Beast ACADEMY

By Art of Problem Solving

Our History

2003: Art of Problem Solving Online School is established and begins teaching live online courses.

2012: Beast Academy makes its debut, launching with the comic book curriculum for elementary students.

2019: Beast Academy sells its 500,000th book.

2023: AoPS Online Community surpasses 1,000,000 members and Beast Academy Online surpasses 60,000 students

Art of Problem Solving has been preparing top math students for success in competitions at all levels for years!

- 15 out of 19 USA Math Olympiad gold medalists in 2022 were AoPS students
  - All six members of the USA IMO team were among these 15 AoPS alumni, and they won 4 gold, 1 silver, and 1 bronze medal among them

What is Beast Academy?

Beast Academy (BA) is the leading online math curriculum for advanced elementary school students ages 6-13.

In this interactive math program, students begin building out their problem-solving skill stack through rigorous math lessons taught by engaging, comic-style characters.

AoPS Beast ACADEMY

Our **Mission**

We help schools introduce advanced math concepts early, so students can build a problem solving foundation for 21st century skills for college, career, and life:

Problem Solving

Critical Thinking

Creative Reasoning

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Meet the Beasts: **Students**

Beast Academy follows the adventures of four little monsters. Students see themselves in the math beasts and the challenges they face.

Alex

- Loves to solve problems
- Sometimes inflexible approach
- Highly engaged and by the book

Lizzie

- Typical high ability student
- Loves to share her answers
- The “Hermione Granger” of the group

Winnie

- Street smart
- Practical approach
- Creative thinker

Grogg

- Creative intuition
- Goofball
- Unafraid of getting things wrong

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Meet the Beasts: **Teachers**

R&G

Discover New Tools

Ms. Q.

Create a Foundation

Professor Grok

Experiment with Strategies

Sergeant Rote

Practice Your Skills

Captain Kraken

Explore Your Boundaries

Fiona

Push Your Limits

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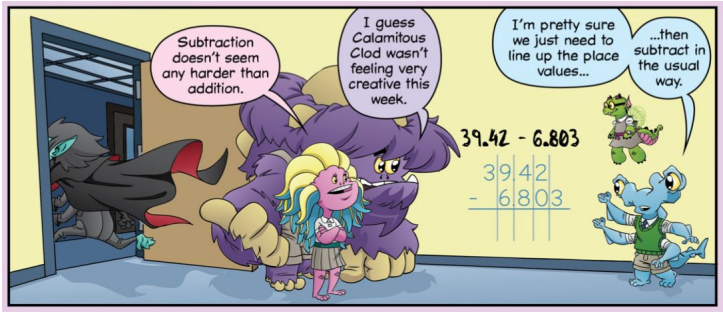
Problem Solving in Math
Authentic Engagement

Problem solving in math “means engaging in a task for which the solution method is not known in advance” (NCTM 2000, p. 52).

- If a solution strategy is already known, then students are engaging in an exercise (practicing a process/skill or applying previous knowledge to a context).

- Authentic problem solving means that the student is engaged in developing new mathematical ideas or applying prior knowledge in new ways.

(Problem Solving in All Seasons -- PreK-Grade 2, NCTM)



Set-up Structures for Success: **Where the Magic Happens**

Chapter 4
Multiplication

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Art of Problem Solving

The Times Table 3.OA.A.1, 3.OA.B.5, 3.OA.C.7, 3.OA.D.9	**Guide:** 3B pg. 14-25 (R&G, Gym) **Practice:** 3B pg. 7 (#1-8) **Online:** Repeated Addition
Multiplication Facts 3.OA.C.7	**Practice:** 3B pg. 8-9 (#9-17) **Online:** Rope Climb
Multiplication Charts 3.OA.B.6, 3.OA.C.7, 2.OA.C.4	**Guide:** 3B pg. 26-27 (R&G) **Practice:** 3B pg. 10 (#18) **Online:** Multiplication Chart
Multiplication Tables 3.OA.A.4, 3.OA.B.6, 3.OA.C.7	**Practice:** 3B pg. 11-12 (#19-27, with #28 optional) **Online:** Twisted Times Table
Overlapping Squares 3.OA.B.6, 3.OA.C.7	**Practice:** 3B pg. 13-15 (#29-37 and #39-40, with #38 optional)
Perimeter and Area 3.OA.A.1, 3.OA.D.8, 3.MD.C.7, 3.MD.D.8	**Practice:** 3B pg. 16-17 (#41-50) **Online:** Perimeter and Area
Block Blob *Enrichment*	**Guide:** 3B pg. 28 (Recess)

