High School Math Pathways

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Padlet

This session will be recorded, so it can be posted on the Department's website. The recording will begin at the end of this slide.

Ohio | Department of Education

Jobs Landscape

OCCUPATIONAL OUTLOOK HANDBOOK

Fastest Growing Occupations

Fastest growing occupations: 20 occupations with the highest percent change of employment between 2018-28.

Click on an occupation name to see the full occupational profile.

OCCUPATION	GROWTH RATE, 2018-28	2018 MEDIAN PAY
Solar photovoltaic installers	63%	$42,680 per year
Wind turbine service technicians	57%	$54,370 per year
Home health aides	37%	$24,200 per year
Personal care aides	36%	$24,020 per year
Occupational therapy assistants	33%	$60,220 per year
Information security analysts	32%	$98,350 per year
Physician assistants	31%	$108,610 per year
Statisticians	31%	$87,780 per year
Nurse practitioners	28%	$107,030 per year
Speech-language pathologists	27%	$77,510 per year
Physical therapist assistants	27%	$58,040 per year

Genetic counselors	27%	$80,370 per year
Mathematicians	26%	$101,900 per year
Operations research analysts	26%	$83,390 per year
Software developers, applications	26%	$103,620 per year
Forest fire inspectors and prevention specialists	24%	$39,600 per year
Health specialties teachers, postsecondary	23%	$97,370 per year
Phlebotomists	23%	$34,480 per year
Physical therapist aides	23%	$26,240 per year
Medical assistants	23%	$33,610 per year

Last Modified Date: Wednesday, September 4, 2019

From U.S. Bureau of Labor Statistics: https://www.bls.gov/ooh/fastest-growing.htm

The Jobs Landscape in 2022

Notice the emphasis on Data and Computers

emerging roles, global change by 2022

133 Million

Top 10 Emerging

1. Data Analysts and Scientists
2. AI and Machine Learning Specialists
3. General and Operations Managers
4. Software and Applications Developers and Analysts
5. Sales and Marketing Professionals
6. Big Data Specialists
7. Digital Transformation Specialists
8. New Technology Specialists
9. Organisational Development Specialists
10. Information Technology Services

declining roles, global change by 2022

75 Million

Top 10 Declining

1. Data Entry Clerks
2. Accounting, Bookkeeping and Payroll Clerks
3. Administrative and Executive Secretaries
4. Assembly and Factory Workers
5. Client Information and Customer Service Workers
6. Business Services and Administration Managers
7. Accountants and Auditors
8. Material-Recording and Stock-Keeping Clerks
9. General and Operations Managers
10. Postal Service Clerks

Source: Future of Jobs Report 2018, World Economic Forum

Higher Education Landscape

Ohio Department of Education

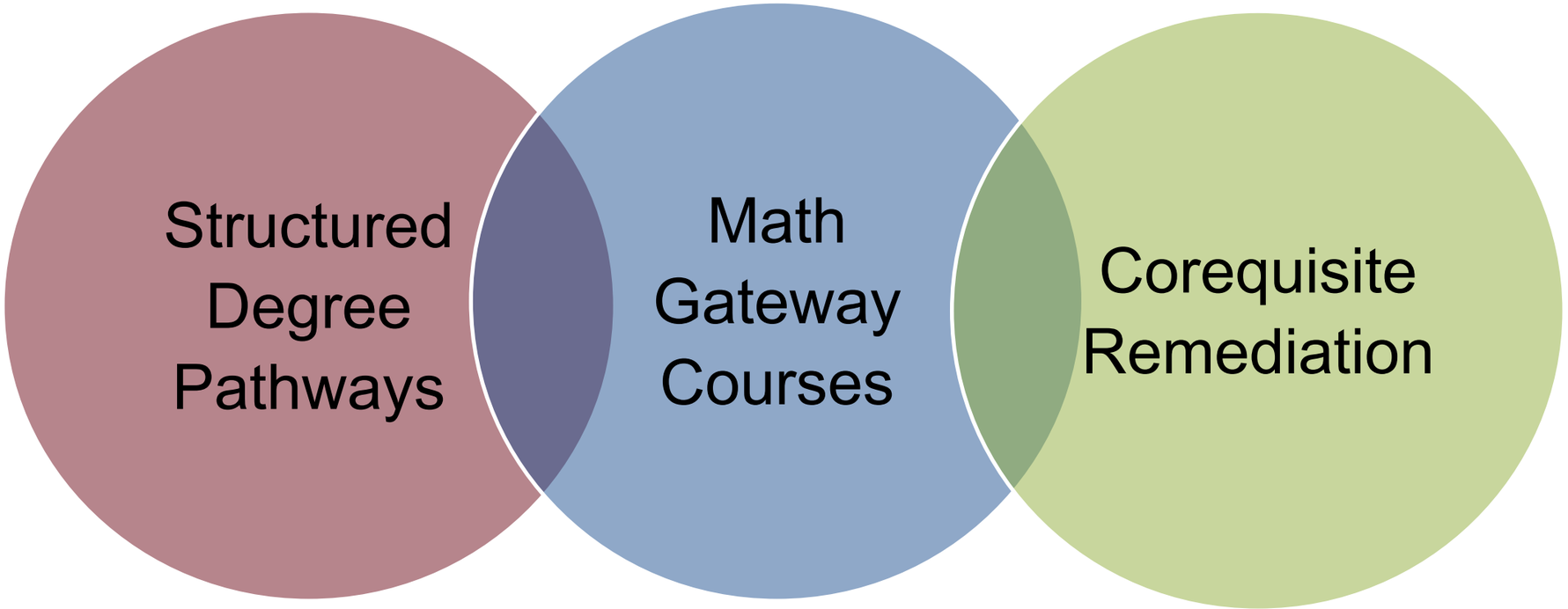
Ohio Mathematics Initiative

Rethinking mathematics courses, curricula and their relationships with other disciplines

