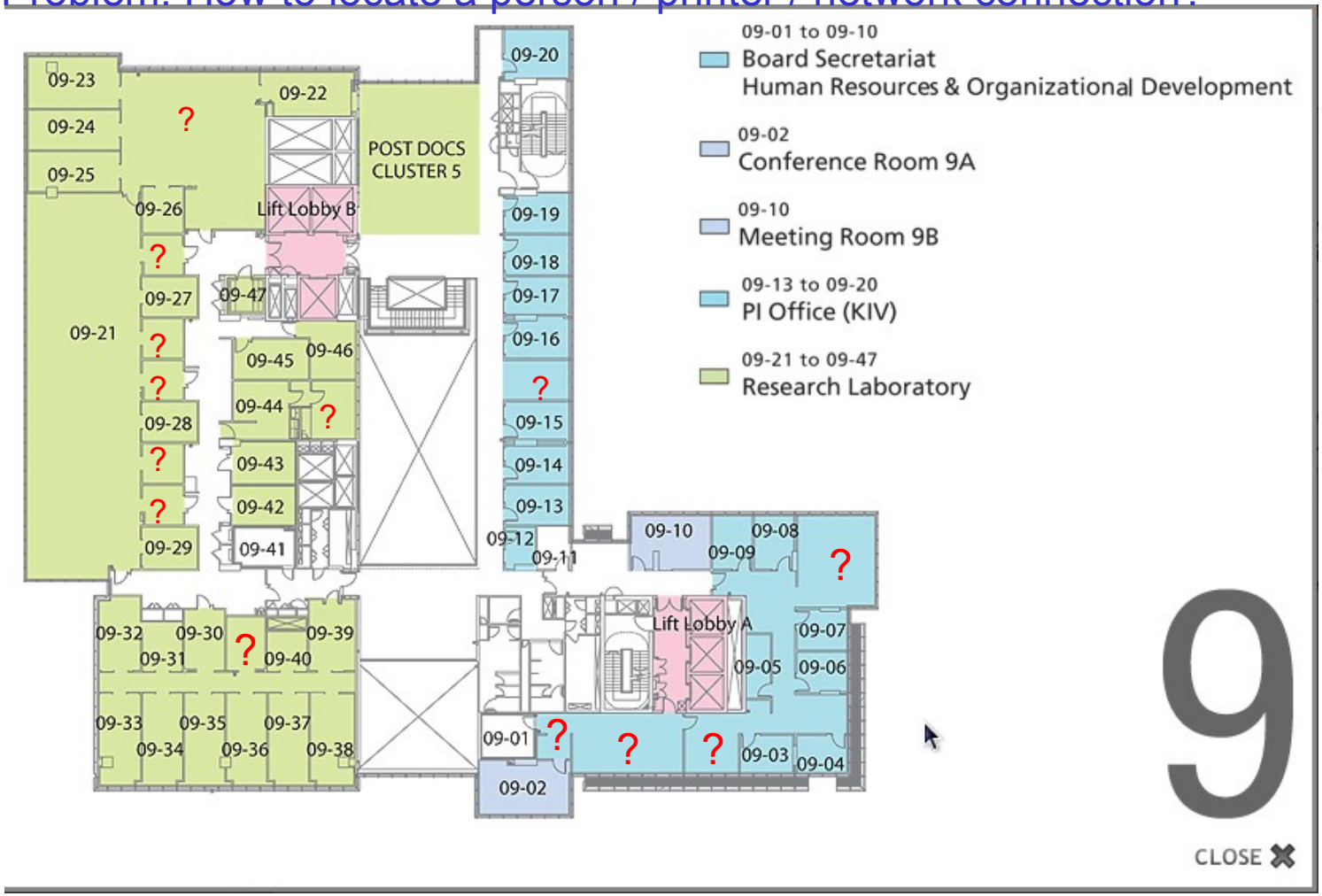
Problem: How to locate a person / printer / network connection?



