



Developing **Mathematical** Thinkers

Math for College & Career Success

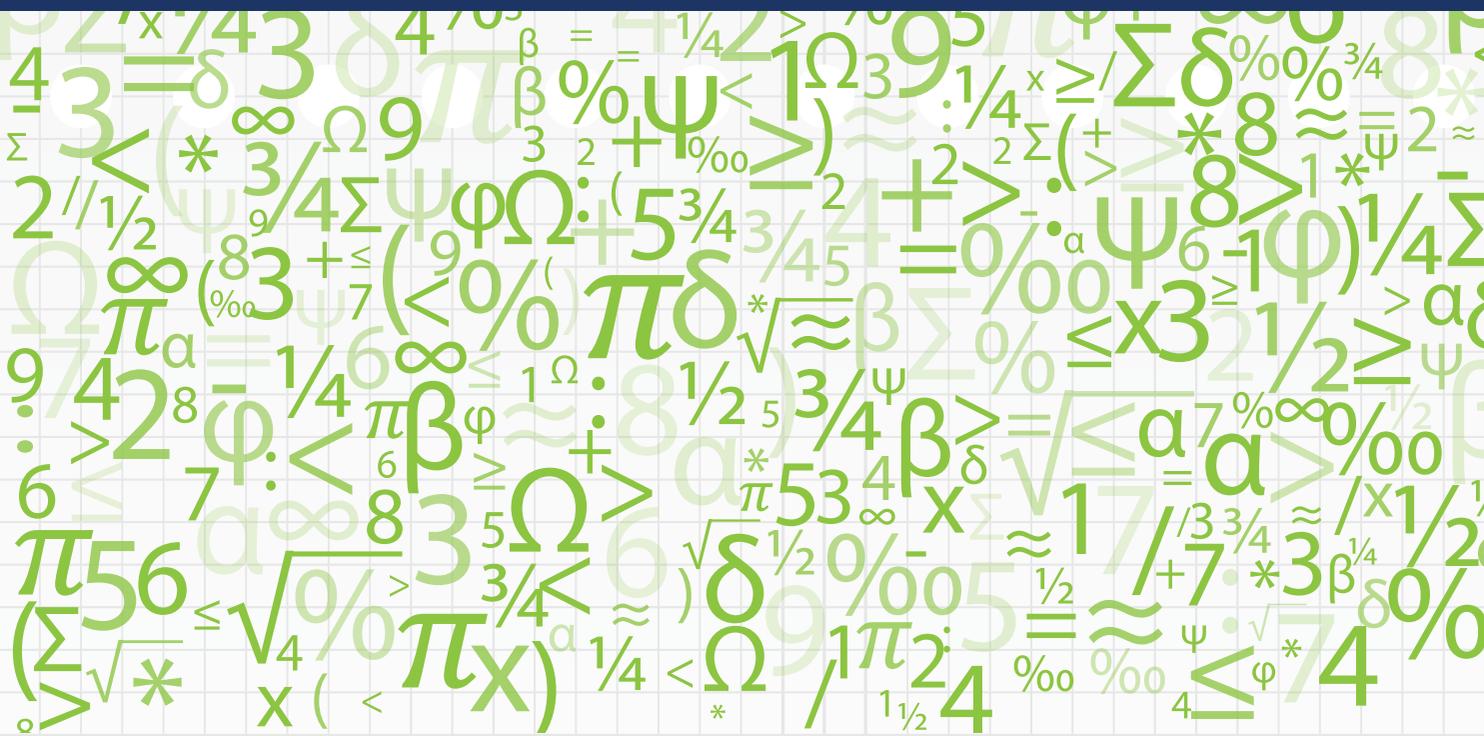
Developing Mathematical Thinkers

“A teacher of mathematics has a great opportunity. If he fills his allotted time with drilling his students in routine operations, he kills their interest, hampers their intellectual development, and misuses his opportunity. But if he challenges the curiosity of his students by setting their problems proportionate to their knowledge, and helps them to solve their problems with stimulating questions, he may give them a taste for, and some means of, independent thinking.” **George Polya, 1945**

Learning mathematics should be a *joyful* experience. The lessons need to be engaging and meaningful, challenging yet achievable. Using an inquiry approach, teachers have the opportunity to create curriculum that makes the classroom an exciting place to be.

Asking students to think mathematically is essential to the math classroom. In inquiry-based instruction, students are asked to think when they grapple with open-ended tasks independently or in collaboration with other students. In developing an understanding of concepts, procedures, rules, and formulas, students are often asked to think about patterns, make conjectures and generalizations, and attempt to prove or disprove them. The thinking can be visual, algebraic, or logical. In all cases, students use their reasoning skills to develop understanding.