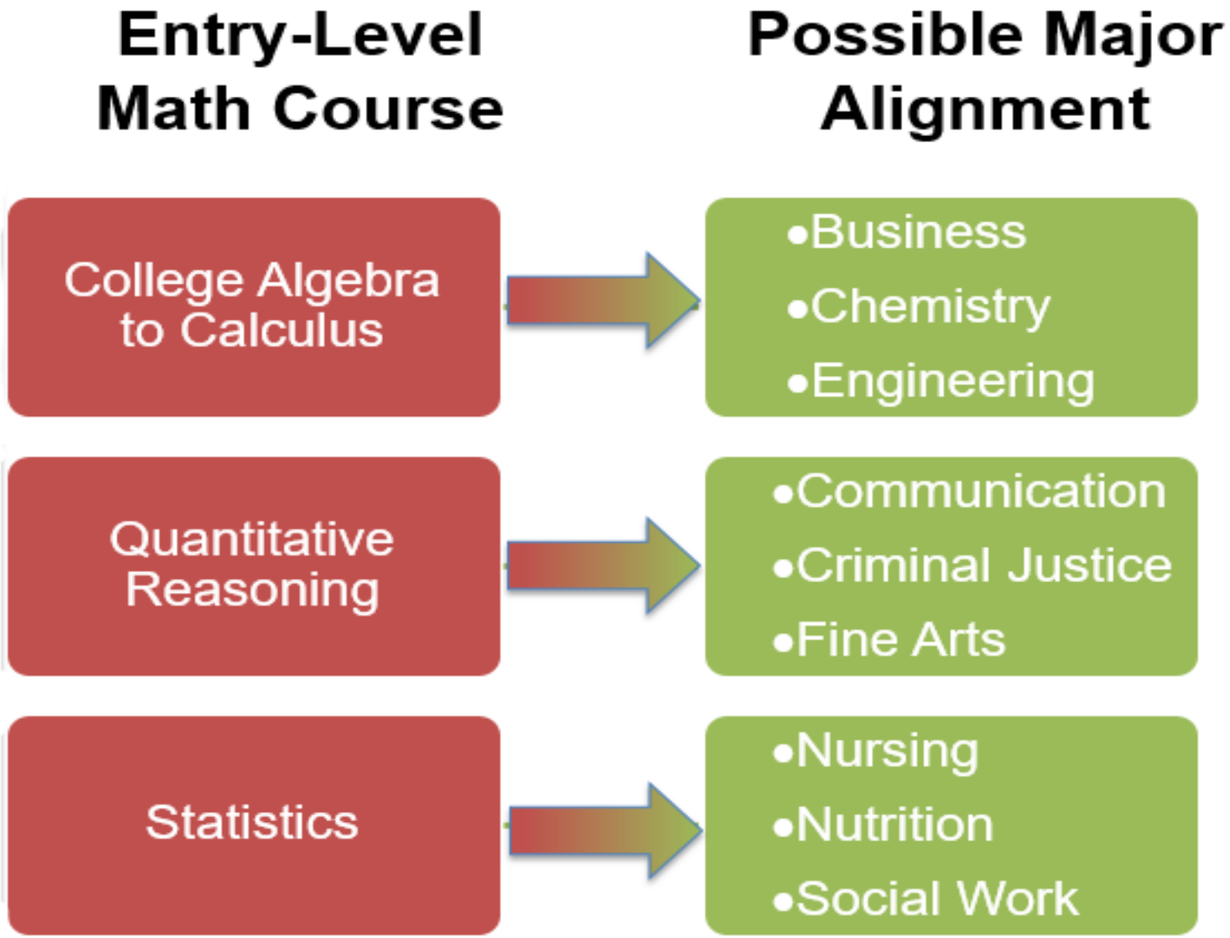
OMI's Subgroups

1. New and Alternative Pathways
2. Revision of the Ohio Transfer Module Criteria
3. Communication Outreach and Engagement
4. Data collection, Analysis and Sharing
5. Secondary and Postsecondary Alignment

BRIDGES TO SUCCESS



Higher Education
Mathematics Gateway Courses



New Emerging Pathways in Ohio

- **Data Science** (still being drafted)
- **Technical Math** (recently posted)
- **Discrete Math** (recently posted)
- **Math for Elementary Education** (recently posted)

Research

Students randomly assigned to statistics corequisite courses were 50 percent more likely to graduate from CUNY compared to those randomly assigned to a remedial Algebra course. (Burdman, 2019, Logue 2019)

Statistics was not easier than the Algebra. The statistics students were 39 percent more likely to graduate and were more likely to pass advanced quantitative courses. (Burdman, 2019, Logue 2019)

Research implies that quantitative and statistical pathways have three to four times the success rate of traditional pathways in only half of the time. (Huang, 2018)

Ohio TRANSFER TO DEGREE guarantee

Guaranteed Transfer Pathways

Statewide

Social Work/Social Services/ Human Services Associate of Arts

June 20, 2018

GENERAL EDUCATION REQUIREMENTS/OHIO TRANSFER MODULE		Minimum Credit Hours
ENGLISH COMPOSITION AND ORAL COMMUNICATION:		3
Course 1:	Any OTM approved First Writing (TME001) course	3
MATHEMATICS, STATISTICS, AND LOGIC:		3
Course 1:	Any OTM approved mathematics [Highly recommended: Introductory Statistics (TMM010)][1]	3
ARTS AND HUMANITIES:		6
+ Course 1:	Any OTM approved Arts and Humanities course (Arts related)	3
+ Course 2:	Any OTM approved Arts and Humanities course (Humanities related)	3
SOCIAL AND BEHAVIORAL SCIENCES:		6
+ Course 1:	Introduction to Psychology (OSS015)	3
+ Course 2:	Introduction to Sociology (OSS021)	3
NATURAL SCIENCES:		6-7
Course 1:	Any OTM approved Natural Sciences course	3
Course 2:	OTM approved Biological Science course with lab (Recommended: Human Biology)[2]	3-4
ADDITIONAL CREDITS:		12
Course 1:	Any OTM approved Second Writing (TME002) course	3
Courses:	Up to 9 hours of additional OTM approved courses[3]	9
GENERAL EDUCATION/OHIO TRANSFER MODULE TOTAL:		36-38

https://www.ohiohighered.org/OGTP

Ohio TRANSFER TO DEGREE guarantee

Guaranteed Transfer Pathways

Completed	Gateway Course	Completed	Gateway Course
Business		**Arts & Humanities**	
• Business	Calc 1 or B. Calc	• Art History	QR
Social & Behavioral Sciences		• Communication Studies	QR
• Anthropology	Intro Stats	• English	
• Economics	Calc 1 or B. Calc	• History	QR
• Geography	Intro Stats	• Music	QR
• Political Science	Intro Stats	• Philosophy	QR
• Psychology (B.A.)	Intro Stats	• Studio/Fine Arts	QR
• Psychology (B.S.)	College Algebra	• Theatre	QR
• Social Work	Intro Stats	**STEM**	QR
• Sociology	Intro Stats	• Biology	
Still Undecided		• Chemistry	Calc 1
• Social & Behavior Sciences for Undecided Students	Intro Stats	• Geology	Calc 1
		• Mathematics	Calc 1
		• Physics	Calc 1
			Calc 1

