Bridging the Gap

The High School–University Transition in Chemistry

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with

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Chemical Education Survey:

- Pilot study in 2006-7
- First major survey in 2007-8
- Continuing this year...

What factors contribute to a successful high school–university transition?

What can schools and universities do to help students manage this transition?

Related US Study:

Survey of 12 US colleges & universities:

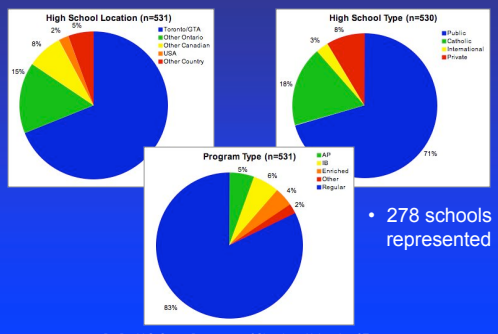
- R. H. Tai, P. M. Sadler, and J. F. Loehr
  - *J. Res. Sci. Teaching*, 2005, *42(9)*, 987-1012
- R. H. Tai, R. B. Ward, and P. M. Sadler
  - *J. Chem. Ed.*, 2006, *83(11)*, 1703-1711
- R. H. Tai and P. M. Sadler
  - *J. Chem. Ed.*, 2007, *84(6)*, 1040-1046

Who Are Our Students?

- 1003 in CHM 138F (Intro. Organic Chem)
- 640 in CHM 139F (Gen. Physical Chem)
- 160 in CHM 151Y (Advanced Intro. Chem)

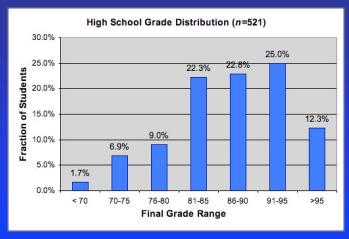
Survey Response Rate (n = 536):	29.7%
Female:	60.6%
Male:	39.4%
Native English-speaker:	44.8%
Semestered Courses:	58.3%
Performed Independent Study Unit:	57.7%

Student Demographics:

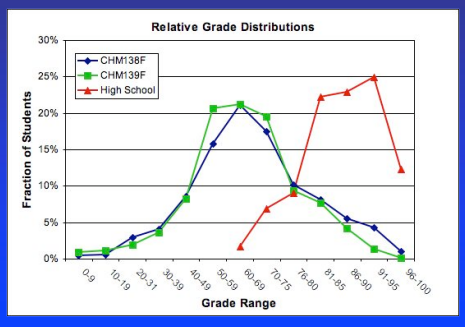


- 278 schools represented

Student Grade Distributions:



A Grade Disappointment:



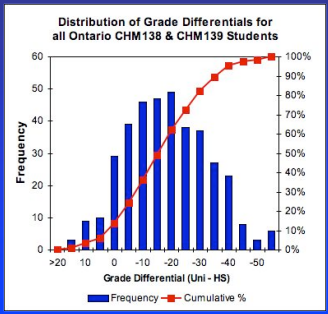
Mean Grades:

- CHM 138F: 65.0% (n = 1003)
- CHM 139F: 63.3% (n = 640)
- High School: ~87% (n = 521)

Note:

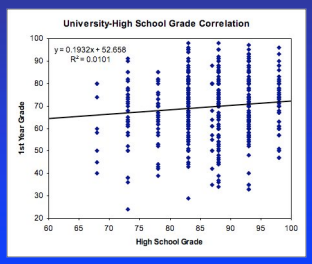
- U of T average for admissions in sciences:[1]
  - 87.4% (Fall 2005)
  - 88.5% (Fall 2006)

Gains and Losses:



- GD = Uni – HS
- Mean GD for all students is –16.4 (n = 374, s = 14.5)
- Mean GD for AP/IB students only is –15.9 (n = 31, s = 13.5)

A Grade Disappointment (2):



- High school grades assigned as central value for each range
- Missing high school grades imputed from average
- Only students who wrote 1st-year final exam

Correlation Analysis:

- Calculate product moment correlation coefficients, r
- Perform 2-tailed t-test using:

$$t = \frac{|r|\sqrt{n-2}}{\sqrt{1-r^2}}$$

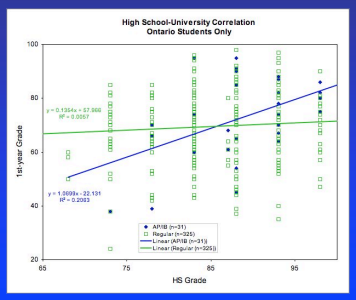
Correlation Results:

Course	n	r	t	p
Both				
CHM138F				
CHM139F				

Correlation Results:

Course	*n*	*r*	*t*	*p*
Both	478	0.100	2.193	0.029
CHM138F	333	0.0985	1.801	0.073
CHM139F	145	0.0872	1.046	0.297

AP/IB Student Advantage?