What is *Developing Mathematical Thinkers*?

It is a three-year mathematics support system that:

Aligns with NCTM and/or state standards, teaches students mathematics conceptual and procedural knowledge and skills, and prepares students for post-secondary education and careers;

Incorporates ISA's inquiry-based curriculum resources and performance task library to increase engagement, support teachers, and model new approaches;

Includes on-site coaching for teachers and instructional leaders, supporting an inquiry-based approach to developing mathematical thinking essential for student proficiency;

Culminates in:

- Improved math instruction, cultivation of an inquiry-based classroom, and further development of the coherence and connections within mathematics
- Improved student math outcomes, including increased procedural, conceptual, and problem-solving knowledge and skills
- Increased mathematical thinking and further development of a productive disposition among students
- A greater appreciation for the beauty of mathematics by students and teachers alike
- Teachers working with students to understand mathematics as science of patterns and relationships

The Developing Mathematical Thinkers Package

Developing Mathematical Thinkers provides teachers and leaders with the resources necessary to implement an inquiry-based math program successfully, including online curriculum resources, a library of performance tasks, professional development, and job-embedded classroom support.

1. Access to ISA's Online Mathematics Curricula, Performance Task Library, and Instructional Resources

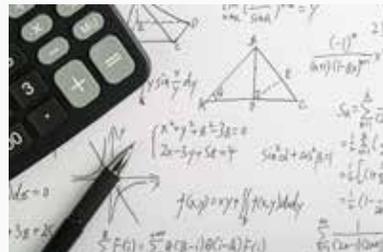
- Provides over 100 inquiry-based model lessons in Algebra 1, Algebra 2, and Geometry
- Provides over 30 Performance Tasks which may be incorporated into lesson plans or used as assessments
- Includes teacher development resources, such as planning tools, inquiry-based protocols for investigating student work or teacher developed materials, ISA Mathematics Rubric and resources for reflection

2. Copies of the book, *Developing Mathematical Thinking: A Guide to Rethinking the Mathematics Classroom* by Jonathan D. Katz.

- Books will be provided to all teachers and leaders.

3. Implementation Manual

- Connects theory to practice
- Provides orientation tools for school stakeholders
- Outlines a process for customization and implementation



4. A College Readiness Mathematics Plan

- Presents a vision-development activity to articulate the team's vision for their graduates and set a course of growth for the team
- Provides key resources such as the Math Program Self-Assessment, Teacher and Student Perception Continuums, and course sequencing ideas

5. Expert Embedded Coaching and Professional Development

- Coaching individual teachers
- Coaching math content teams
- Coaching school leaders
- Coach-crafted workshop experiences

Is ISA's Developing Mathematical Thinkers right for your school?

These questions will help you decide:

1. Will ISA's inquiry-based approach to mathematics help us achieve our outcomes?
2. Do our instructional commitments align with ISA's inquiry approach?
3. Will an inquiry approach engage our teachers? Our students?

Expert Coaching Services

ISA math coaches have experience and expertise coaching math teachers and facilitating math teams in knowledge-building and implementing an inquiry approach to mathematics with diverse students. ISA coaches have expertise in collaborating with teachers and school leaders to customize ISA's math curricula to meet each school's unique needs.

Coaching Teachers

Coaches and principals collaborate in the design of the coaching plan and develop a on-going dialogue related to the coaching. ISA coaches work with novice, experienced, and expert teachers to support their achievement of the agreed-upon outcomes. Individual coaching sessions support teachers in the following ways:

- Co-planning and/or modifying lessons, tasks, activities, etc. to incorporate multiple opportunities for mathematical thinking and higher-order thinking skills which students will need to succeed in college
- Collaborating on classroom management strategies and models for effective implementation of inquiry learning
- Co-teaching lessons and/or demonstrating particular strategies so that teachers can see how particular practices are implemented
- Developing curriculum-embedded assessments to monitor students progress on inquiry learning and analyzing data to inform teachers' implementation of inquiry-based instruction
- Providing relevant readings and resources related to mathematics instruction as well as teachers' particular pedagogical needs
- Discussing the relevance of *8 Aspects of Developing Great Mathematics Teachers* to teachers' practice and how it might be useful in the coaching process

Coaching the Math Team/Department

The ISA math coaching for the math team/department maps onto the outcomes agreed upon with the principal. Working in collaboration with the leader/supervisor of the math team/department, the coaching may include:

- Development of meeting norms, routines, protocols, and strategies for conducting effective and productive team meetings
- Co-plan meetings with team/department leader
- Conduct workshops
- Share effective practices and problem-solve challenges
- Review student work for evidence of inquiry, higher order thinking, understanding and misconceptions of math concepts
- Coordinate and debrief teacher intervisitations