Ohio TRANSFER TO DEGREE guarantee

Guaranteed Transfer Pathways

Under Construction		
Business • Applied Business **Social & Behavioral Sciences** • Social/Human Services **Arts & Humanities** • Journalism • Public Relations/Advertising • Telecommunications **Education** • AYA • Middle • Intervention Specialist • ECE	**Public Safety** • Fire Science/EMT • EMS/Paramedic • Criminal Justice **Health Sciences** • Dietetics • Exercise Science/OT/PT • Health Information Management • Medical/Clinical Laboratory • Nursing • Respiratory Therapy	**STEM** • Aerospace, Agricultural & Mechanical Engineering • Civil Engineering • Civil/Construction Engineering Technology • Computer/Electrical Engineering • Computer Science • Information Systems • Information Technology

The Problem

- ✓College Algebra was not meeting the needs of **all** students
- ✓Coherence between high school and college math
- ✓The workforce recognizes that all students need reasoning skills to be successful

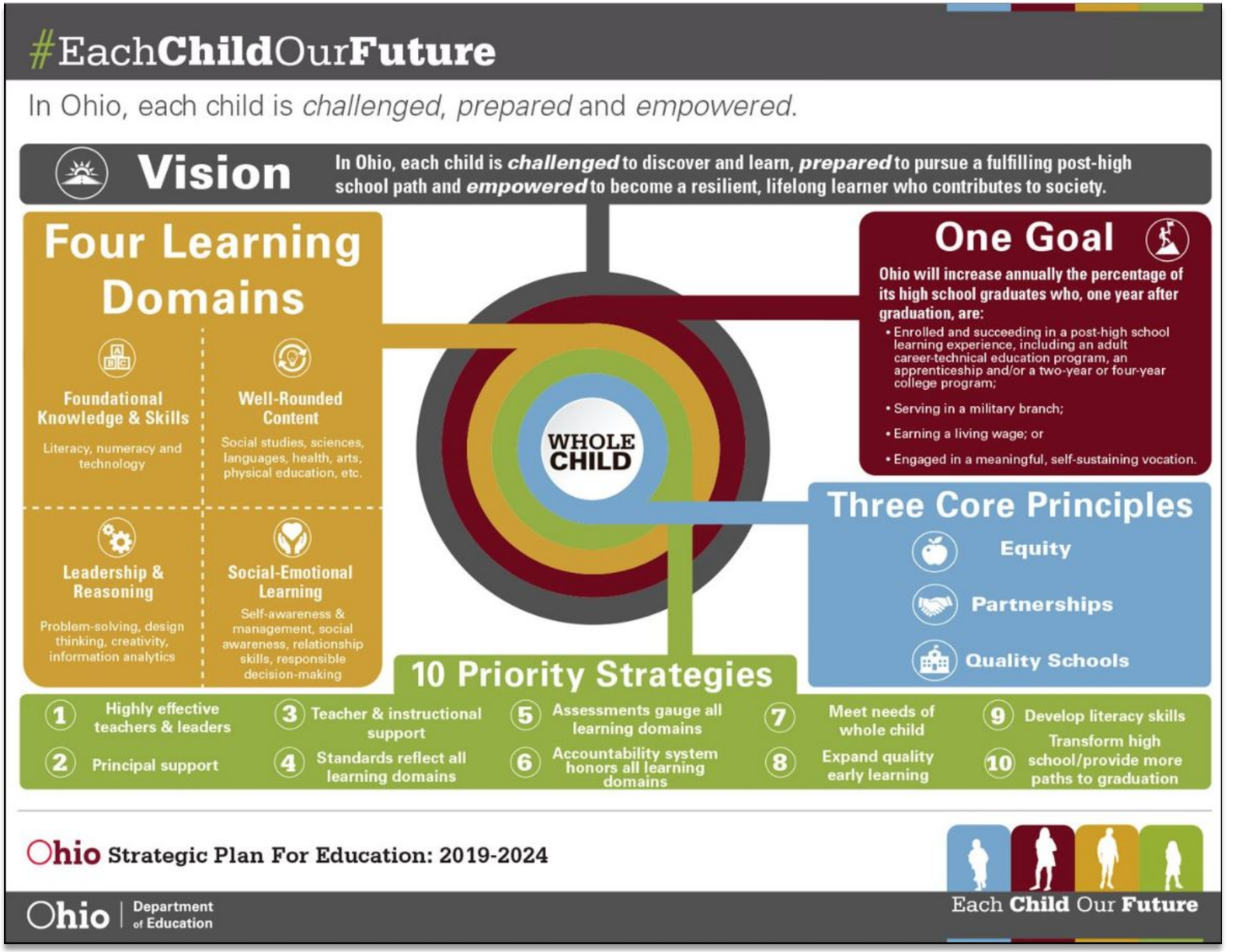
Other States

California University Systems

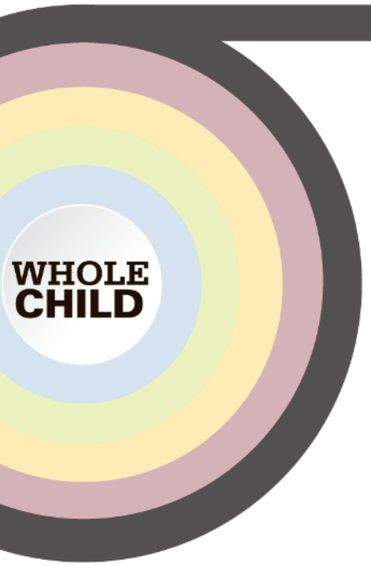
Students in 11th and 12th Grade can take other courses to satisfy the third math credit.