Set-up Structures for Success: **Where the Magic Happens**

Chapter Overviews

Beast Academy 3
Chapter 4: Multiplication

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Sequence: BA3, Chapter 2 Skip-Counting → **BA3, Chapter 4 This Chapter** → BA3, Chapter 5 Perfect Squares → BA3, Chapter 6 Division

Multiplication can be used as a shortcut for repeated addition. This chapter transitions students from skip-counting to memorizing multiplication facts.

Overview

This is one time when memorization is critical.

Students who can quickly recall every basic multiplication fact (to at least 10×10) will have a significant advantage over those who can't. For example, a student who does not recognize that both 45 and 63 are divisible by 9 will have no idea how to simplify $\frac{45}{63}$.

Students will memorize multiplications facts at different rates. We recommend **including extra drill as needed** to help all students memorize their multiplication facts, and continuing to supplementing with multiplication practice for students who need it.

The Times Table

Memorizing 121 multiplication facts may seem daunting. Help students recognize that there isn't much to memorize.

Start with a basic times table (0×0 through 10×10). This can be filled by **skip-counting**. Students should have had significant practice with skip-counting.

Review the chart with your students. Students should notice some helpful **patterns**. Practice multiplying by 0, 1, 2, and 10. We will learn some quick ways to multiply by 4 and 5 later.

Help students see that almost every fact has a **"twin"** (3×7 = 7×3). If you know one, you know the other.

If we remove the ×0, ×1, ×2, and ×10 facts, and one of each pair of "twin" facts (like 3×7 and 7×3), there are just 28 facts to memorize.

×	0	1	2	3	4	5	6	7	8	9	10
0	0	0	0	0	0	0	0	0	0	0	0
1	0	1	2	3	4	5	6	7	8	9	10
2	0	2	4	6	8	10	12	14	16	18	20
3	0	3	6	9	12	15	18	21	24	27	30
4	0	4	8	12	16	20	24	28	32	36	40
5	0	5	10	15	20	25	30	35	40	45	50
6	0	6	12	18	24	30	36	42	48	54	60
7	0	7	14	21	28	35	42	49	56	63	70
8	0	8	16	24	32	40	48	56	64	72	80
9	0	9	18	27	36	45	54	63	72	81	90
10	0	10	20	30	40	50	60	70	80	90	100

Memorizing **perfect squares** is useful. If you know 7×7 = 49, it is easy to get to 8×7 and 9×7 by counting up by 7's. Almost all of the hardest facts to memorize are within 1 or 2 steps of a perfect square.

With **practice**, students should eventually move away from skip-counting methods to recalling facts.

Memorizing multiplication facts early will provide huge benefits. Students will use them for the rest of their life, both in school and outside the classroom.

Memorizing perfect squares will help students quickly compute near-perfect-squares by counting up.

