imagine plus math

Imagine+ Math's

STEM-Focused Application Tasks

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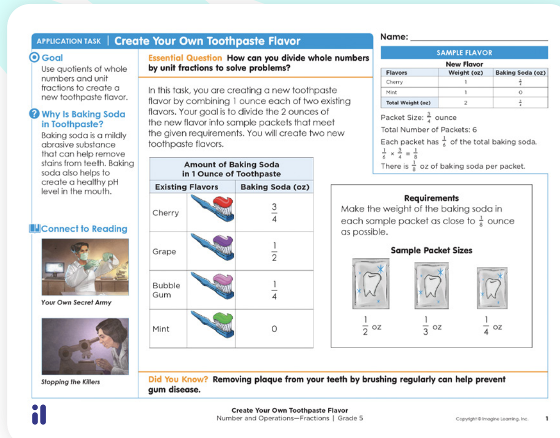
What are Imagine+ Math's STEM-focused Application Tasks?

In Imagine+ Math Grade 3–8, teachers and students have access to Application Tasks. **Application Tasks** are rigorous tasks aligned to STEM and College and Career Readiness standards. Teachers can implement these tasks after a unit of study to extend students' understanding of essential math concepts. These tasks are intentionally designed to foster collaboration, meaningful discourse, and cross-disciplinary connections. Teachers can print and implement these tasks during whole-group or small-group instruction. Each grade level includes between six and eight Application Tasks.

EACH APPLICATION TASK INCLUDES

- an essential question;
- background information to activate prior knowledge;
- a rich problem situation grounded in a real-world context;
- academic vocabulary;
- opportunities to use multiple problem-solving strategies;
- multi-disciplinary connections;
- prompts to explain and justify one's thinking;
- an extension activity; and
- a teacher lesson plan.



APPLICATION TASK | Create Your Own Toothpaste Flavor

Name: ______

Goal
Use quotients of whole numbers and unit fractions to create a new toothpaste flavor.

Why Is Baking Soda in Toothpaste?
Baking soda is a mildly abrasive substance that can help remove stains from teeth. Baking soda also helps to create a healthy pH level in the mouth.

Connect to Reading

Your Own Secret Army

Stopping the Killers

Essential Question **How can you divide whole numbers by unit fractions to solve problems?**

In this task, you are creating a new toothpaste flavor by combining 1 ounce each of two existing flavors. Your goal is to divide the 2 ounces of the new flavor into sample packets that meet the given requirements. You will create two new toothpaste flavors.

Amount of Baking Soda in 1 Ounce of Toothpaste

Existing Flavors	Baking Soda (oz)
Cherry	$\frac{3}{4}$
Grape	$\frac{1}{2}$
Bubble Gum	$\frac{1}{4}$
Mint	0

SAMPLE FLAVOR

New Flavor

Flavors	Weight (oz)	Baking Soda (oz)
Cherry	1	$\frac{3}{4}$
Mint	1	0
Total Weight (oz)	2	$\frac{3}{4}$

Packet Size: $\frac{3}{4}$ ounce
Total Number of Packets: 6
Each packet has $\frac{1}{6}$ of the total baking soda.
$\frac{1}{6} \times \frac{3}{4} = \frac{1}{8}$
There is $\frac{1}{8}$ oz of baking soda per packet.

Requirements
Make the weight of the baking soda in each sample packet as close to $\frac{1}{8}$ ounce as possible.

Sample Packet Sizes

$\frac{1}{2}$ oz $\frac{1}{3}$ oz $\frac{1}{4}$ oz

Did You Know? **Removing plaque from your teeth by brushing regularly can help prevent gum disease.**

Create Your Own Toothpaste Flavor
Number and Operations—Fractions | Grade 5

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Where is the research to support the use of these tasks?

Application Tasks are **cognitively demanding tasks** that require students to engage in higher-level thinking. Solving these tasks prompts students to make connections across concepts; reason about relationships, processes, and procedures; and utilize multiple representations and strategies to solve problems.[i] This helps students deepen their conceptual understanding of math and reason at more sophisticated levels.

Application Tasks also help teachers facilitate **mathematical discourse**. The National Council of Teachers of Mathematics (2014) describes discourse as "the purposeful exchange of ideas through classroom discussion" (p. 24) and a "primary mechanism for developing conceptual understanding" (p. 30).[ii] For meaningful discourse to take place, students must engage in tasks worth talking about.[iii] Application Tasks promote discourse by encouraging students to respond to high-level questions, share their ideas, explain and justify their thinking, critique the reasoning of others, and reflect on their own thought processes.[iv] These opportunities are important because they teach students how to communicate clearly, while strengthening their understanding of key concepts.