Examples of such courses include, but are not limited to, applied mathematics, calculus, **computer science**, **data science**, **discrete mathematics**, linear algebra, pre-calculus (analytic geometry and mathematical analysis), **probability, statistics** and trigonometry

K-12 Landscape


#EachChildOurFuture
In Ohio, each child is challenged, prepared and empowered.
Vision
In Ohio, each child is challenged to discover and learn, prepared to pursue a fulfilling post-high school path and empowered to become a resilient, lifelong learner who contributes to society.
Four Learning Domains
Foundational Knowledge & Skills
Literacy, numeracy and technology
Well-Rounded Content
Social studies, sciences, languages, health, arts, physical education, etc.
Leadership & Reasoning
Problem-solving, design thinking, creativity, information analytics
Social-Emotional Learning
Self-awareness & management, social awareness, relationship skills, responsible decision-making
WHOLE CHILD
One Goal
Ohio will increase annually the percentage of its high school graduates who, one year after graduation, are:
• Enrolled and succeeding in a post-high school learning experience, including an adult career-technical education program, an apprenticeship and/or a two-year or four-year college program;
• Serving in a military branch;
• Earning a living wage; or
• Engaged in a meaningful, self-sustaining vocation.
Three Core Principles
Equity
Partnerships
Quality Schools
10 Priority Strategies
1 Highly effective teachers & leaders
2 Principal support
3 Teacher & instructional support
4 Standards reflect all learning domains
5 Assessments gauge all learning domains
6 Accountability system honors all learning domains
7 Meet needs of whole child
8 Expand quality early learning
9 Develop literacy skills
10 Transform high school/provide more paths to graduation
Ohio Strategic Plan For Education: 2019-2024
Ohio | Department of Education
Each Child Our Future

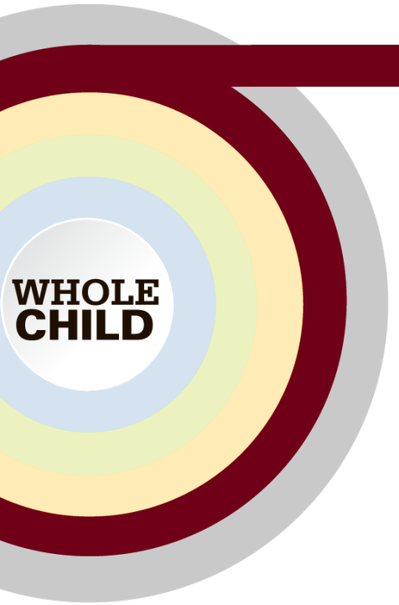
Each Child, Our Future



Vision

In Ohio, each child is ***challenged*** to discover and learn, ***prepared*** to pursue a fulfilling post-high school path and ***empowered*** to become a resilient, lifelong learner who contributes to society.

Each Child, Our Future



One Goal

Ohio will increase annually the percentage of its high school graduates who, one year after graduation, are:

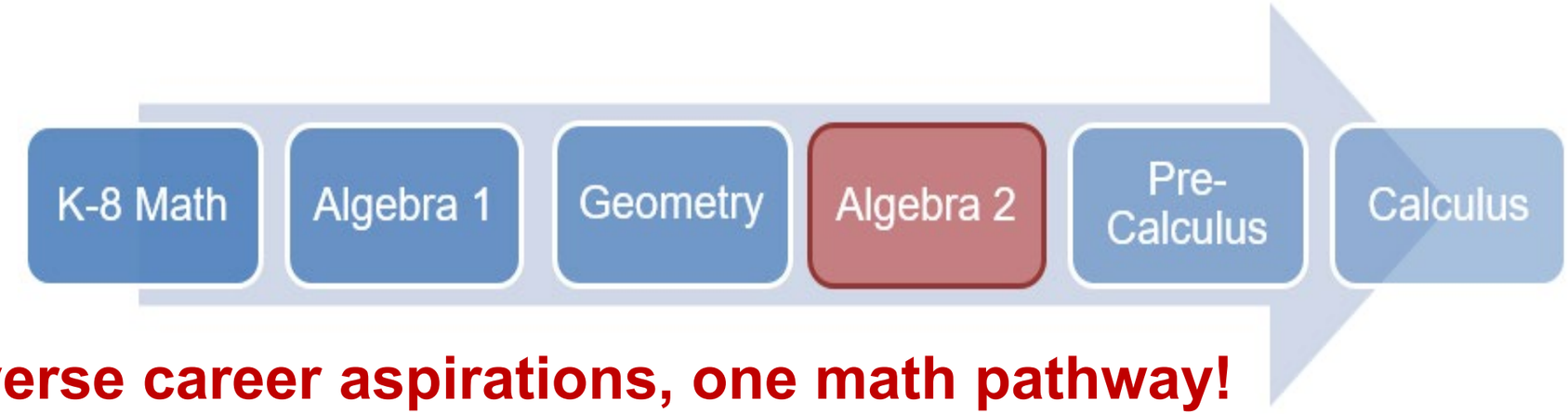
Each Child, Our Future

One Goal

- Enrolled and succeeding in a post-high school learning experience, including an adult career-technical education program, an apprenticeship and/or a two-year or four-year college program;
- Serving in a military branch;
- Earning a living wage; or
- Engaged in a meaningful, self-sustaining vocation.