×	0	1	2	3	4	5	6	7	8	9	10
0	0	0	0	0	0	0	0	0	0	0	0
1	0	1	2	3	4	5	6	7	8	9	10
2	0	2	4	6	8	10	12	14	16	18	20
3	0	3	6	9	12	15	18	21	24	27	30
4	0	4	8	12	16	20	24	28	32	36	40
5	0	5	10	15	20	25	30	35	40	45	50
6	0	6	12	18	24	30	36	42	48	54	60
7	0	7	14	21	28	35	42	49	56	63	70
8	0	8	16	24	32	40	48	56	64	72	80
9	0	9	18	27	36	45	54	63	72	81	90
10	0	10	20	30	40	50	60	70	80	90	100

Set-up Structures for Success: **Where the Magic Happens**

Standards Aligned Documents

Grade 3 Common Core Standards	3A			3B			3C			3D		
Operations & Algebraic Thinking	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
3.OA.A.1 Interpret products of whole numbers, e.g., interpret 5×7 as the total number of objects in 5 groups of 7 objects each.				✓								
3.OA.A.2 Interpret whole-number quotients of whole numbers, e.g., interpret $56 \div 8$ as the number of objects in each share when 56 objects are partitioned equally into 8 shares, or as a number of shares when 56 objects are partitioned into equal shares of 8 objects each.								✓				
3.OA.A.3 Use multiplication and division within 100 to solve word problems in situations involving equal groups, arrays, and measurement quantities, e.g., by using drawings and equations with a symbol for the unknown number to represent the problem.				✓	✓	✓		✓	✓			✓
3.OA.A.4 Determine the unknown whole number in a multiplication or division equation relating three whole numbers.				✓		✓	✓	✓				
3.OA.B.5 Apply properties of operations as strategies to multiply and divide.				✓		✓		✓				
3.OA.B.6 Understand division as an unknown-factor problem.				✓				✓				
3.OA.C.7 Fluently multiply and divide within 100, using strategies such as the relationship between multiplication and division (e.g., knowing that $8 \times 5 = 40$, one knows $40 \div 5 = 8$) or properties of operations. By the end of Grade 3, know from memory all products of two one-digit numbers.				✓	✓			✓				

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Set-up Structures for Success: **Where the Magic Happens**

Consider the Following Possibilities for Implementation:

- As a full math curriculum
- During MTSS/RTI/WIN
- During Math Block
- Meaningful enrichment for your fast finishers
- Replacement tasks for those who have shown mastery of the required content

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Talent Development **Recommendations**

- Need is all day, every day–different needs, different content
- Consider need for services, not “gifted” or “nongifted”–research shifts
  - Serve the need, not the label
- Accelerate the complexity and depth
- Talent Development Model is good for all students

Why to Enrich?

When **highly able students** are exposed to content that is **below their instruction level**, research has shown that this often **creates a halt in development** as well as **motivational issues.** Some of your **most talented students** have **learned** to be **lazy** and **not react well** to your attempt to challenge them at higher levels. – *University of Connecticut Center for Gifted*

Productive Struggle
Where the Magic Happens

- We learn mathematics by actively grappling with new concepts.
- As teachers, we are tempted to decrease student struggle by removing obstacles or showing them the way – this reduces their opportunities to learn math for understanding.
- High ability students need to know that math is not about a quick, easy answer – we need to introduce productive struggle EARLY.

(Problem Solving in All Seasons -- PreK-Grade 2, NCTM)

We know that struggle can be good for us.
Math is the same way.

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Talent Development
Beast Academy Math Philosophy

“If a student discovers math for themselves, it becomes their math, instead of just something that was told to them.”

— Richard Rusczyk, founder of Art of Problem Solving

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Success Stories Across the Country

Des Moines Public Schools
Des Moines, IA

“The great thing about Beast Academy is that it promotes team-talk and team thinking. That's not typical in instruction in mathematics. Beast brings about discussion with students and students learn from each other. It teaches students how to think mathematically, but also how to bring in problem-solving skills as adults. It provides the framework, structure, and motivation for students to learn from each other as well as from the material.”

- *Jolene Teske, Supervisor of G&T Education*

Princeton Public Schools
Princeton, MN

Parents have noticed the positive impact of both Beast Academy and AoPS Online on their children. When asked about their children’s experience with Beast Academy this year, one parent said, “In many ways this course will, and has been, a key factor in my child's success in school and beyond. His confidence and engagement has soared. Prior to the course, he was bored in school and acquiring negative (lazy) learning habits. I love seeing him thrive and enjoy the challenges and successes this course provides!”