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PBL does not scale well

	TBL	PBL	Lecture
Center of Instruction	Student/Faculty mix (faculty direct what is learned in prework, students determine what is learned in class)	Student (students determine what questions need to be answered to solve clinical problem)	Teacher (faculty determine what is to be learned)
Size of learning groups	Teams of 6-7 students, but all teams in single room, (learning occurs from other teams)	Groups of 6-7 each meeting by themselves (learning mostly within own team, limited learning from other Teams + mentor)	Entire class in a room
Engagement in class	Active	Active	Passive

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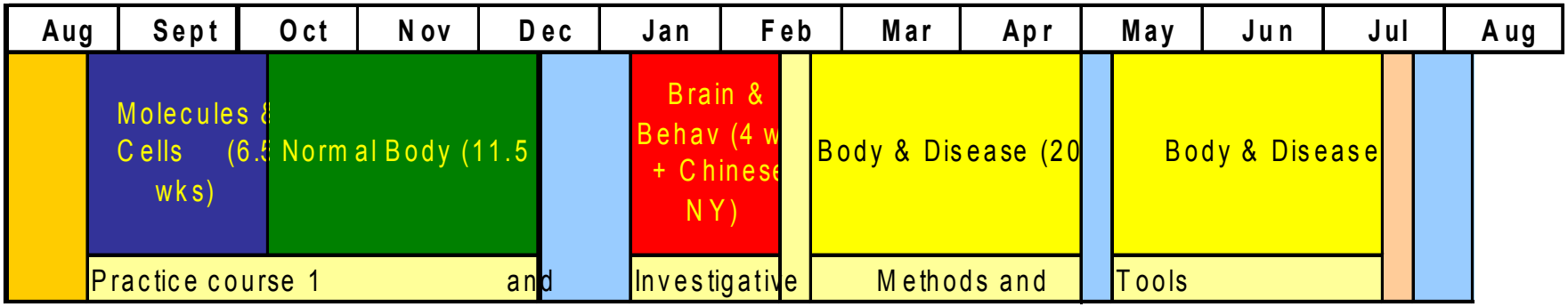
	TBL	PBL	Lecture
Scalability in larger class size	Moderate (can be done in larger classes)	Difficult to scale up, requires more faculty as class size increases	Easy to increase class size without additional faculty
Learning skills	Student/Faculty mix (faculty direct what is learned in prework, students determine what is learned in class)	Student (students determine what ?s need to be answered to solve clinical problem)	Teacher (faculty determine what is to be learned)
Faculty	Facilitator and Expert	Facilitator and Expert	Expert
Student preparation before class	Well prepared	Limited preparation	Limited preparation
Outside homework	Preparation only, no homework	Extensive group activities required	No homework routinely

1st y



- 4 Integrated Courses
- 2 Longitudinal Courses
- Instructional strategy uniquely Duke-NUS

