



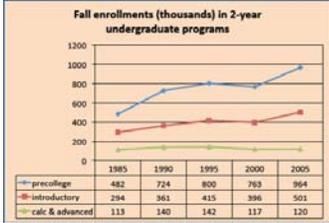
Supporting STEM Transfer Students

Looking Beyond Required Courses

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Why should CC's get more involved with STEM?

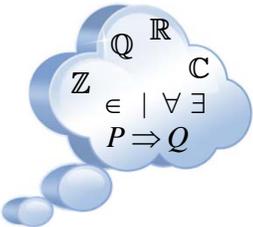


	1985	1990	1995	2000	2005
precollege	482	724	800	763	964
introductory	294	361	415	396	501
calc & advanced	113	140	142	117	120

Bressoud (AMATYC, 2010)

What are the gaps for our students?

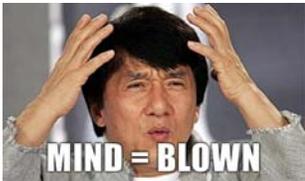
- Number systems
- Sets and set notation
- Basic proofs
- Argumentation
- Conventions of mathematical notation and terminology



How can we expose students to upper division mathematics?

- Provide opportunities for students to work with proofs that use sophisticated logic
- Preview course content from upper level courses
- Show students some mind-blowing ideas

$3 + 3 = 2 \pmod{4}$



A few ideas for supporting STEM students at CC's

- Organize presentations about mathematics
- Talk with students about academic options for mathematics

Engineering Major + Math Minor \geq Engineering Major

- Create conditions that encourage student-student dialogue
- Encourage students to apply for scholarships and internships

Additional ideas for supporting STEM students at CC's

- Support the STEM efforts of colleagues at other schools
- Model mathematics culture in the classroom
- Mentor a student or even a few students
- Sponsor a math club
- Offer a bridge course once a year





Offer Math Presentations



**π and ice cream
lecture series
(1999-present)**



**Dead Mathematicians' Society
(1986-present)**

- At Clackamas CC, there are typically one or two math-focused lectures during spring term and then following the talk, we serve ice cream.
- At Mt. Hood CC, there are as many as eight lectures a year and some of them are interdisciplinary.

Math 299: A Bridge To University Mathematics

- Math 299 originated in the spring of 2005
- Many of these students had exhausted our mathematics courses and were looking for something that would help prepare them prior to transferring
- This elective course has been taught in a variety of formats at Clackamas Community College since 2005

The Evolution of Math 299

Year	FTE	#I	Curriculum
2005	10	3	Proof, topology, group theory
2007	6	1	Group theory, proof, math history
2008	6	2	Group theory (g.r.), topology
2009	9	1	Group theory (g.r.)
2010	13	1	Group theory (g.r.)
2011	14	2*	Group theory (g.r.)

Portland State University Mathematics BA/BS Requirements

Mth 251, 252, 253*, 254: Calculus I-IV (16)
 Mth 256 or Mth 421: Differential Equations (4/3)
 Mth 261: Introduction to Linear Algebra (4)

A GAP IN THE CURRICULUM

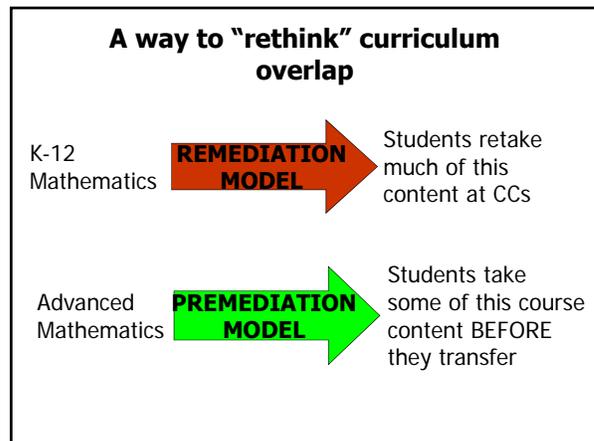
Mth 311, Math 312: Advanced Calculus (8)
 and Mth 344*: Group Theory (4)

Minor: additional 9 - 12 credits of elective courses

What is a mathematics bridge course?

Often synonymous with a transition or transition-to-proof course, Selden & Selden (1995) describe a bridge course as being

“designed to ease the transition from lower division, more computational, mathematics courses to upper division, more abstract, mathematics courses such as modern algebra and advanced calculus.”



**A description of Math 299:
Bridge to University Mathematics**

Low risk

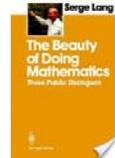
- An elective course (A, B, or No Pass)
- Little written homework required
- Inexpensive (3 credits, no textbook)
- Comparatively low-level prerequisite (Trig)



What is the Math 299 curriculum?

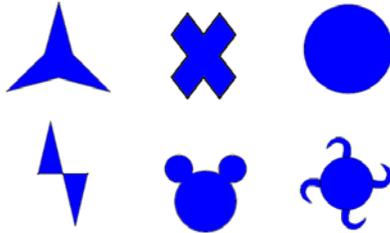
Math 299 uses the guided reinvention group theory curriculum (since 2009)

- Students are expected to be active participants in the class every day (private think time, group share, group brainstorm, whole-class discussion)
- Students make conjectures and debate their ideas every class meeting



Activity: Ranking Symmetries

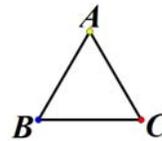
Rank the figures in order from least to most symmetric. Note: there is not a single right way to do this. Base your responses on instinct, intuition, or aesthetic sense.



Activity: Triangle Symmetries

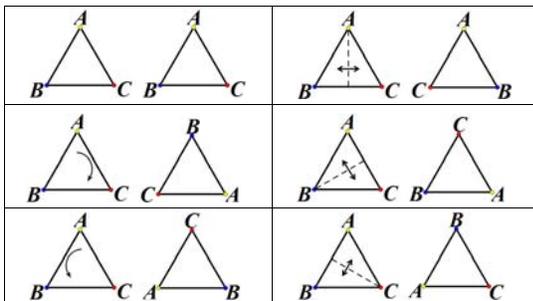
After a few class sessions, the students have:

- Defined "symmetry of a figure"
- Found all the symmetries of an equilateral triangle.



In this activity, the students develop a notation for these symmetries.

Activity: Triangle Symmetries



Write each triangle symmetry using a combination of the symbols **R** and **F**, where **R** stands for a 120° clockwise rotation and **F** stands for a flip across the vertical axis.

Examples of Student Notation

F stands for a flip across the vertical axis
R stands for a 120° clockwise rotation.

		2R R₂ R+R
		R² R₂ RR
		R⁻¹ F0R2
		FR F+R
		RRF R²F R+R+F
		-R Я

Some preliminary results from the data collected in Math 299 ('09 and '10)

- Students were empowered and took ownership of the mathematics
- The exit interview data suggests that most of the students thought they had changed the way they thought about mathematics
- Our transfer students were glad they had overlapping content and felt more prepared once they were at Portland State University

What we get out of this course

- We make a more conscious effort to use some of the protocols, even in courses that are structured more traditionally
- We are better able to use inquiry-based learning as a way to teach our students
- Mark is a mathematics education researcher, but Bruce is not. This collaboration makes him more invested in the process and products of math education research
- We are convinced that many of the strengths of our course comes from our collaboration

Are there other things that you or other faculty are doing at your community college to support STEM development?