Problem Statement

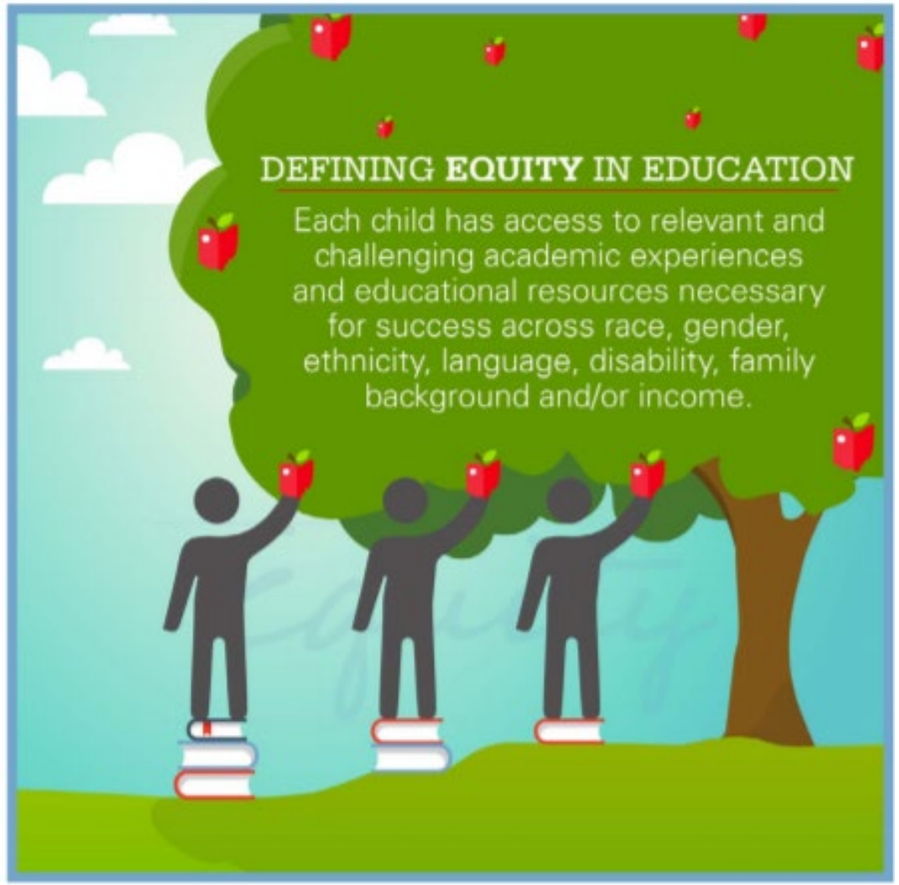
Ohio has a diverse student body, where each child has unique postsecondary aspirations.



Diverse career aspirations, one math pathway!

Algebra 2

Equity

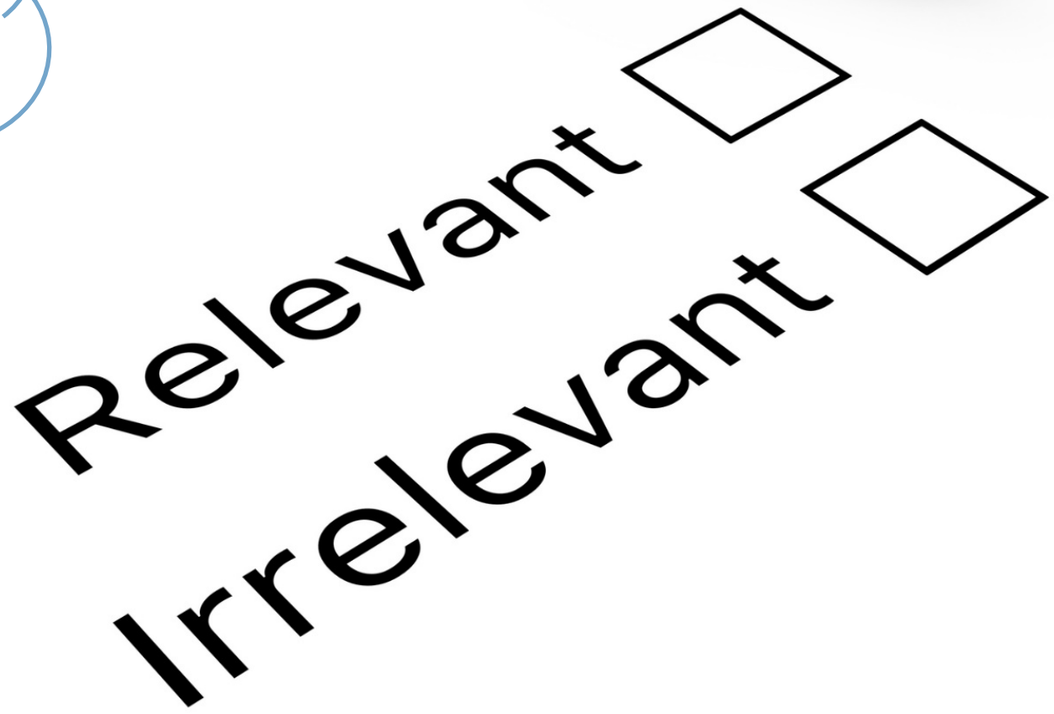


VS.

Roadblock

Algebra 2

Not meeting the need for **ALL** students



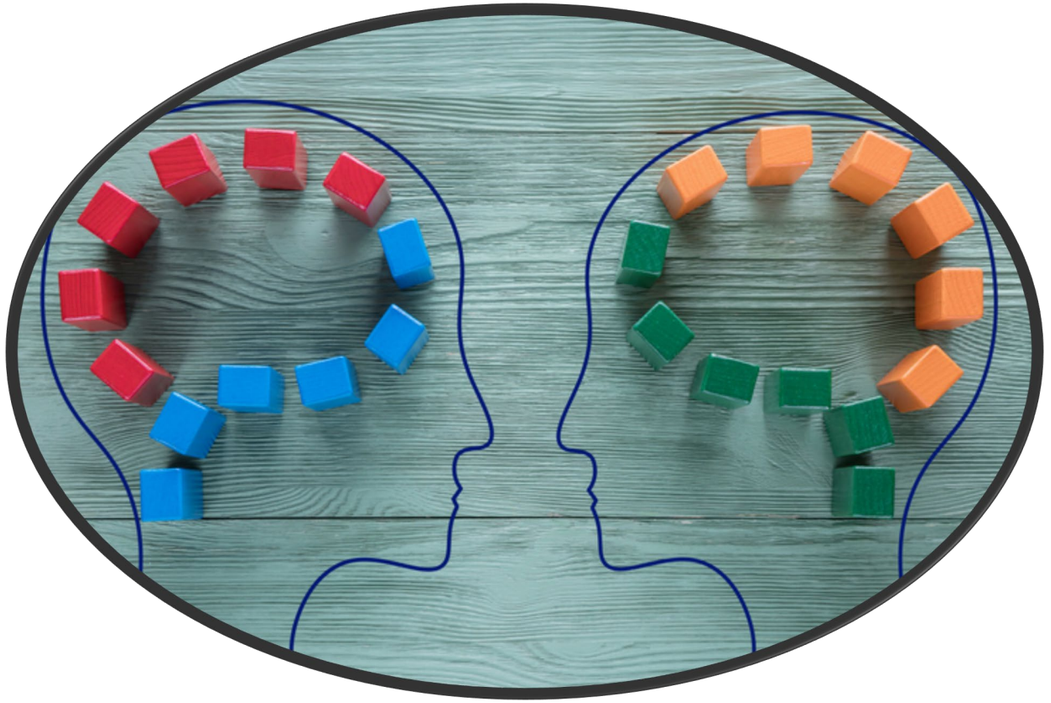
New Initiative: Strengthening Ohio's High School Math Pathways

Equivalence

Mathematics units must include one unit of Algebra 2 or the *equivalent* of Algebra 2.

