

Precalculus Program



Steve Benoit

Associate Professor and Precalculus Program Co-Director
steve.benoit@colostate.edu ---- (970) 491-0549

November 8, 2021



Colorado State University



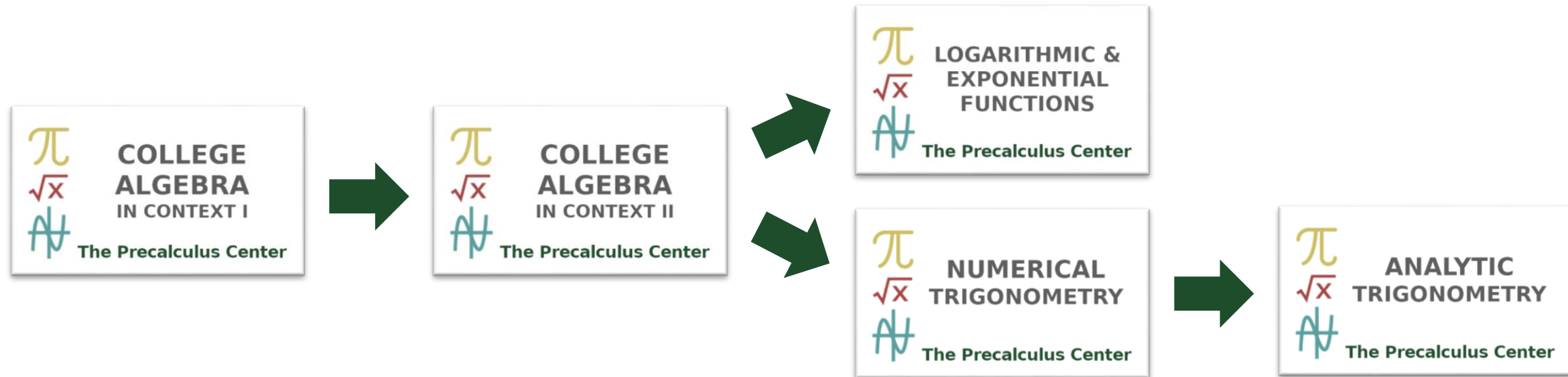
Outline of Talk

- Courses and program structure
- Integrated math placement
- Curriculum and mastery
- Program operation
- Outcomes
- Our future plans
- Q & A



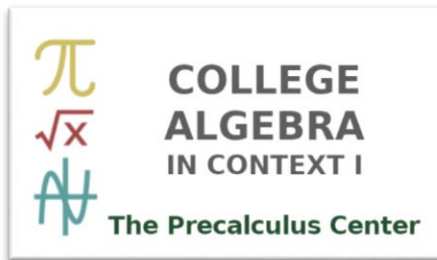
Courses and Program Structure

Suite of Precalculus Courses



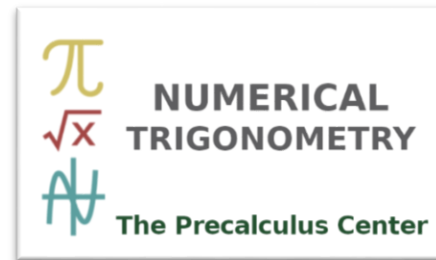
- Five courses, each 1 credit
- Courses have prerequisite relationships, but concurrent enrollment is allowed
- Students can register for just one, all five, anything in between (respecting prereqs)

Suite of Precalculus Courses



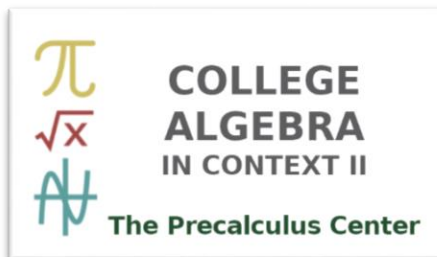
MATH 117

Linear Functions
Piecewise, Abs. Value Functions
Quadratic Functions
Systems of Equations



MATH 125

Trigonometric Functions
Laws of Sines and Cosines
Unit Circle & Radian Measure
Periodic Functions



MATH 118

Polynomial Functions
Rational Functions
Radical and Root Functions
Power Functions



MATH 126

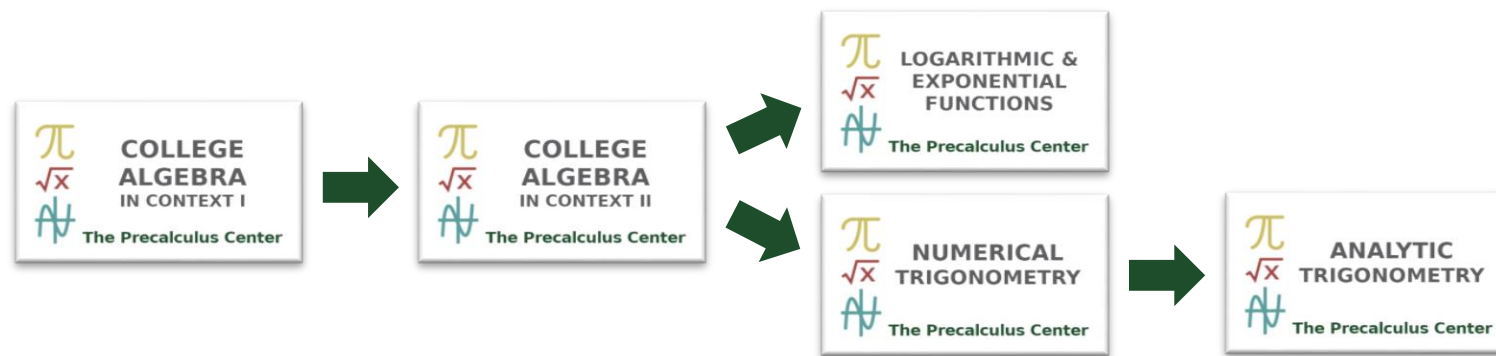
Inverse Trigonometric Functions
Fundamental Identities
Sum & Difference Identities
Double & Half Angle Identities



MATH 124

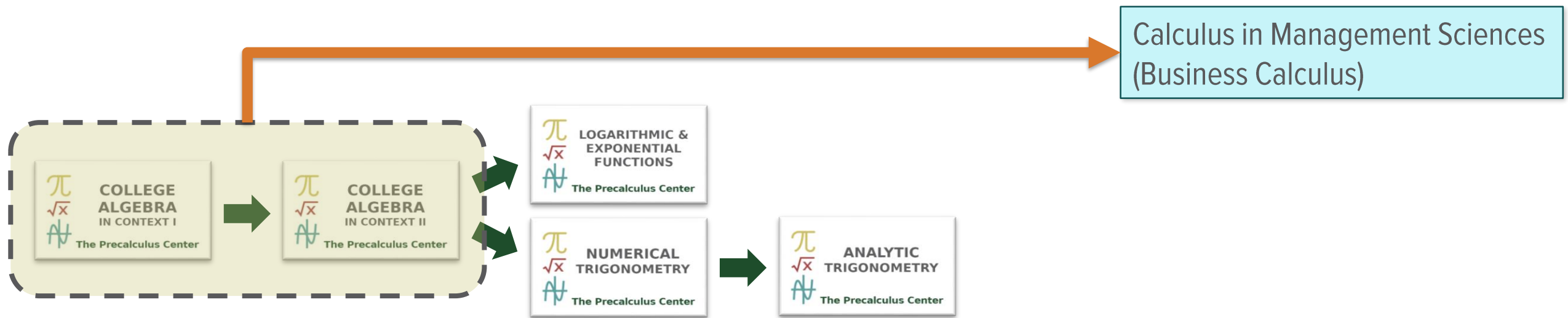
Functions and Rates of Change
Exponential Functions
Logarithms
Exponential and Logarithmic Models

Suite of Precalculus Courses



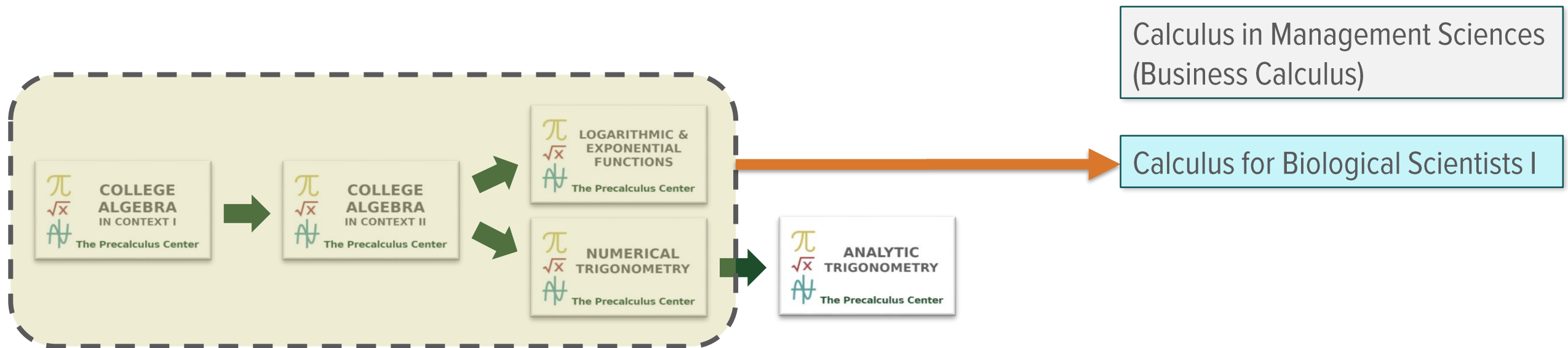
- Several flavors of Calculus, each with a set of prerequisite Precalculus courses