Coaching School Leaders

The coach's work with the school leaders includes developing a strategic plan, year by year, including an action plan aligned with *Developing Mathematical Thinkers*. Together, coaches and leaders will:

- Identify student mathematics outcomes
- Design structures and mechanisms to operationalize the framework
- Develop school's mathematics resource plan
- Design supports for college preparatory math instruction

ISA's Online Mathematics Curricula



The ISA Mathematics Curricula Library includes inquiry-based lesson plans, tasks, activities, and performance assessments that have been field tested and proven successful in classrooms with diverse learners. ISA coaches work with teachers on planning and implementing customized instructional strategies so that students are successful with the inquiry tasks and activities. Teachers acquire new strategies, experience new approaches, and learn what works best for their students.

"My coach was an absolute joy to work with. The feedback on next steps, looking at student work, co-planning, co-reflection was very impactful on each visit or electronic contacts. Our conversations have led to insights that were subsequently applied or further developed in the classroom."

- 9th Grade Teacher, Brooklyn NY Math Teacher



"Through discussion with my coach about the changes in the geometry curriculum, I have come to see the connections between all the ideas presented in geometry and have come to appreciate why we teach topics in the order we do. I was also very apprehensive about the constructions in the curriculum, but working with my coach and practicing was extremely helpful when I worked through them with the students."

- Geometry Teacher, Bronx NY

"Working with my coach and the curriculum has dramatically altered my teaching. My instruction used to be primarily teacher-driven and now it is primarily student-driven."

- Algebra/Geometry Teacher, Brooklyn NY

"I really appreciated the ISA curriculum library. It took me eight hours to design a 50-minute lesson. There is no way that I could have designed a lesson from scratch every day."

- Sapphira Hendrix, Brooklyn NY Math Teacher

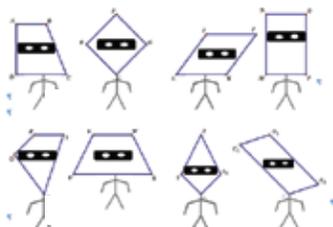
ISA's Math Tasks Library

In mathematics, we ask, "What would it mean to create tasks in which students solve problems like a mathematician?" This idea is at the foundation of the *Developing Mathematical Thinkers* curriculum.

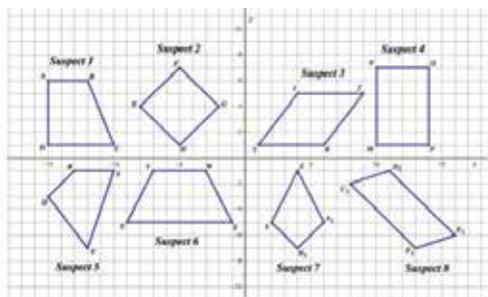
Geometry Task: 3 The Line-Up

"Crime Solving"

A notorious bank robber broke into a bank last Thursday, stole thousands from the bank's vault and left without any alarm being sounded. Friday morning, the bank manger turned over the security footage that showed part of a shape. He alerted the police, and the police need your help narrowing the suspects based on the security footage.



Use all your knowledge of quadrilaterals and coordinate geometry.



segment are exactly those equidistant from the segment's endpoints.

G-PE 5. Prove the slope criteria for parallel and perpendicular lines and use them to solve geometric problems (e.g., find the equation of a line parallel or perpendicular to a given line that passes through a given point).

Before assigning the task to your students we encourage you to read through both the attached rubric and description of the dimension handouts. We designed these tools to help you think about instruction methods and teaching moves that could help generate the kinds of thinking that we believe students can and should display on this task.

In assessing student work, be mindful of assessing the dimensions independent of one

"Now, my classrooms are 100% student-centered, not teacher-centered. The students take ownership of their learning. My students predict, make inferences, pose ideas and defend them, and have discussions with their peers about why they used a certain process to solve a problem. Their voices, thoughts, and ideas are valued and respected. Using the inquiry approach to teaching math is the best preparation that they could possibly get to succeed at the college level."

- Mary Ellen Tyrell, Queens NY STEM Team Leader

"I was happy to have been able to communicate with the ISA team during this year with the implementation of the Common Core standards in Geometry. I was particularly appreciative of the coaching and materials provided on the Transformations unit since the CC approach to this topic was very different from the old Regents standards."

- 10th Grade, Brooklyn NY Math Teacher

"Using some of the ISA materials this year helped me to more frequently incorporate discovery tasks in which students gathered information, looked for patterns, and drew conclusions from those patterns."

- Geometry Teacher, Brooklyn NY