Equivalence

Equivalent thinking and reasoning but **NOT** equivalent content



Ohio Secondary and Postsecondary Math Faculty have come together to define rigor which is the basis of creating equivalent courses.

Rigor

It has been decided that *equivalent* refers to the level of rigor and reasoning, not content. There are many branches of mathematics that are **equally rigorous** but have **different content** focuses. All equivalent courses should have the same level of rigor and reasoning that are needed to be successful in an entry-level, credit-bearing postsecondary mathematics course.

Ohio has defined rigor as the following:

- “Students use mathematical language to communicate effectively and to describe their work with clarity and precision. Students demonstrate how, when and why their procedure works, and why it is appropriate. Students can answer the question, ‘How do we know?’”

Goals of Initiative

Ohio needs to develop pathways for high school mathematics that provide a seamless transition to a student's postsecondary aspirations.

1. To promote **equity**, any courses that are created should be equally **rigorous** to the traditional math pathway.
2. Pathways should be **relevant** to a student's future career goals. Not only will relevant courses help a student achieve their goals, but they will also create more buy-in from the students and help develop a positive math identity.
3. Pathways should also be **flexible** in case a student changes his or her mind about his or her future plans.
4. Pathways should be **coherent** with pathways in higher education to provide students with a seamless transition.

What this initiative is NOT about

- Changing graduation requirements
- Reducing rigor
- Tracking

What is this initiative about?

Relevance

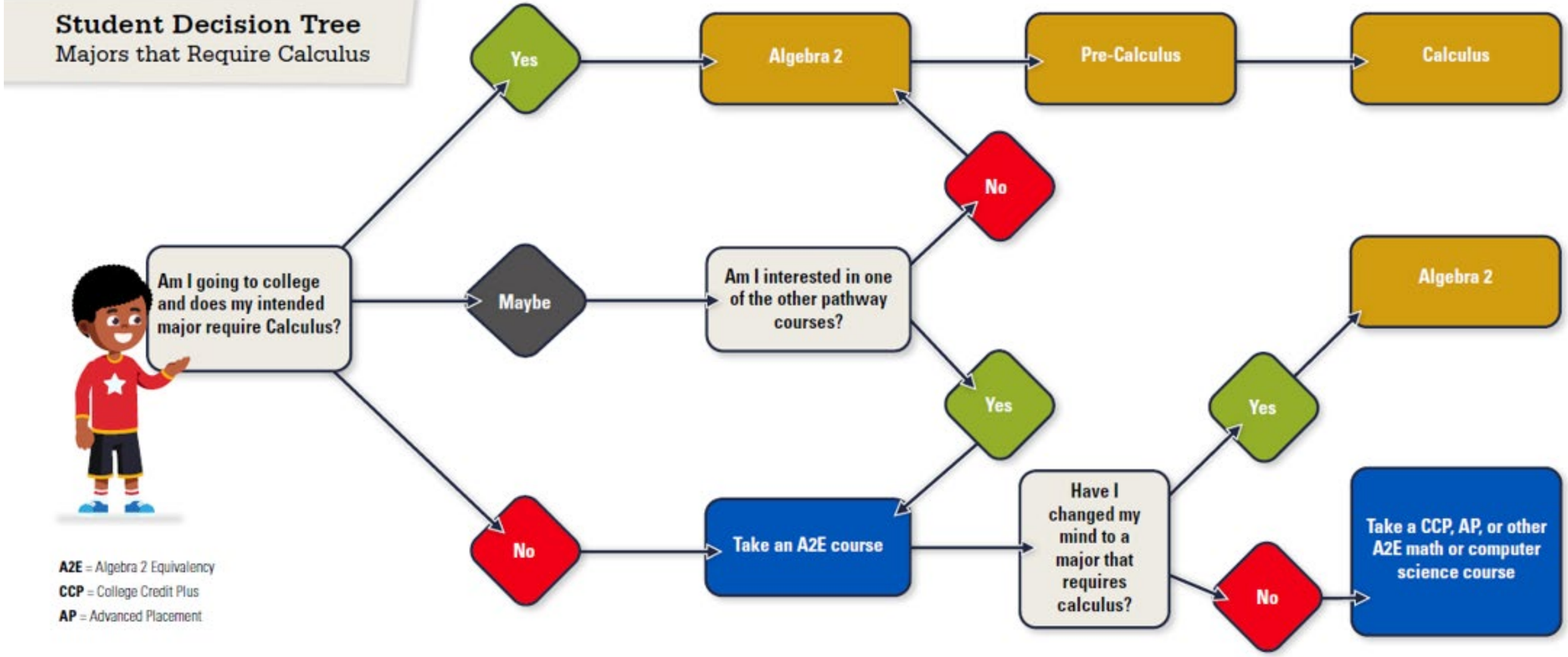
Equity

Rigor

Math Identity

Student Success!!