Suite of Precalculus Courses



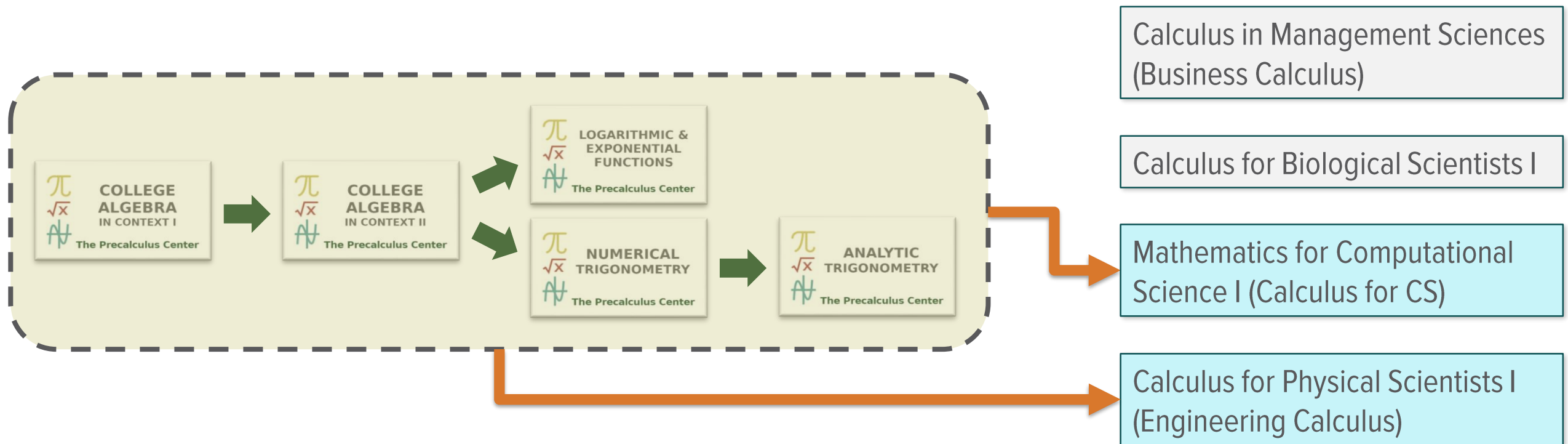
- Several flavors of Calculus, each with a set of prerequisite Precalculus courses

Suite of Precalculus Courses



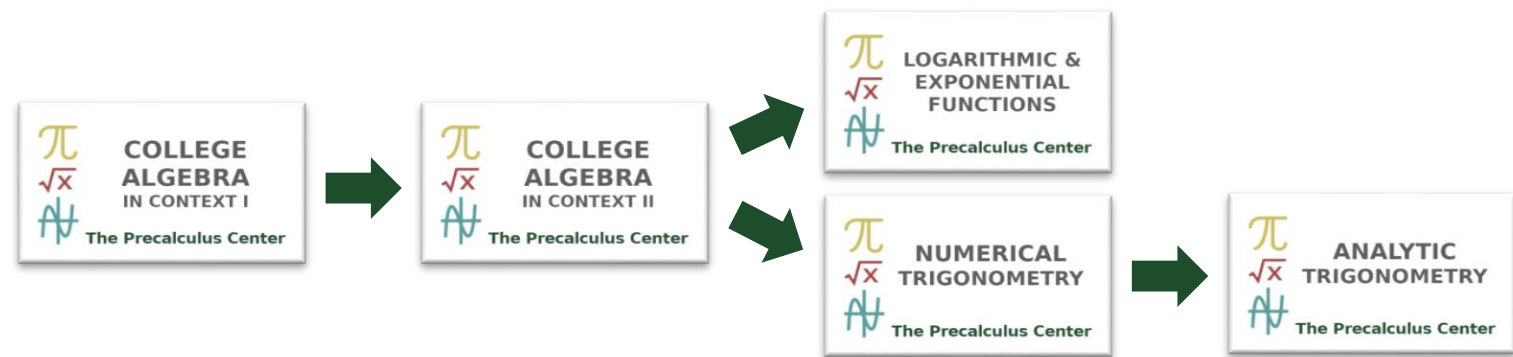
- Several flavors of Calculus, each with a set of prerequisite Precalculus courses

Suite of Precalculus Courses



- Several flavors of Calculus, each with a set of prerequisite Precalculus courses

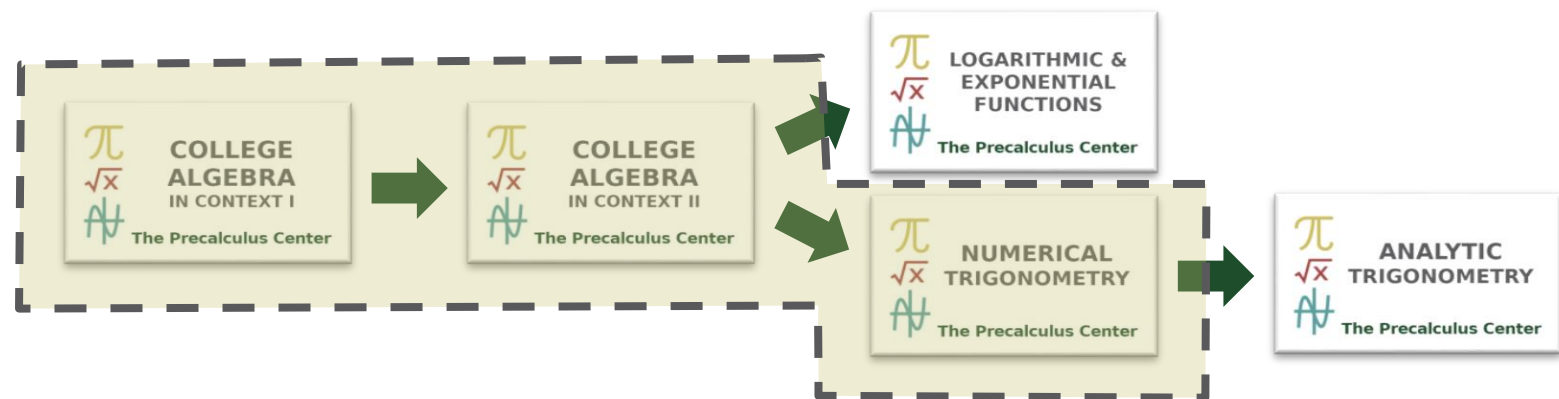
Suite of Precalculus Courses



- Degree programs on campus that do not require Calculus can choose the Precalculus courses their students need

Suite of Precalculus Courses

Construction Management

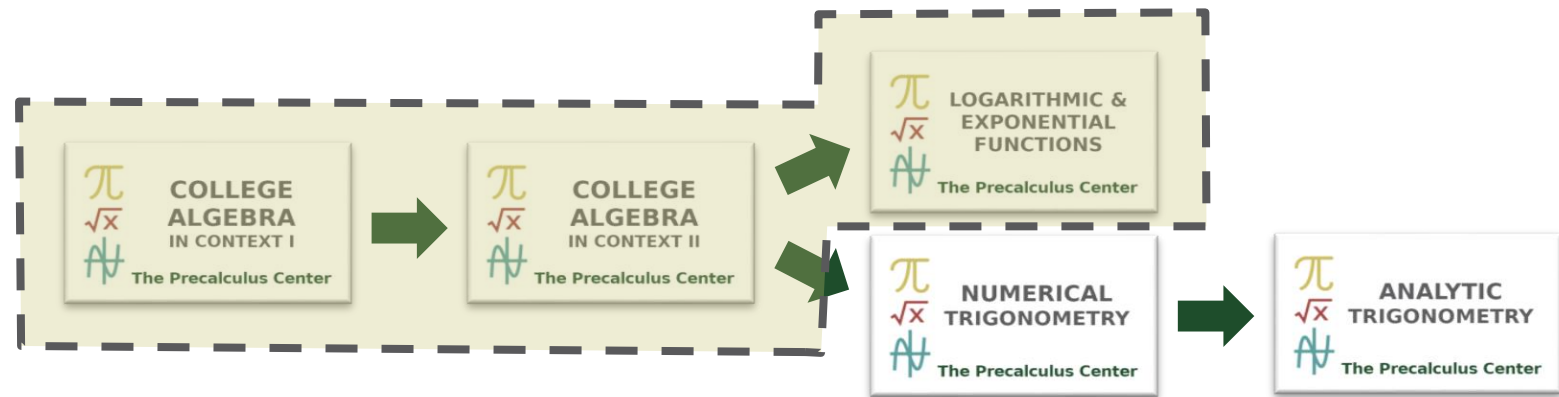


- Degree programs on campus that do not require Calculus can choose the Precalculus courses their students need

Suite of Precalculus Courses

Construction Management

Psychology



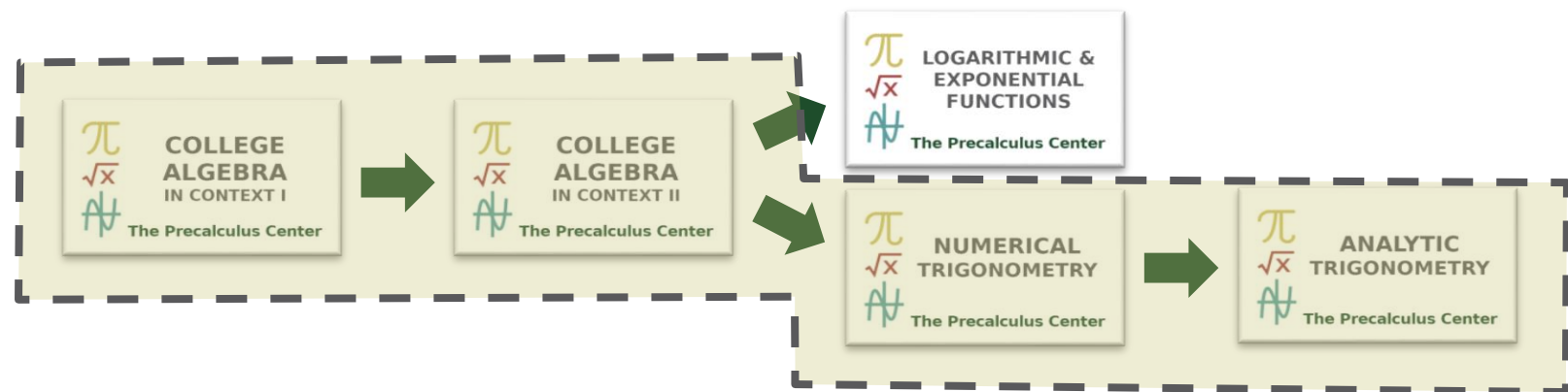
- Degree programs on campus that do not require Calculus can choose the Precalculus courses their students need

Suite of Precalculus Courses

Construction Management

Psychology

Landscape Architecture



- Degree programs on campus that do not require Calculus can choose the Precalculus courses their students need



Integrated Math Placement

Math Placement

- A “**My Math Plan**” web site to tell students what courses they need and when they should plan to complete them to stay on track for their major(s) of interest.
- A custom **Math Placement Tool** that aligns with the five-course structure.
- A suite of no-cost **tutorials** that earn placement but not course credit.
- Course **challenge exams** to earn credit by exam.