Neurophysiology:
Learning Models

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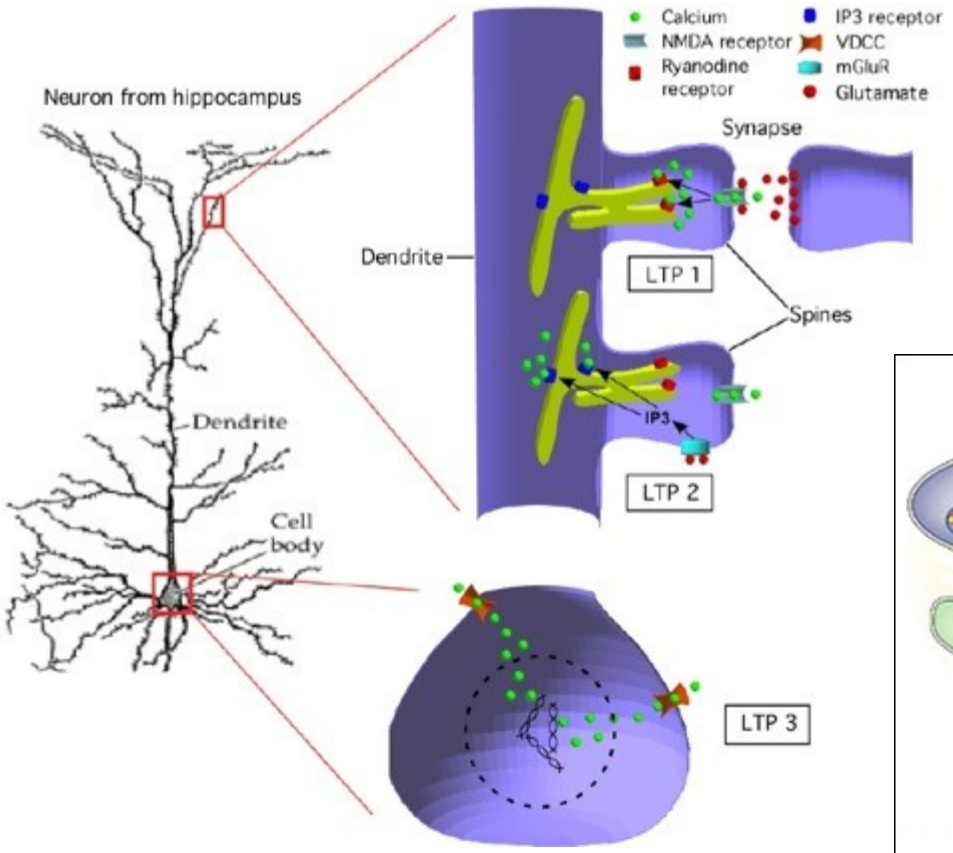
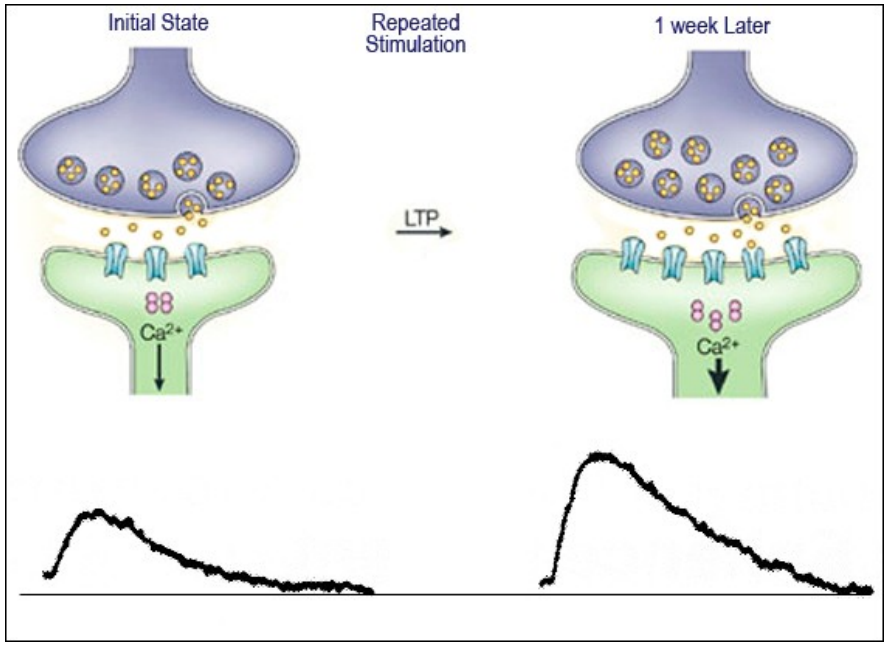


Repetition-dependent long term potentiation



From http://web.bvu.edu/faculty/ferguson/Course_Material/Gen_Psy_New/Modules_18_19_Memory/Default.htm