Student Decision Tree
Majors that Require Calculus



A2E = Algebra 2 Equivalency
CCP = College Credit Plus
AP = Advanced Placement

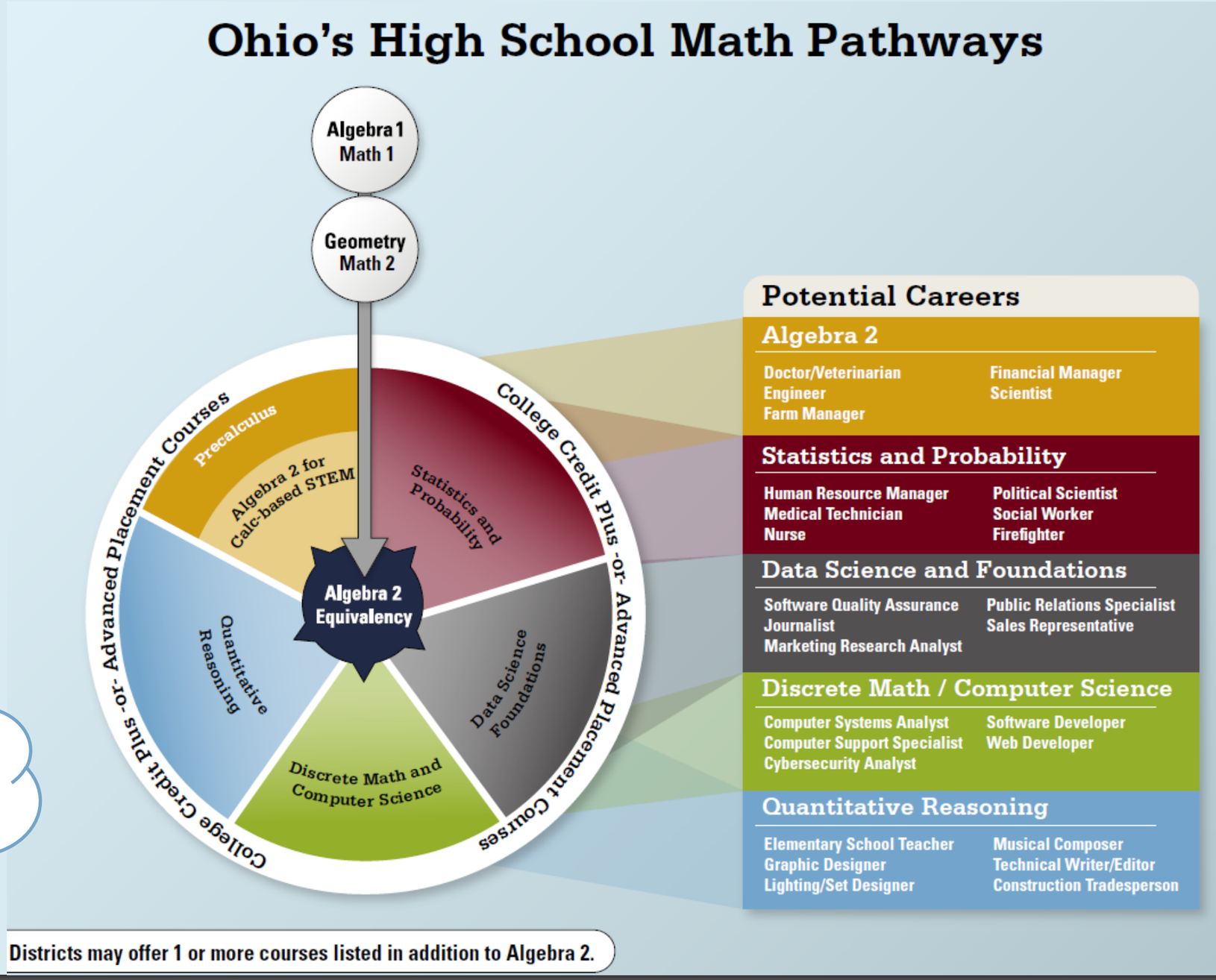
Majors that Require Calculus

- Actuarial Science
- Accounting
- Agribusiness
- Architecture*
- Astronomy
- Astrophysics
- Aviation (B.S)
- Biology**
- Biochemistry
- Bioinformatics
- Biomedical Science
- Botany
- Business (B.S)
- Chemistry
- City and Regional Planning*
- Computer Science (B.S)
- Data Analytics (B.S)
- Earth Science
- Economics
- Engineering
- Environmental Science
- Finance
- Forensic Science
- Forestries, Fisheries, and Wildlife
- Geology**
- Information Science
- Logistics Management
- Marketing***
- Mathematics
- Math or Science Teacher
- Microeconomic Theory
- Neuroscience
- Nutrition Science (B.S)
- Operations Management
- Physics
- Physiological Optics
- Public Health
- Pre-Health Professional (Doctor, Vet, Pharmacy)
- Psychology (B.S)
- Real Estate and Urban Analysis

** Check with your local institution. ** Some institutions may require Precalculus for Bachelor's of Arts Degrees. *** Check with your local feeder school. Some Marketing programs may require statistics.*

Math Pathways

ALL Pathways are college preparatory



Descriptions of Courses

COURSE	DESCRIPTION
Statistics and Probability	In-depth study of probability, data analysis, and statistics including applying the concept of random variables to generate and interpret probability distributions, transforming data to aid in interpretation and prediction, and testing hypotheses using appropriate statistics
Quantitative Reasoning	Application of mathematics skills such as algebra to the analysis and interpretation of quantitative information (numbers and units) in a real-world context to make decisions that are relevant to daily life. Critical thinking is its primary objective and outcome.
Data Science	Data Science is a blend of various tools, algorithms, and machine learning principles with the goal to discover hidden patterns from raw data. The difference between data science and statistics is that where statistics focuses on explaining the data, data science focuses on using data to make predictions and decisions.
Discrete Math	The study of mathematical properties of sets and systems that have a countable number of elements including applications of systematic counting techniques and algorithmic thinking to represent, analyze, and solve problems.

Why these courses?

Statistics & Probability

- It aligns to a primary higher-education math pathways course.
- There is a need for a statistically literate society.

Quantitative Reasoning

- It aligns to a primary higher-education math pathways course.
- The reasoning and communication around quantitative information is what is needed in both higher education math courses and careers.
- Students positively respond to the pedagogy underlying the course.

Data Science Foundations

- There are many, many emerging jobs around big data requiring various levels of education and this course exposes students to foundational concepts of data science.
- With the rise of big data, understanding data is essential for citizenship and to understand our world.
- It aligns to a higher-education math pathways course.
- *Note: Students who want to pursue a Data Science degree requiring Calculus should take Algebra 2 as a follow-on course.*

Why these courses?

Discrete Math/ Computer Science

- There are many, many jobs in computer science and technology and students need exposure to these concepts.
- More students will have access to computer science concepts because math teachers can teach the course.
- By Ohio law students can use Advanced Computer Science to satisfy the Algebra 2 curricular requirement. However, Advanced Computer Science does not need to contain any advanced mathematics.
- Most jobs in computer science and technology need some knowledge of advanced mathematics and computational thinking.
- Discrete Math is the mathematics of computer science. Integrating Discrete Math into a computer science course gives students the reasoning they need to be successful in a computer science field.
- Note: Students who want to pursue a computer science major requiring calculus should also take Algebra 2 in tandem with AP Computer Science A as follow-on courses.