Math Plan



COLORADO STATE UNIVERSITY

DEPARTMENT OF MATHEMATICS

Math Placement Overview

The Math
Placement Process

Create a Personalized
Math Plan

General
Information

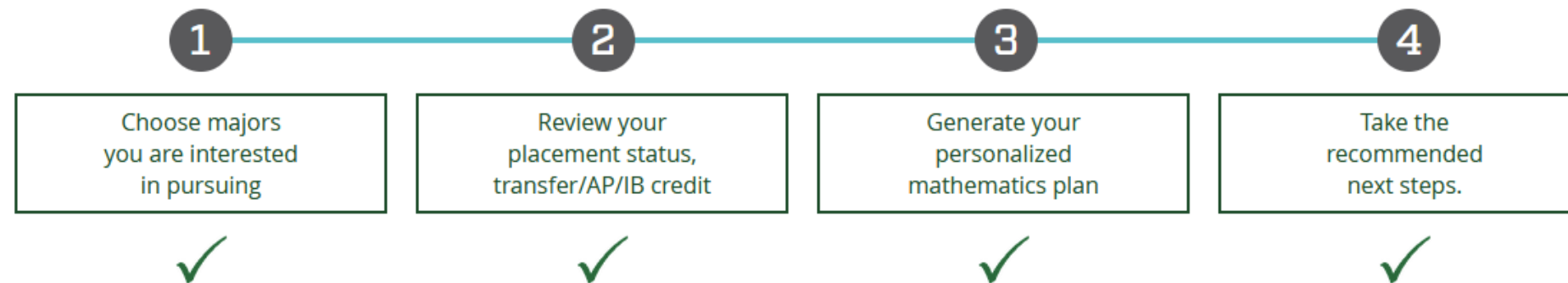
Explore 100-Level
Math Courses

Create a Personalized Math Plan

Welcome, Steve Benoit.

Creating your personalized math plan will help you identify the mathematics course(s) that best match your mathematical preparation with your academic goals, and will help determine if the Math Placement process is right for you.

Creating your plan takes four simple steps. You can come back and change your selections at any time to update your plan.



Math Plan

Personalized Math Plan for Steve Benoit

Sep 30, 2021

I am interested in majoring in...

- [Construction Management](#)
- [Zoology](#)

My current declared major: **none**

This plan is based on the mathematics courses required for **any** of the majors you selected. Following this plan keeps your options open to choose any of the majors listed above.

During your first semester, your goal should be to take these courses, or to place out of them through Math Placement:

- [MATH 117](#): College Algebra in Context I (1 credit)
- [MATH 118](#): College Algebra in Context II (1 credit)
- [MATH 124](#): Logarithmic and Exponential Functions (1 credit)
- [MATH 125](#): Numerical Trigonometry (1 credit)

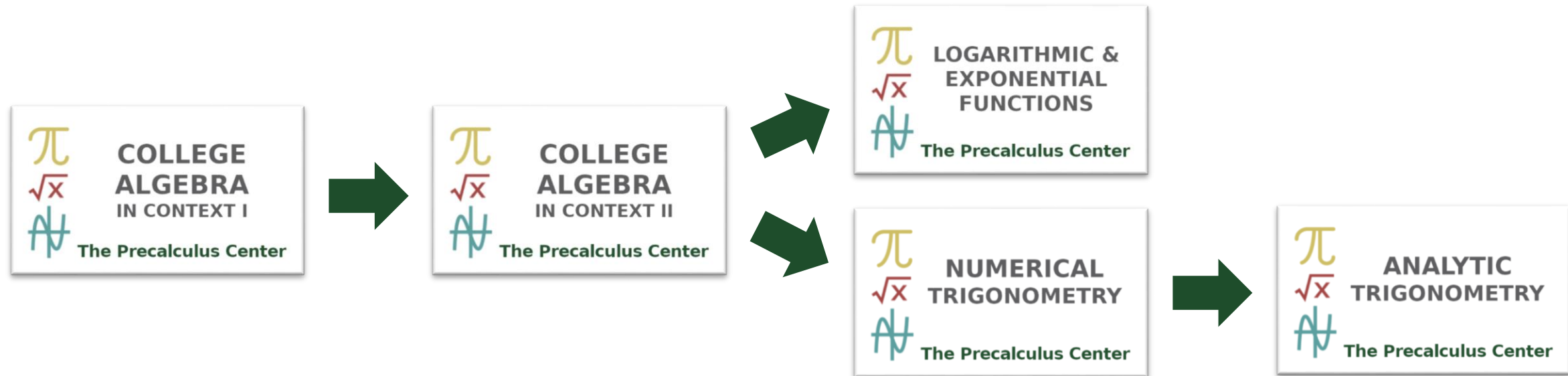
During your second semester, your goal should be to take:

- The **Calculus I** course appropriate for your major

- It is important that you take **MATH 117: College Algebra in Context I** as quickly as possible.
- The fastest way to become eligible for **MATH 117** is through **Math Placement**. Examples and practice materials are provided if you would like to review.

[Tell me about Math Placement...](#)

Math Placement Tool



- Students can place into the first course, or place out of any sequence of courses.
- To place out of course X, student must place out of all prerequisite courses too.
- Placement out of a course satisfies prerequisites as if the course had been completed.

Math Placement Tool



COLORADO STATE UNIVERSITY

DEPARTMENT OF MATHEMATICS

Math Placement Overview

The Math
Placement Process

Create a Personalized
Math Plan

General
Information

Explore 100-Level
Math Courses

The Math Placement Tool

To request accommodations related to a disability for access to the Math Placement Tool, please contact [The Student Disability Center](#).

You have not completed the Math Placement Tool.

Your options:

- You are eligible to complete the Math Placement Tool remotely.
 - [Tell me how to complete the Math Placement Tool remotely.](#) (this option is available until Dec 12, 2021)
- You are also eligible to complete the proctored Math Placement Tool.
 - [Tell me how to complete the Math Placement Tool in the Precalculus Center.](#)
 - [Tell me how to complete the Math Placement Tool using ProctorU.](#)

Math Placement Tool

- 50-item assessment, delivered online, with randomized items.
- Incoming students can complete tool from home before arriving on campus.
- All students have two total attempts.
- Review materials are provided and review is encouraged.

The screenshot displays the 'Math Placement Tool' interface. At the top, the title 'Math Placement Tool' is centered, with a timer below it showing 'Time Remaining: 2:18:23'. On the left side, there is a vertical list of question numbers from 19 to 42. Questions 19 through 24 are grouped under the heading 'II. Trigonometry', and questions 25 through 42 are grouped under 'III. Exponentials & Logs'. Question 36 is highlighted with a green background. The main area of the interface is a large light blue box containing the question: $\sin\left(\frac{\pi}{2} - \theta\right) + \cos(-\theta) =$. Below the equation are five radio button options: $1 - \sin \theta - \cos \theta$, $\cos \theta + \sin \theta$, $2 \cos \theta$, $1 - \sin \theta + \cos \theta$, and 0 .

Math Placement Tutorials

- No-cost online tutorials with proctored final exams are available to improve placement results (they carry no credit and do not require registration)
- Tutorials are free to any student after their **Math Placement Tool**, before they arrive on campus – which tutorial is available depends on current placement results.
- **Entry Level Mathematics Tutorial** earns placement into first Algebra course.
- Every Precalculus course has a corresponding **Precalculus Tutorial** to earn placement out of the corresponding course.
- Tutorials use same curricular materials as the actual courses, and same final exam.
- Goal is to get students Calculus-ready or ready for other courses with Precalculus prerequisites (Chemistry, Biology, etc.) before arriving on campus.

Challenge Exams

- Students who need course credit can take a low-cost course challenge exam.
- Final exam from the corresponding course, with 80% threshold to pass.
- Student must be eligible to take course in order to challenge, and cannot be currently enrolled (it's not a way to escape a low grade at the end of a course).



Curriculum and Mastery

Course Content

- **MATH 117:** Linear functions, Absolute value and piecewise functions, Quadratic relations and functions, Systems of equations and inequalities
- **MATH 118:** Polynomial functions, Rational functions, Radical functions, Power functions
- **MATH 124:** Functions and inverses, Exponential functions, Logarithms, Modeling with exponential and logarithmic functions
- **MATH 125:** Trigonometric functions, Laws of sines and cosines, The unit circle and radian measure, Periodic functions and applications
- **MATH 126:** Inverse trigonometric functions, Fundamental identities, Sum and difference identities, Double- and half-angle identities

Course Delivery

Courses delivered through a web site that presents:

- The student's current score/status.
- The "e-text" in outline format, with video lessons and examples, online assignments.
- All exams the student has taken, with their answers, the correct answers, and detailed solutions.
- How to get help.

COLORADO STATE UNIVERSITY | DEPARTMENT OF MATHEMATICS

Logged in as STEVE TEST-PROD | Mon, Oct 18, 2021

MATH 124: Logarithmic & Exponential Functions Section 001

Your Current Status:

	Review Exam	Proctored Exam	Points
Unit 1:	Not taken - due Sep 13	Not taken	
Unit 2:	Not taken - due Sep 30	Not taken	
Unit 3:	Not taken - due Oct 19	Not taken	
Unit 4:	Not taken - due Nov 5	Not taken	
Final Exam:		Not taken - due Nov 18	
Total Points Earned:			0

Grading Scale: 65 - 72 = A, 62 - 64 = B, 54 - 61 = C, <54 = U

NOTE: The prerequisite for **MATH 160** (Calculus for Physical Scientists I) **requires a grade of B or higher** in MATH 124 and MATH 126.