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Focusing Curiosity:

Water: Liquid and Vapor Phases (physical process)

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Focusing Curiosity:
Spider Mating (behavior)

Miagrammopes

Repeat visits to the same place: an opportunity to observe behavior over time

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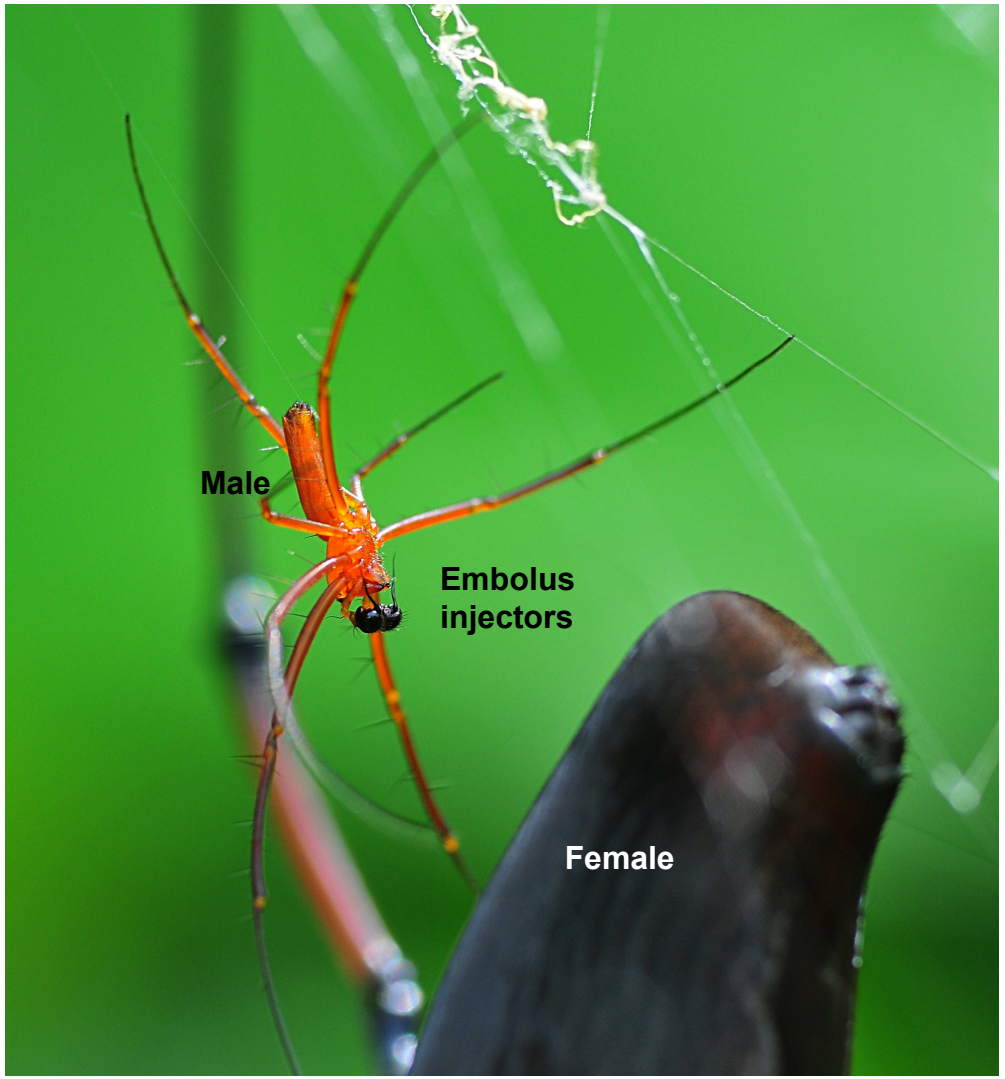