TVT Community Day School
Irvine, CA

TVT students in 2nd through 5th grade have used the curriculum since 2018. Participating students use the curriculum for their entire daily math block. From Lindsay Melia's perspective, an elementary teacher at TVT, the main benefits of Beast Academy are that it teaches abstract thinking and includes highly engaging materials.
"Beast Academy problems present a challenge, often in the form of a puzzle. The open-ended approach is very appealing,” said Melia.

*"It **builds the confidence** of my students but also helps them **build grit**, and know that math isn't always linear.*
- Diana Castellano, Madison Metropolitan School District

"One of our learners… said it is the first time he's ever been challenged in math. Another dyslexic learner shared how he loves the puzzles and they make so much sense."
- Kathryn Veldhuizen, Head of School, Acton Academy

*"One student **decided he was a mathematician** since he did so well on a particular chapter."*
- Julie Miller, G&T Teacher, St. Anthony-New Brighton

"Even my highest students still have to stop and really think about the problems."
- Jill Solomon, Oakwood School

Mankato Public School Case Study

Design

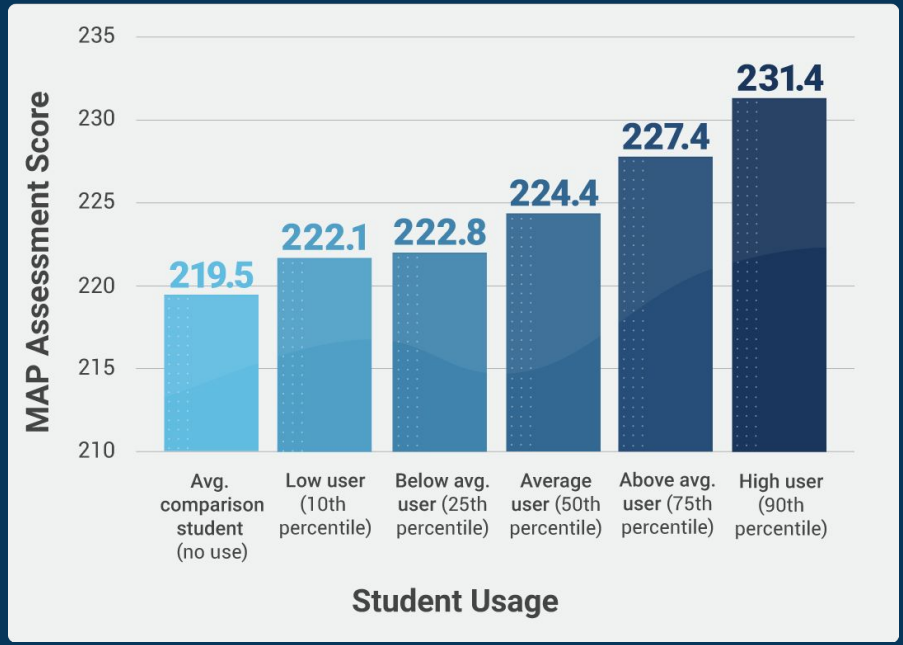
Three sets of students, each split into matched comparison groups: one to use BA, and one for control.

1. "Cluster" students: Gifted and Talented
2. "Rising Scholar" students: High-ability students from historically marginalized communities
3. Students who were neither Cluster nor Rising Scholar

Mankato Public School Case Study

Math Performance

Higher levels of Beast Academy usage are associated with larger differences in math performance between Beast Academy students and their matched comparison group peers who did not use the program.



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Mankato Public School Case Study

Beast Academy makes me want to keep trying and not give up in math even when it's hard.

- *Mankato Area Student*

Attitudes and Perceptions

↑ Higher **motivation** to study

↑ Higher **effort and perseverance**

↑ Increased **interest** in mathematics

↑ Improved appraisals of their own **abilities in math**

↑ Increased levels of **confidence** in their ability to do difficult math work

↑ Increased beliefs about **math as a learnable subject**

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