E-Text Table of Contents

Course Overview | Course Outline

Skills Review

Skills Review materials

Skills Review Exam Passed

Review your Skills Review Exam submitted Aug 12, 2021 at 01:46 PM

1: Functions

Unit Video Problems

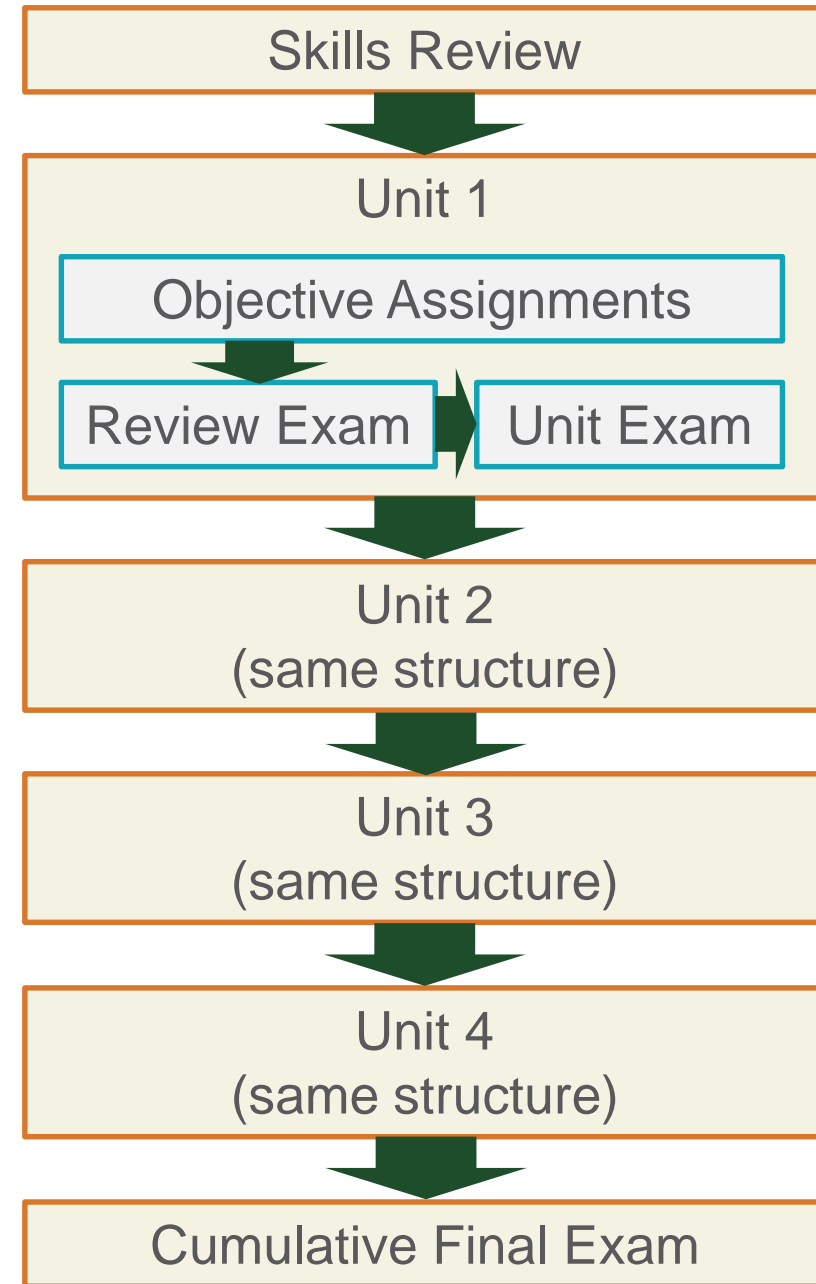
The Unit 1 Review Exam is due Sep 13, 2021.

- 1.1: Evaluate and graph relations and functions Completed
- 1.2: Evaluate functions and determine average rates of change Completed
- 1.3: Solve equations related to functions Not Yet Completed
- 1.4: Perform operations on functions
- 1.5: Given a function, find its inverse

Unit 1 Review Exam (due Sep 13, 2021) Unit required assignments not yet completed.

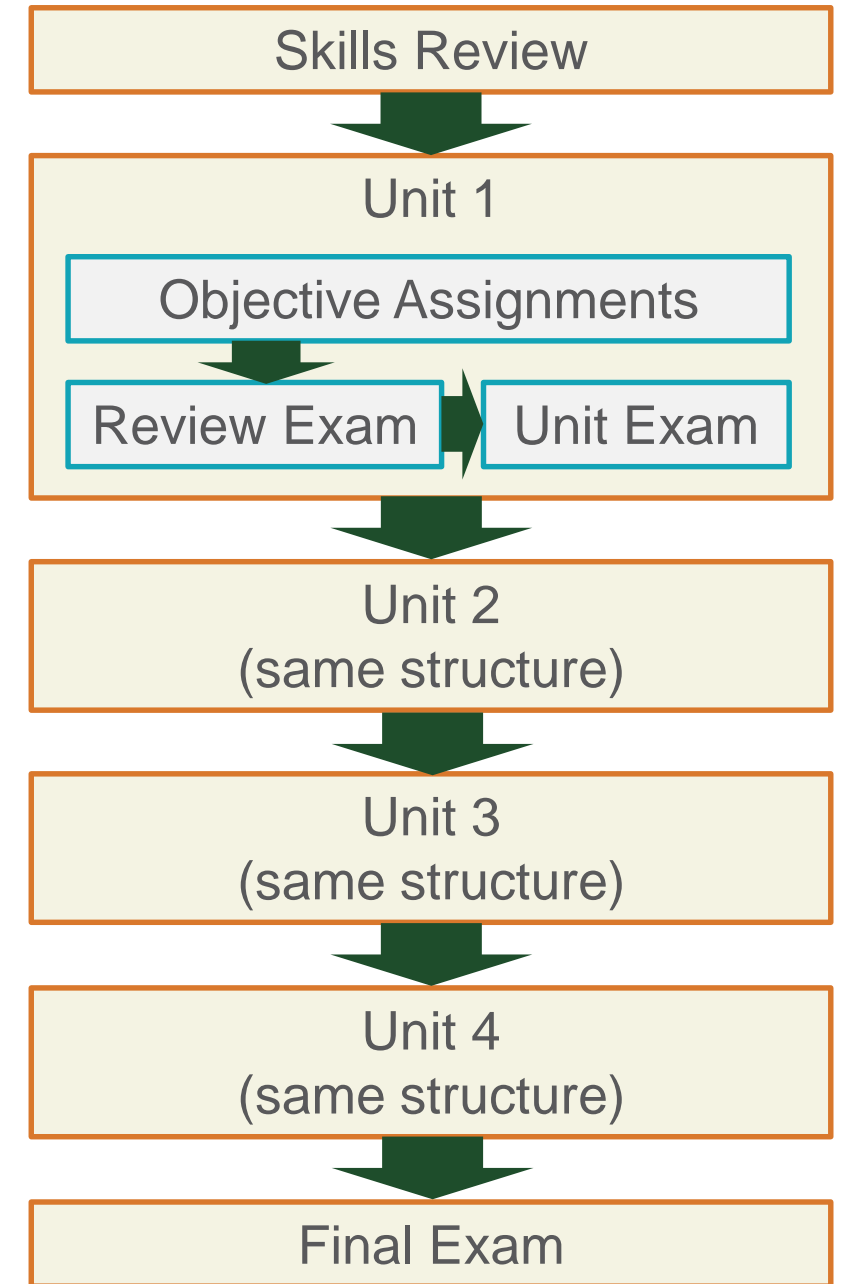
Course Structure

- Each course has 4 units of content.
- Skills review exam before unit 1
- Each unit has instructional content, short formative assessments.
- Each unit culminates with a 10-item exam
 - Unproctored review exam
 - Proctored unit exam (counts toward grade)
- Course culminates with comprehensive 20-item final exam.