Nephila philipes:
Mating tools

Argyrodes flavescens: a kleptoparasite

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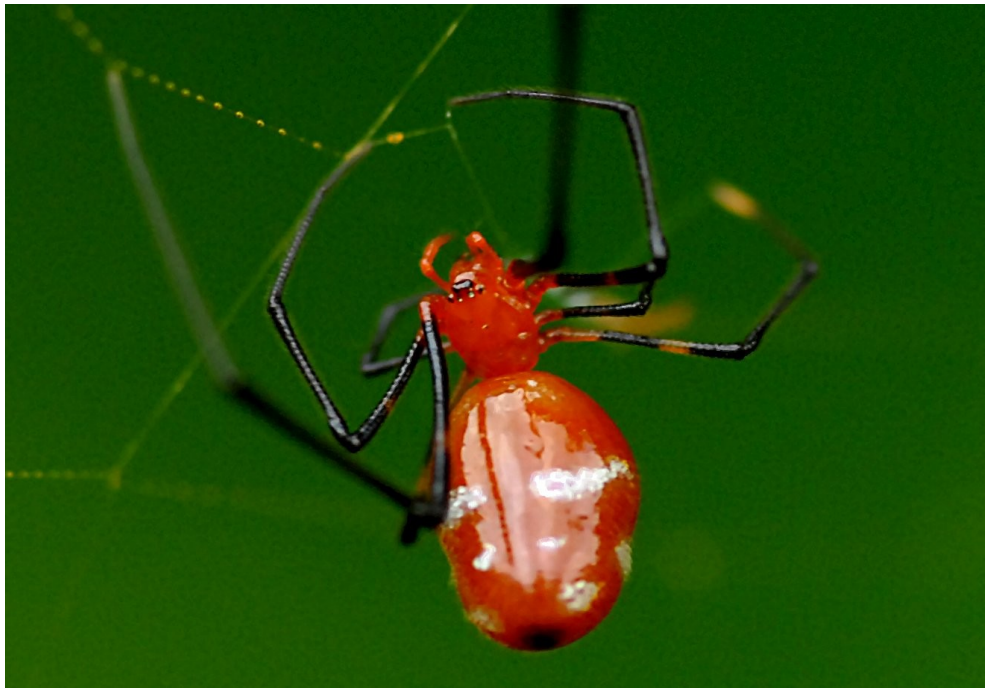

Sky Reflections

Size scale

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Water vapor condensation: morning dew

Some thoughts about learning

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- Repetition is the first law of learning
- We can't learn everything: we forget what we infrequently use
- Curiosity fuels my learning and passion (because its fun)
- When I can focus my curiosity, I'm more likely to find something interesting
- Repeated observations accelerates recognizing patterns
- Detecting deviations from expected patterns = curiosity
- Learning without subsequent use or as fuel for thinking is probably pointless

2: Refine focus. Repeated observations enables temporal pattern recognition

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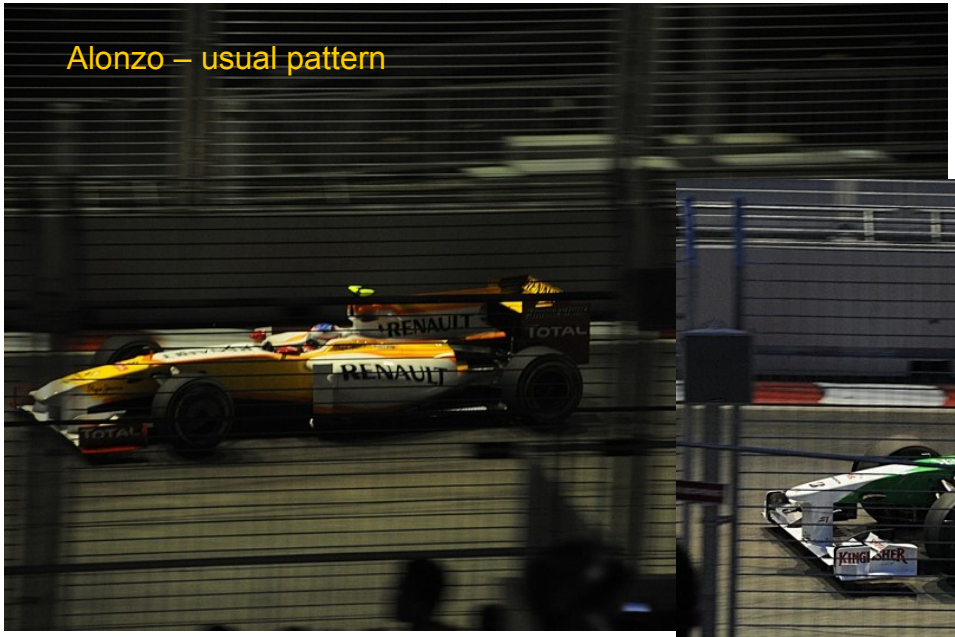