- Ontario only
- Regular stream (green, *n*=325)
- AP (16) & IB (15) combined (blue)

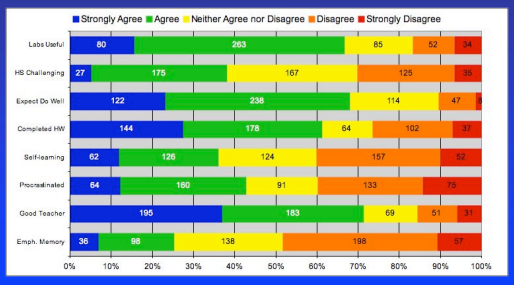
Correlation Results:

Course	*n*	*r*	*t*	*p*
Both	478	0.100	2.193	0.029
CHM138F	333	0.0985	1.801	0.073
CHM139F	145	0.0872	1.046	0.297
Regular	326	0.0755	1.363	0.174
AP/IB	31	0.4542	2.745	0.010
Enriched	18	-0.2883	1.204	0.246

Student Perceptions - HS:

1. Labs were useful and relevant to topics
2. I found HS chemistry challenging
3. I expect to do well in university chemistry
4. I always completed my homework
5. I learnt much independently
6. I procrastinated over my homework
7. My HS teacher performed effectively
8. HS placed more emphasis on memorization

Student Perceptions - HS:



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Topical Content:

- Nuclear Chemistry (isotopes, radio decay, *etc.*)
- Biochemistry (enzymes, proteins, DNA/RNA)
- Forces & Bonding (VSEPR. van der Waal's, *etc.*)
- Electrochemistry (redox, galvanic & voltaic cells)
- Thermochemistry & Kinetics (Hess' Law, *etc.*)
- Organic Chemistry (naming, groups, reactions)
- Gases (properties, gas laws)
- Equilibria (reactions, acid/base, solubility)
- Stoichiometry (chemical reactions & equations)
- The Periodic Table (electron config., periodicity)

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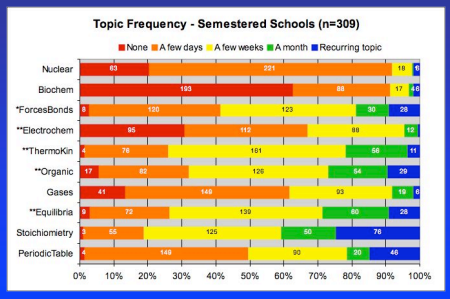
Topical Content - Semestered



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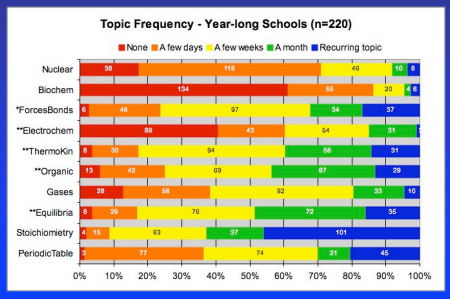
Topical Content - Year-long



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Focus Group Themes:

- Varying background preparation
  - *e.g.* hybridization, stereochemistry, organic reactions
- Test & evaluation practices
  - Problems (*exercises*) *vs.* problem-solving
  - calculations *vs.* application/understanding
- Instructor transitions
  - teaching style, test/exam question format, *etc.*
- TAs
  - tutorial content/approach
  - lab evaluation, marking, feedback

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- U of T 1st-year students, for participating
- The 2006-7 and 2007-8 project teams
- 1st-year instructors and peer mentors
- Faculty of Arts & Science (financial support)

References:

1. Faculty of Arts & Science Annual Report, July 2006–June 2007, page 9.
2. Faculty of Arts & Science Calendar 2008-2009, page 495.

Correlation by School (1):

School	*n*	*r*	*t*	*p*
A	5	-0.428	0.82	0.472
B	6	-0.732	2.15	0.098
C	7	-0.136	0.31	0.771
D	9	+0.143	0.38	0.714
E	5	-0.495	0.99	0.397
F	8	+0.172	0.43	0.683
G	7	-0.055	0.12	0.907
H	5	+0.363	0.67	0.549
J	6	-0.122	0.25	0.818

Correlation by School (2):

School	*n*	*r*	*t*	*p*
K	5	-0.062	0.11	0.922
L	9	+0.457	1.36	0.216
M	11	-0.314	0.99	0.347
N	5	+0.612	1.34	0.273
P	5	+0.561	1.17	0.326
Q	5	+0.430	0.82	0.470
R	7	+0.483	1.23	0.272
S	6	+0.496	1.14	0.317
T	5	-0.704	1.72	0.184

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