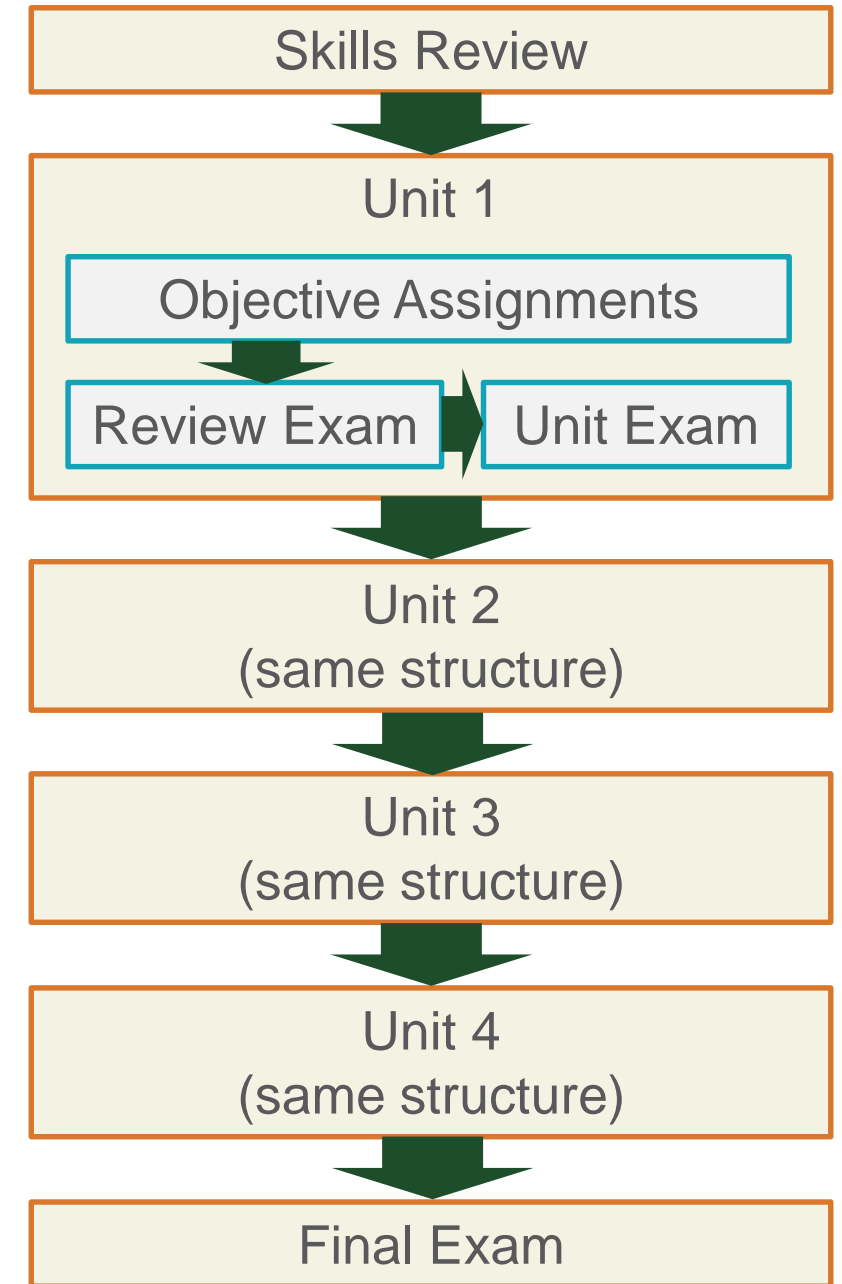
Mastery Requirement

- Mastery defined as 80% correct.
- Skills review exam must be mastered to access Unit 1.
- All objective assignments must be 100% correct to move to Unit Review Exam (unlimited re-tries)
- Review Exam must be mastered to access proctored Unit Exam.
- Unit exam must be mastered to access next unit's Unit Review Exam.
- All Units must be mastered to access Final Exam
- Final exam must be mastered to complete course.



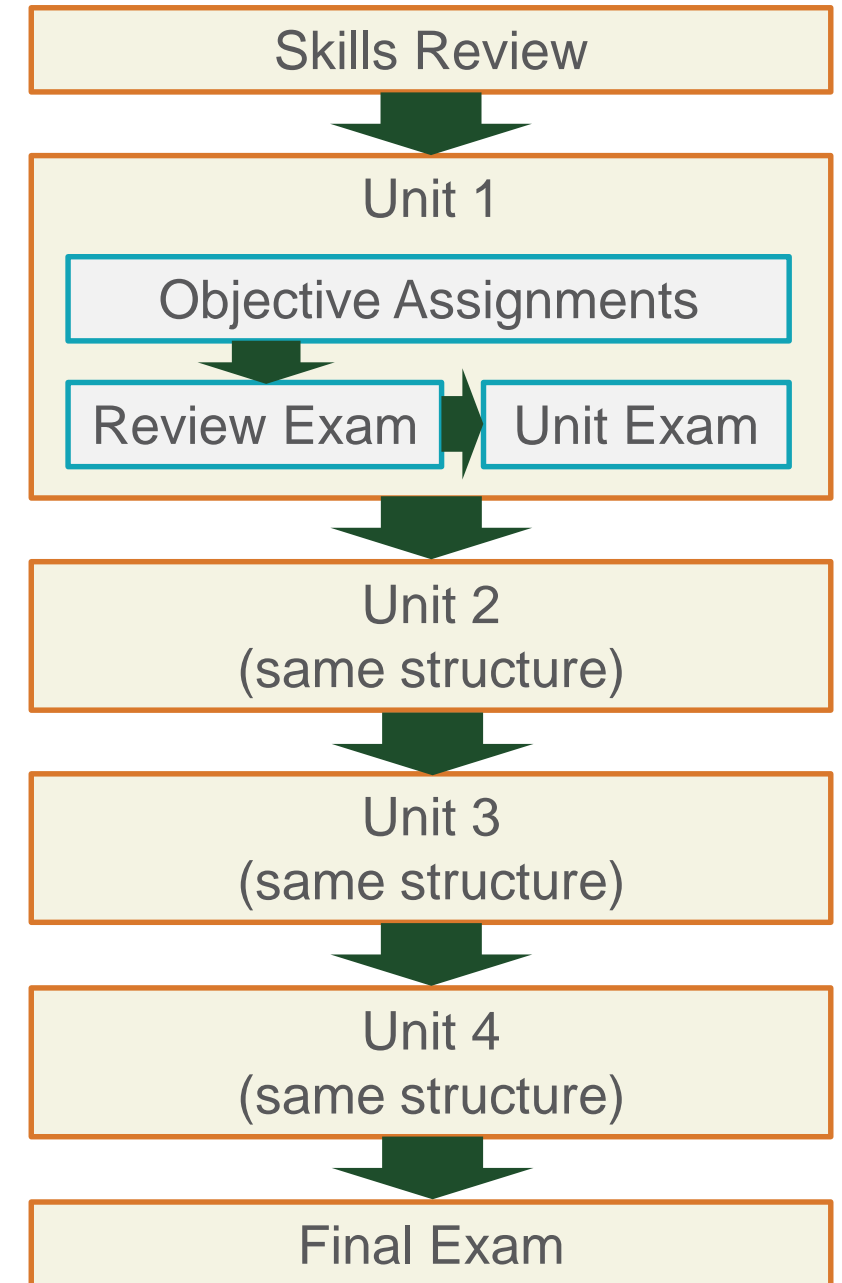
Mastery Scoring and Grades

- 10 points possible per Unit Exam (8/10 required)
- 20 points possible on Final Exam (16/20 required)
- 3 points awarded for completion of Unit Review Exams by posted deadline (to keep students on schedule)
- 72 points total
- “A” grade for 90% or higher (65+ points)
- “B” grade for 86% to 90% (62-64 points)
- “C” grade if all content mastered, but score is below 62 (minimum of 54 required to pass)
- No “D” grades, “U” rather than “F” if not passing.



Mastery Philosophy

- Re-try exams without limit, only highest score counts.
- All graded exams include detailed solutions.
- To prevent rapid-fire retries on proctored Unit exams, a student who fails to master a Unit exam twice in a row has to re-master the unproctored Unit Review Exam (using same item bank) to earn 2 more tries on the Unit exam.
- No limits to Final Exam attempts.
- Students can continue to re-take Unit/Final exams after mastering Final Exam to try to raise point totals.





Program Operation

Enrollment and Sections

- Fall semester: ~3,400 students ~6,300 registrations
- Spring semester: ~2,100 students ~3,500 registrations
- Summer semester: ~600 students ~850 registrations

- On-campus fully online sections (main section, 95% of students)
- Late-start sections (beginning mid-semester)
- Small face-to-face sections, requires dept. approval, for advisers to recommend
- CSU Online (fully distance) sections – same course policies and delivery

Course Tracks and Schedule

	5 Courses	4 Courses	3 Courses	2 Courses	2 Courses	1 Course	1 Course
1st Course				Track A¹	Track B²	Track A³	Track B⁴
1st Review Exam[*]	Tues., Aug. 31	Wed., Sept. 1	Thurs., Sept. 2	Fri., Sept. 3	Wed., Sept. 8	Thurs., Sept. 9	Mon., Sept. 13
2nd Review Exam	Thurs., Sept. 2	Tues., Sept. 7	Thurs., Sept. 9	Tues., Sept. 14	Thurs., Sept. 16	Tues., Sept. 28	Thurs., Sept. 30
3rd Review Exam	Wed., Sept. 8	Fri., Sept. 10	Wed., Sept. 15	Wed., Sept. 22	Fri., Sept. 24	Fri., Oct. 15	Tues., Oct. 19
4th Review Exam	Mon., Sept. 13	Thurs., Sept. 16	Tues., Sept. 21	Fri., Oct. 1	Tues., Oct. 5	Wed., Nov. 3	Fri., Nov. 5
Final Exam^{**}	Wed., Sept. 15	Tues., Sept. 21	Mon., Sept. 27	Fri., Oct. 8	Tues., Oct. 12	Tues., Nov. 16	Thurs., Nov. 18
2nd Course							
1st Review Exam	Mon., Sept. 20	Fri., Sept. 24	Fri., Oct. 1	Tues., Oct. 19	Thurs., Oct. 21		
2nd Review Exam	Thurs., Sept. 23	Wed., Sept. 29	Thurs., Oct. 7	Thurs., Oct. 28	Mon., Nov. 1		
3rd Review Exam	Tues., Sept. 28	Tues., Oct. 5	Wed., Oct. 13	Mon., Nov. 8	Wed., Nov. 10		
4th Review Exam	Fri., Oct. 1	Mon., Oct. 11	Wed., Oct. 20	Wed., Nov. 17	Fri., Nov. 19		
Final Exam	Tues., Oct. 5	Thurs., Oct. 14	Tues., Oct. 26	Wed., Dec. 1	Fri., Dec. 3		
3rd Course							
1st Review Exam	Fri., Oct. 8	Tues., Oct. 19	Tues., Nov. 2				
2nd Review Exam	Wed., Oct. 13	Fri., Oct. 22	Tues., Nov. 9				
3rd Review Exam	Mon., Oct. 18	Thurs., Oct. 28	Tues., Nov. 16				
4th Review Exam	Thurs., Oct. 21	Wed., Nov. 3	Tues., Nov. 30				
Final Exam	Mon., Oct. 25	Mon., Nov. 8	Mon., Dec. 6				
4th Course							
1st Review Exam	Thurs., Oct. 28	Thurs., Nov. 11					
2nd Review Exam	Tues., Nov. 2	Tues., Nov. 16					
3rd Review Exam	Fri., Nov. 5	Mon., Nov. 29					
4th Review Exam	Wed., Nov. 10	Fri., Dec. 3					
Final Exam	Fri., Nov. 12	Wed., Dec. 8					
5th Course							
1st Review Exam	Wed., Nov. 17						
2nd Review Exam	Mon., Nov. 29						
3rd Review Exam	Thurs., Dec. 2						
4th Review Exam	Tues., Dec. 7						
Final Exam	Thurs., Dec. 9						

Grading Scale	
Total Points ⁵	Grade
65 – 72	A
62 – 64	B
54 – 61	C
Below 54	U

⁵ Points are not earned until the exam is passed. There are a total of 12 points possible from the Review Exams, 40 from the Unit Exams, and 20 from the Final Exam.