Lap after lap – braking as they approach turn 18 (Bay Bleachers)

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3: Look for temporal patterns

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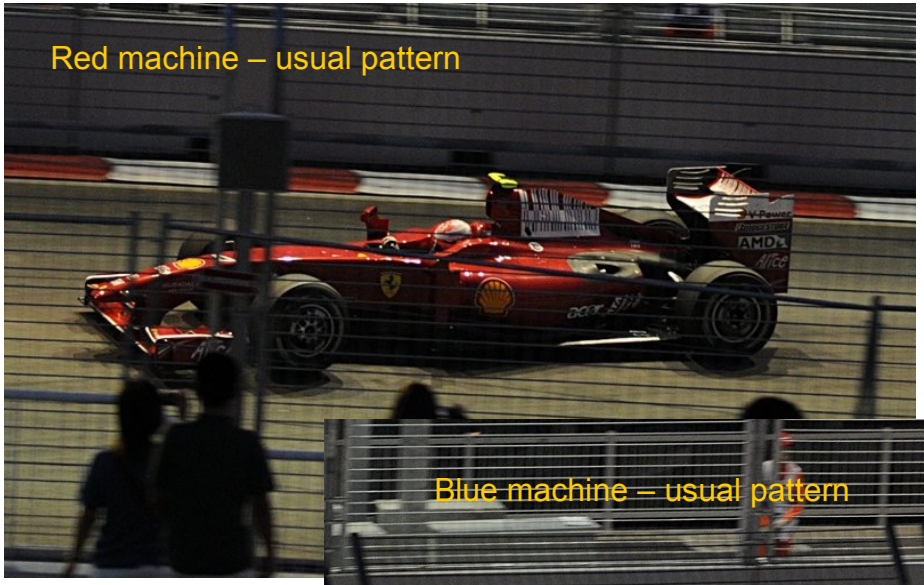

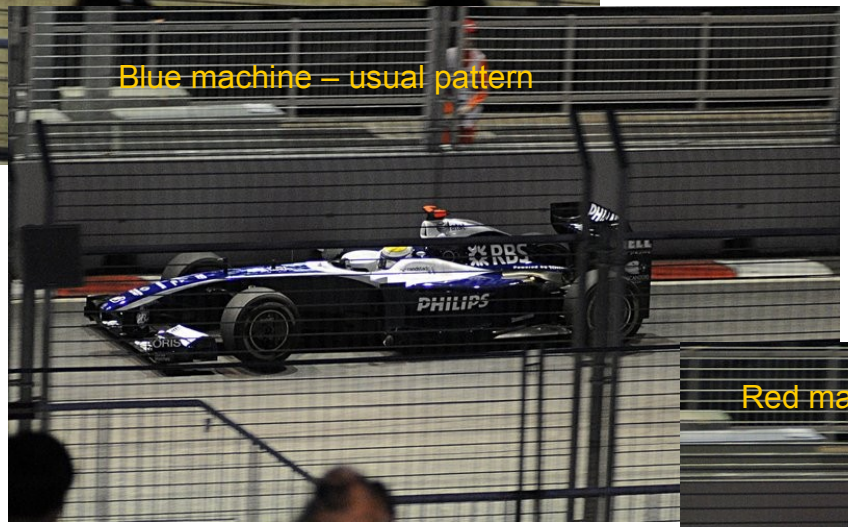

Oops – pattern broken

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Brake fire limited to red machine