Equity

Students **choose** pathways based on their future aspirations. Students are **NOT** placed based on perceived preparation levels.

Tre is undecided about his future. He likes fixing things but has not always had positive experiences with math.

Year Three
He takes a quantitative reasoning class and his interest in math grows when it is applied to the real world. Tre would like to pursue the engineering field.

Year Four
Tre decides to take Algebra 2 and move into the calculus-based STEM path.

The electronics area has always fascinated Mia but she doesn't take an interest in math while at school.

Year Three
Mia takes a quantitative reasoning class and finds out that she really likes math when it is connected to real-world applications.

Year Four
She decides to pursue an associate degree in engineering technology and takes College Credit Plus Technical Math 1.

Hana is undecided about her future but has always held a passion for English language arts.

Year Three
While she is undecided, Hana elects to take a quantitative reasoning class.

Year Four
Hana becomes more interested in social work, so she takes AP Statistics and Probability.

Noah loves art and would like to pursue it as a future career.

Year Three
He takes quantitative reasoning and is amazed how math connects to art. He wants to major in graphic design.

Year Four
Noah takes a College Credit Plus quantitative reasoning class for dual credit.

Changing from A STEM to a Non-STEM Major

Key Findings from National & State Studies

- Of students who entered four-year Ohio public colleges in fall 1998, most (95%) students intending to major in non-STEM fields stayed in non-STEM fields with only **5%** changing to STEM majors (Bettinger, 2010).
- An analysis of first-time students enrolled in postsecondary education examined student entrance, persistence, and attainment in STEM fields from 1995 to 2001 (Chen, 2009). The study found 36% of intending STEM students changed their majors to non-STEM fields and **7%** of intending non-STEM students changed their majors to STEM fields.

Changing from A STEM to a Non-STEM Major

Key Findings from National & State Studies

- Enrollment and completion data from the National Student Clearinghouse from 2004 to 2010 revealed that of the 34,616 students who graduated with a STEM degree, only **17%** had originally intended to pursue a non-STEM major (Eagan, Hurtado, Figueroa, & Hughes, 2014).

"The evidence from these studies overwhelmingly shows that the vast majority of students who start in a non-STEM field will remain in a similar field. Therefore, institutions should design normative practice of mathematics pathways to serve the needs of the greatest number of students possible and ensure that appropriate options exist for students who change to STEM majors."
https://dcmathpathways.org/sites/default/files/resources/2018-01/STEM-transfers-brief%5B1%5D.pdf

Proposed Timeline

Fall 2020

- **Course Development**

Fall 2021

- **The initiative is launched on the website.**
- Quantitative Reasoning and Data Science Foundations are piloted.

Fall 2022

- **Schools implement pathways and Algebra 2 equivalency courses.**
- Computer Science/Discrete Math piloted.
- Quantitative Reasoning and Data Science Foundations Pilots are expanded in phases across the state.

Toolkits

- Counselors
- Administrators
- Parents
- Teachers

*

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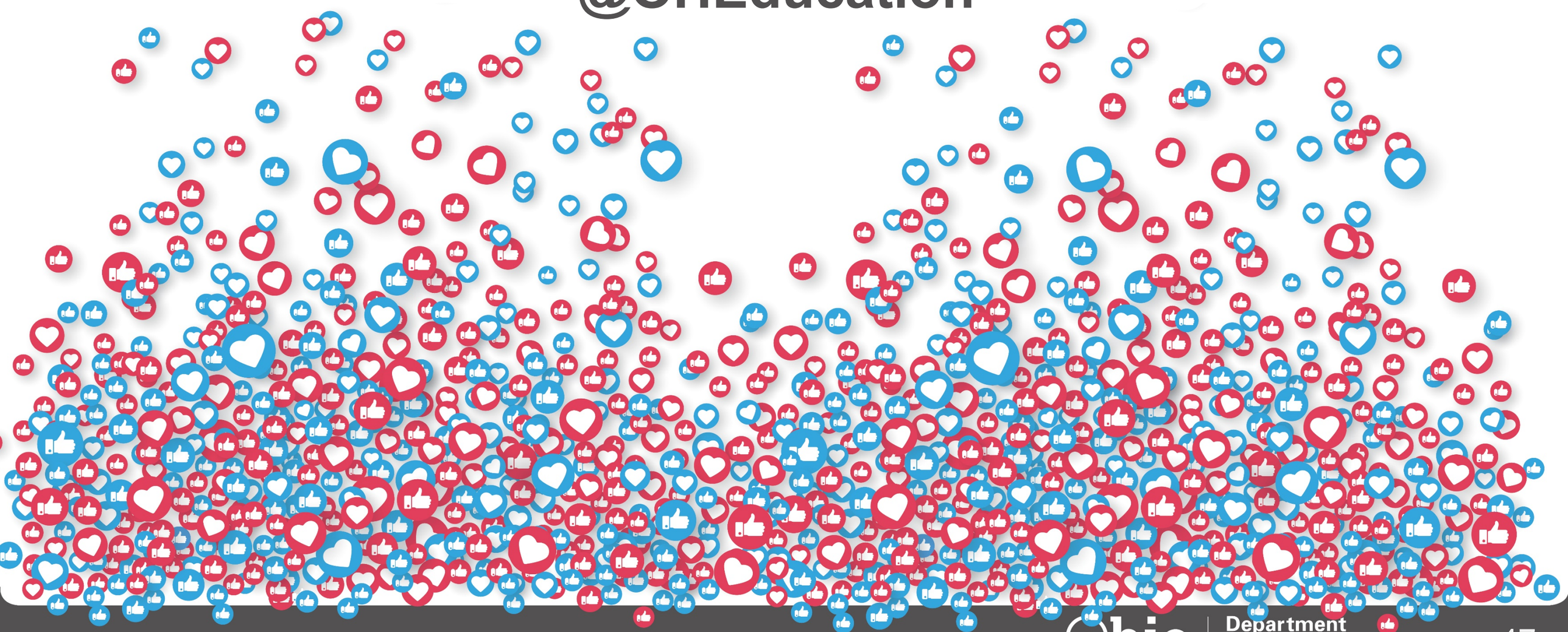

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Celebrate educators!

#OhioLovesTeachers