If you are in two courses, follow the due dates listed if your first course is:
¹MATH 117 (2 Courses, Track A)
²Any other course (2 Courses, Track B)

If you are in one course, follow the due dates listed if your course is:
³MATH 117 or 125 (1 Course, Track A)
⁴MATH 118, 124, or 126 (1 Course, Track B)

* Review Exam

- If passed by midnight (MST) on the due date listed, you will receive 3 points toward your final grade.
- If you do not pass a Review Exam by its due date, you will receive zero points for the Review Exam but will still need to pass it to move on with the course material.

Unit Exam

- There are no due dates for the Unit Exams. However, you must pass the Unit Exam **before** you are able to take the Review Exam for the next unit.
- You may retest on Unit Exams to improve your score until the Final Exam due date for that course.

Precalculus Center Faculty & Staff

Steve Benoit
Co-Director
(Faculty)

Anita Pattison
Co-Director
(Admin Pro)

Assistant Director
(GTA)

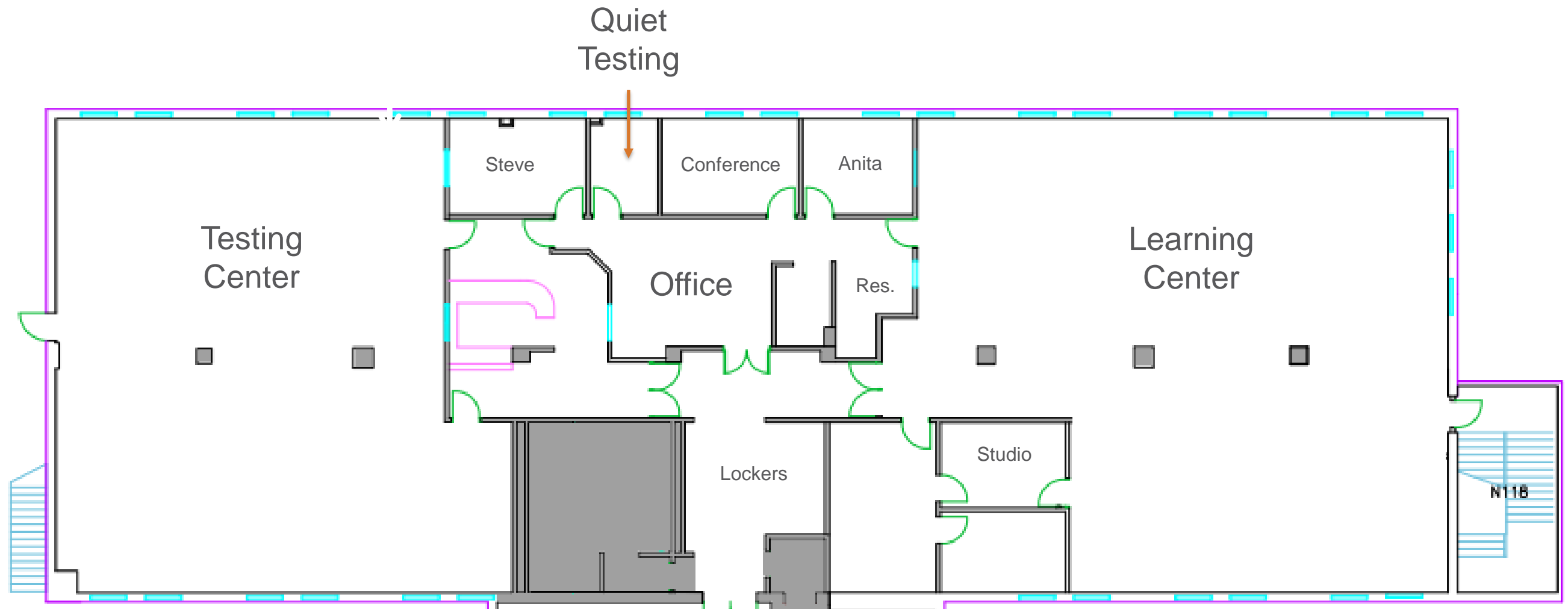
Assistant Director
(GTA)

Office Staff
(Undergrads)

Testing Center Staff
(Undergrads)

Course Assistants
(Undergrads)

Precalculus Center Facility



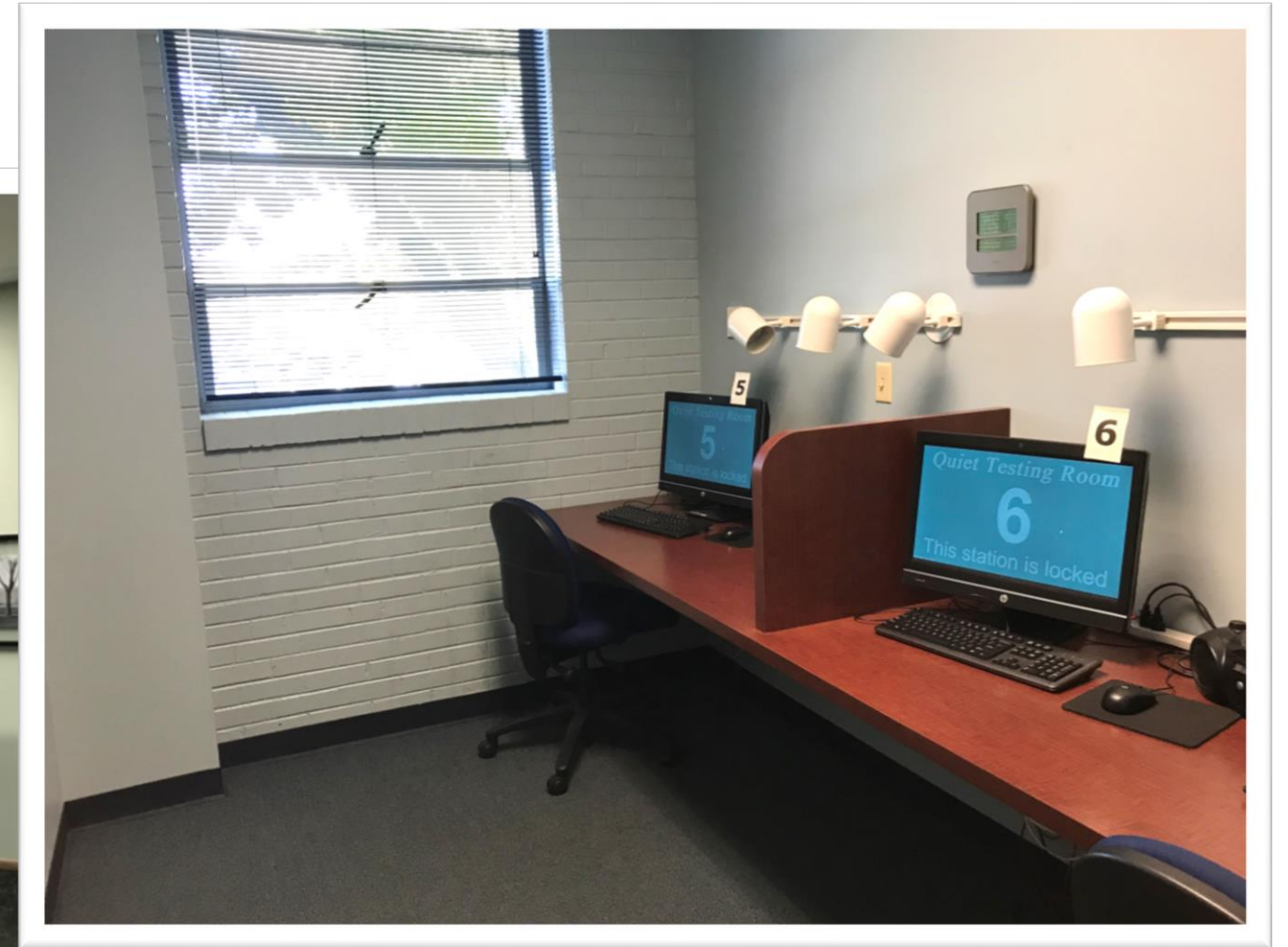
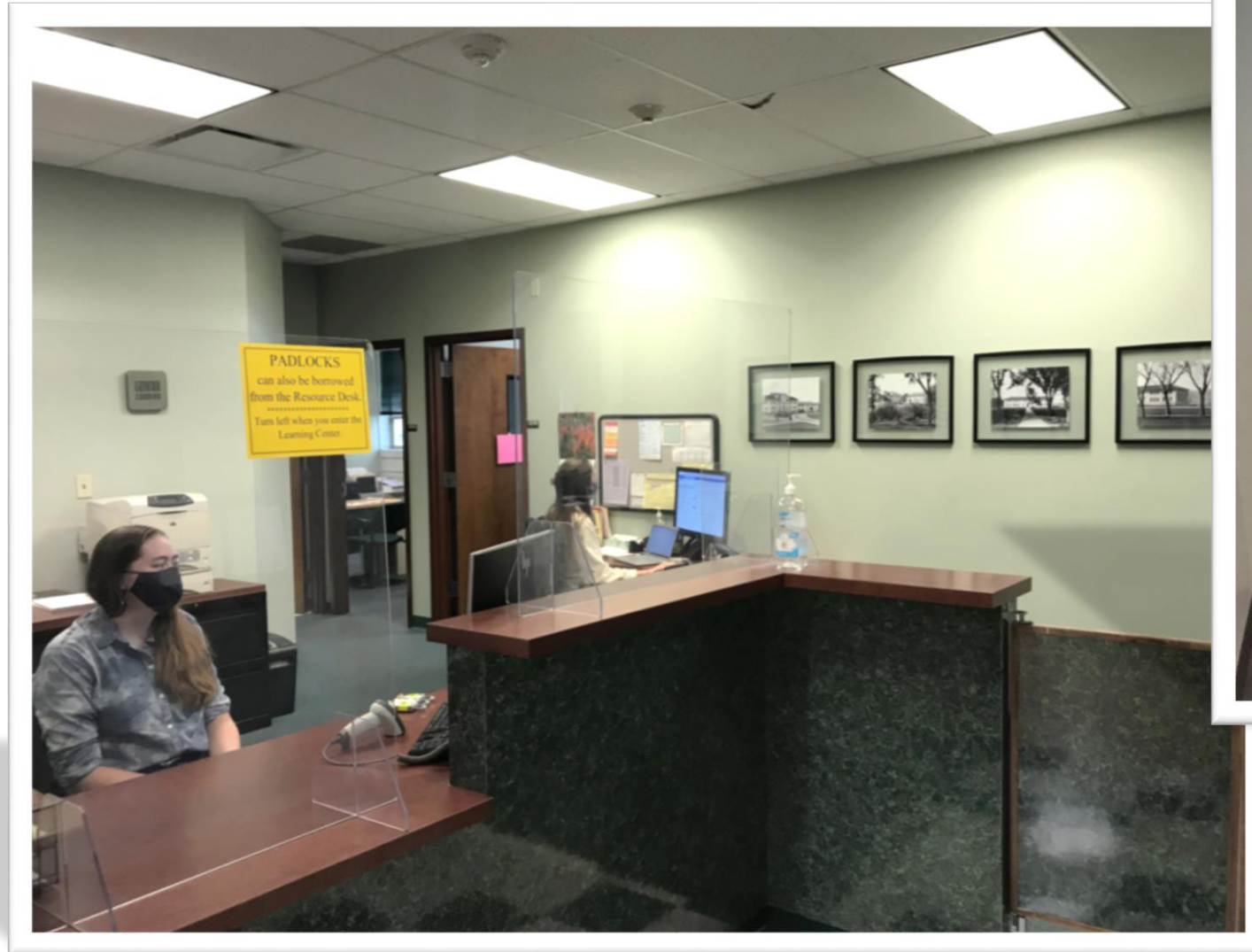
Tour: Learning Center