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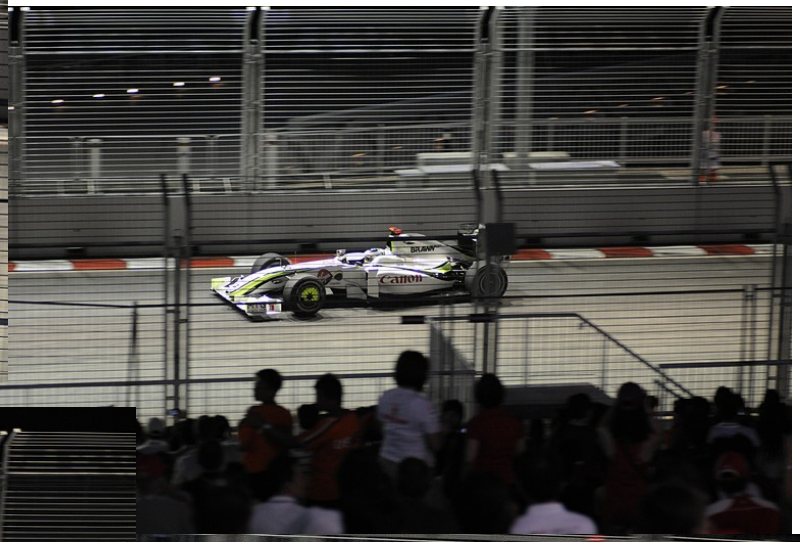

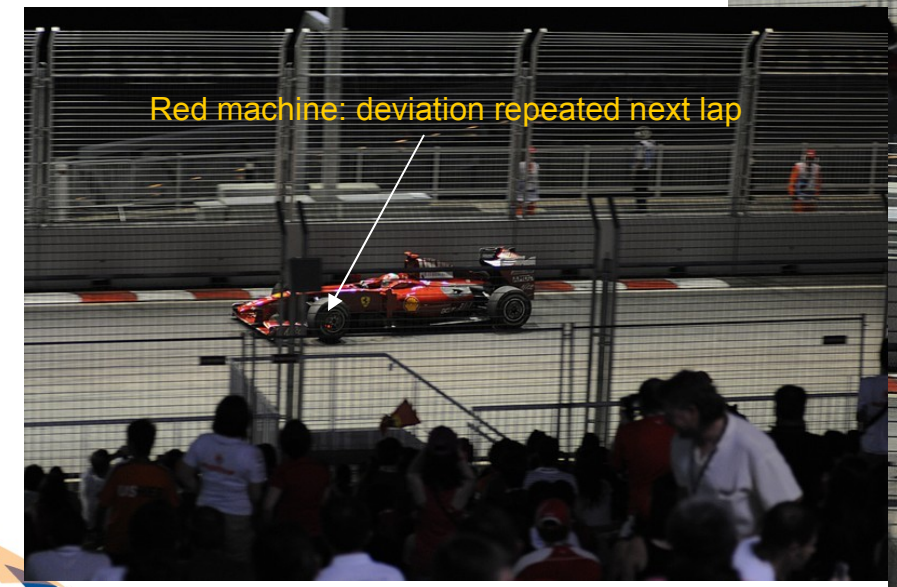

Oops – brake fire infected Hamilton

4: Learning opportunity: What is the overheating mechanism?

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