Tour: Testing Center



Tour: Office

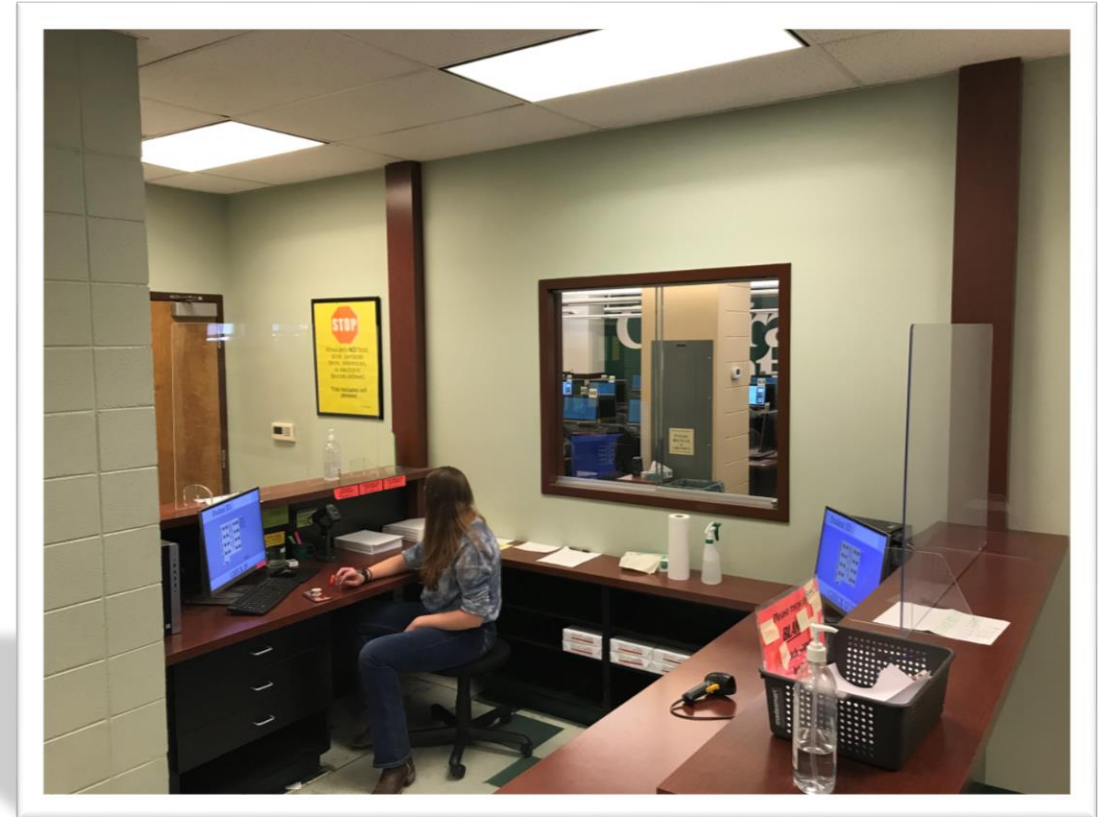


Operations: Learning Center

- No appointment needed, walk-in help with courses, Math Placement review
- Extended/evening hours – open 45 hours per week
- Course assistants circulate and help students with questions
- Two small side rooms for students with common questions
- Resource desk can lend:
 - Laptops or iPads (for use in the Center only)
 - TI-84 Calculators (for use in Center only)
 - Hardcopy textbooks (2-week loan)
 - Padlocks for lockers

Operations: Testing

- Proctored environment
- Lockers to secure personal items – only ID card and pen/pencil in center.
- 96 testing stations on isolated network.
- Custom built testing application.
- On-screen TI-84CE calculator with “copy from calculator” button on numeric items.
- Check-in station checks eligibility, assigns seat
- Check-out station ensure exam submitted
- Supports paper make-up exams for other departmental courses.



Operations: Office

- Front desk to answer student questions, answer phones (undergrad)
- Resource desk to lend and return resources (undergrad)
- Quiet / special-needs testing area
- Time-clock and bulletin board to request hour changes, etc.
- Assistant director (GTA) or Director on duty during all open hours to handle situations
 - Requests for extensions
 - Accommodations
 - Cheating incidents
- Conference room available for conversations with students in a less public setting.

Operations: Online

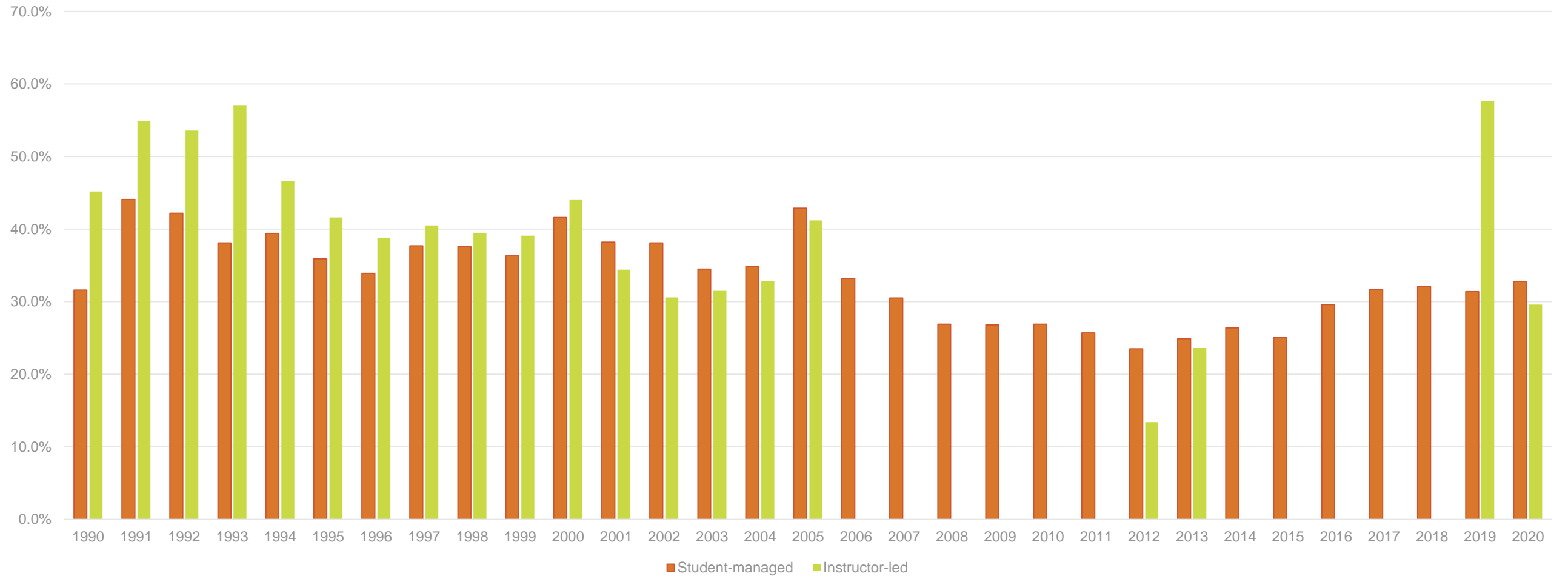
- Automated jobs to update registrations, transfer credit, placement results, etc.
- Automated reports of student progress to groups (athletics, engineering, etc.)
- Tracking outstanding resource loans
- Billing for placement, challenge exams, lost resource items
- Batch to generate list of students for support emails based on status
- Automated grade submission at end of term
- Online proctoring system (built for COVID, but useful for special situations)



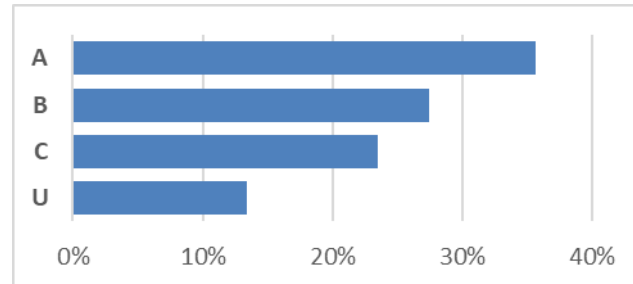
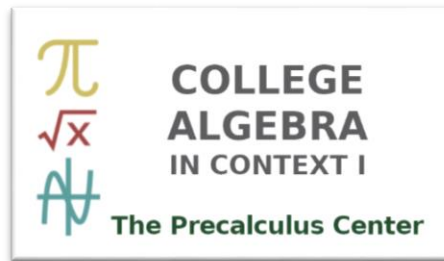
Outcomes

Drop/Withdraw/Fail Rates

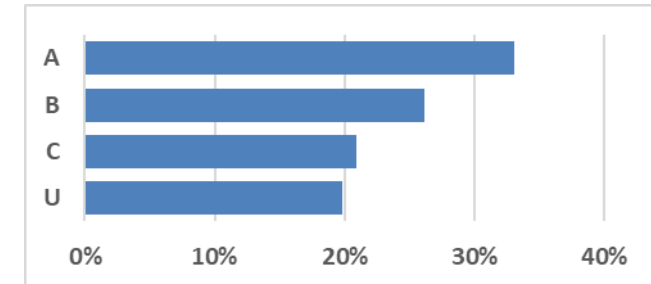
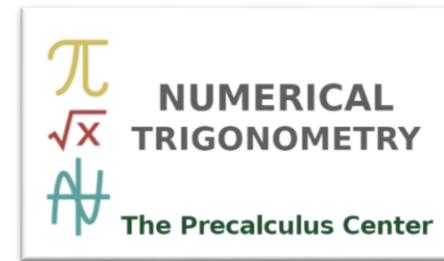
Overall DFW



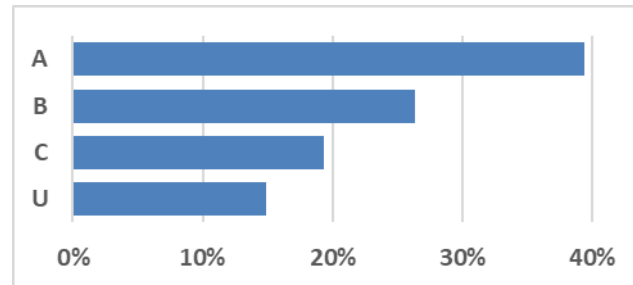
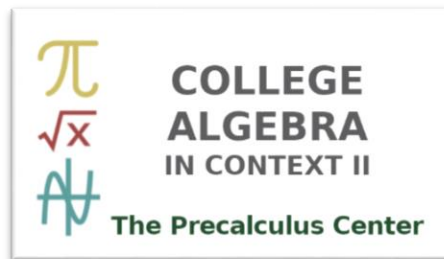
Grades in Completed Courses (Fall, 2019)



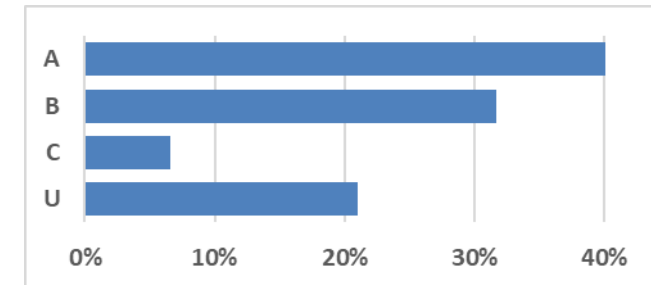
n = 1,141



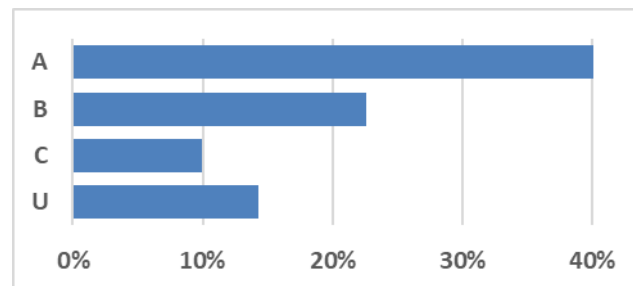
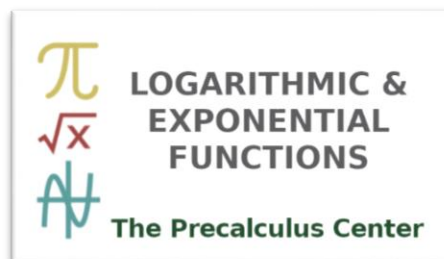
n = 862



n = 1,414



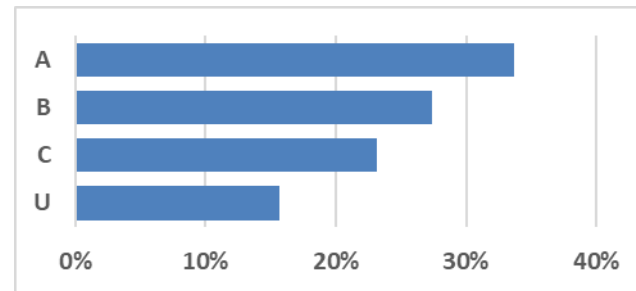
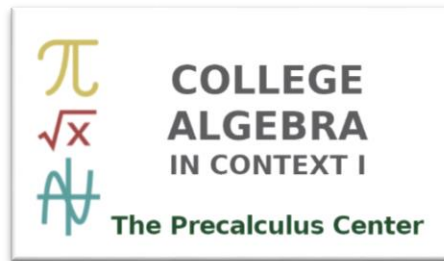
n = 366



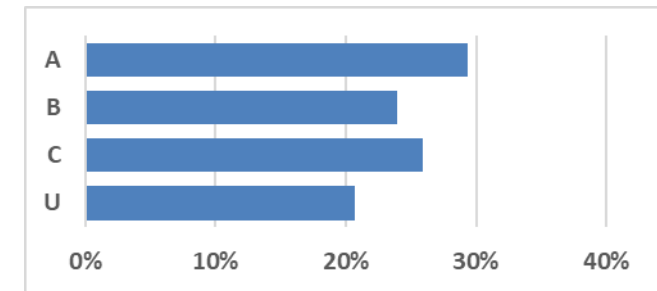
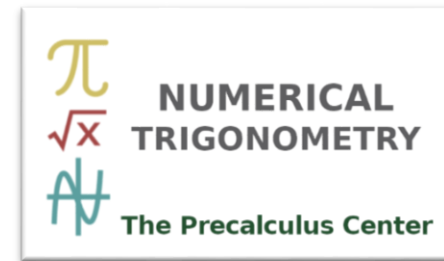
n = 877

- Typical on campus semester

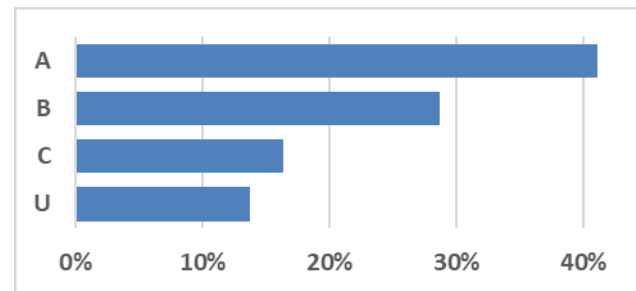
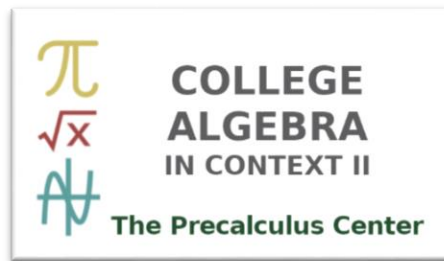
Grades in Completed Courses (Fall, 2020)



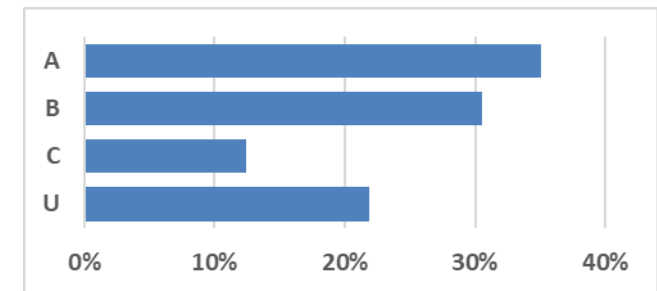
n = 987



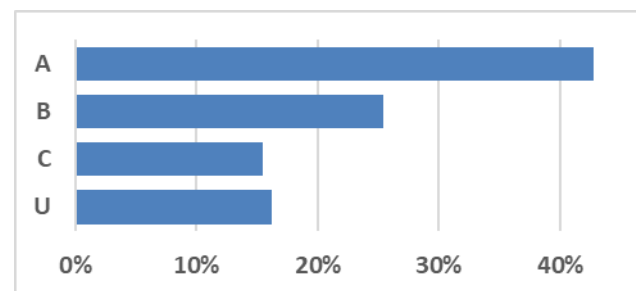
n = 705



n = 1,231



n = 265



n = 703

- Remote semester due to COVID-19



Future Plans

Improve the Curriculum

- Build self-contained modules with instruction, assessments, activities.
- Retool items to reduce “pattern-matching” behaviors
- Reduce / eliminate calculator uses (to avoid students solving everything with graph/trace)
- Remake video lessons, improve quality, clarity, consistency.
- Create face-to-face component with inquiry-based activities.

Improve Teacher/Student Interactions

- Students' principal complaint about the program is that they don't have an instructor.
- Our plan:
 - Group students into cohorts of ~30 students
 - Assign each cohort to an instructor or a pair/trio of instructors
 - Each instructor has many cohorts, but students in each have same mix of courses
 - Instructors send support emails, handle student questions, are 1st line of communication
 - Instructors hold face-to-face sessions with IBL activities for core topic in each unit (4 sessions per semester per 1-credit course).
 - Students view their cohort as a small class – team activities are cohort-based.

Improve the Web Site

- Create online help system where students who have missed a question more than twice get a “help me” button that connects to a (live) course assistant. The course assistant should be able to see what the student was working on when they clicked the button (with the course assistant’s view including hints like what technique the lesson is trying to teach)

Thank you



Colorado State University