Application Tasks incorporate rich, **real-world contexts** that help students see the applicability of math in their lives. Providing opportunities to make sense of math in familiar, real-world situations helps students form connections and develop effective and efficient problem-solving skills.[v]

How can we integrate Application Tasks to elevate STEM instruction?

STEM instruction provides opportunities for all students to learn to think critically and creatively. It also lays the foundation for those who choose to enter a post-secondary STEM major or pursue a STEM-related career.[vi] Imagine+ Math's STEM-focused Application Tasks are grounded in real-world contexts so students can explore STEM concepts and skills in deep and meaningful ways. These tasks help students make cross-disciplinary connections and develop critical-thinking and problem-solving skills in science, technology, engineering, and math.[vii]

Implementing Imagine+ Math's Application Tasks with your whole class

Ms. West is a third-grade teacher who just finished teaching a unit on representing and solving problems involving multiplication and division to 100. She wants to integrate a culminating activity with her class. She wants this activity to reinforce and extend what her students have learned, provide opportunities for rich discussion, and help them make stronger connections to multi-disciplinary content. She decides to use one of Imagine+ Math's STEM-focused Application Tasks, "Build Your Own Museum." She plans to implement this as a whole-class activity and have students work in predetermined heterogeneous groups (3–4 students) to ensure all students have access to rigorous instruction.[viii] She references the **Application Task** and **Implementation Guide** for additional information before implementing this lesson.

Ms. West decides to utilize a three-part lesson format (Launch-Explore-Summarize) when implementing this lesson with her whole class.[ix] To allow students to dive deep into the lesson, Ms. West implements this lesson over the course of two days.

Launch	Explore	Summarize
• Launch the lesson with an engaging hook. • Activate prior knowledge. • Ensure students understand the overarching math concept and have resources to complete the task. • No direct teaching is involved.	• Students collaborate in small groups. • The task integrates multiple representations and encourages problem solving, reasoning, and explanations/justifications. • Facilitate learning by asking questions and gathering information on students' solutions.	• Student-owned, teacher-facilitated whole-group discussion. • Discuss problem solving and a diverse set of strategies. • Make connections to the overarching math concept.

Lesson Objective

Students will use the dimensions of a rectangle to determine its area and describe how area is related to multiplication.

MATERIALS

- Copies of the "Build Your Own Museum" Application Task for each group
- Real-world photographs of the Osher Rainforest exhibit (reference the **California Academy of Sciences** website)
- Copies of "Museums" for each student, found in the Application Task (p. 5)
- Square tiles, unit cubes, and grid paper
- Writing materials (markers, crayons, pencils, and extra paper)
- Optional: Books about different climates

Day 1: Launch (10–15 minutes)

Select an engaging hook to activate students' background knowledge, make learning accessible, and engage all students in the task.[x]

Launch the lesson by showing an engaging real-world photograph or video of the Osher Rainforest, one of the largest rainforest exhibits in the world.

- Ask students, "What do you notice? What do you wonder?"
- In this conversation, make cross-disciplinary connections by
  - discussing what climate is and how climate works;
  - asking students to share examples of different climates (arid desert, tropical rainforest, etc.); and
  - asking students how scientists look at past climate changes to make future predictions.

In this task, students will explore how area is related to addition and multiplication. Explain that they will design two floor plans for a climate museum, with each representing a different climate.

Distribute a copy of the Application Task, "Build Your Own Museum," to each small group. Before students begin reading,

- review key vocabulary and math ideas (e.g., area, climate, dimensions, floor plan, museum, rectangle) so students have background knowledge to begin the task.
- review the design requirements, making connections to area (a previously learned concept) and the sample floor plan. Provide time for students to ask and clarify questions.

Day 1: Explore (30 minutes)

To ensure students have the appropriate knowledge, distribute a copy of "Museums" to each student. Ask students to read this in their small groups. Delegate a "student leader" to read the passage out loud while the others follow along. The student leader should be able to guide group members successfully through this passage.

Once all groups finish, pose questions to discuss what a museum is, what is found in a museum, and why people go there.

Purposefully assigning small groups of students with different reading abilities allows students to support one another.[xi]

SECTION A

Students will work on Section A in these same groups. Before they begin working, prompt students to discuss how their group will solve these problems and how the table in this section will help them meet the requirements of this task.

Pass out manipulatives (square tiles, unit cubes) and grid paper as resources to support student exploration.

Use concrete objects, like square tiles, to help struggling students make connections back to their experiences using multiplication to find area.[xii]

Students will complete the table, as well as the "Think About It" and "Explain It" sections.

- As they work, encourage students to use manipulatives and grid paper.
- Stop at the different groups to ask questions. Make note of the groups' exhibit measurements.

Did you know?

Teachers play a critical role during the Explore phase of a lesson. This phase allows teachers to gather important information to facilitate a discussion at the end of a lesson.[xiii]

For groups that are...

struggling to get started	still developing vocabulary	finishing early
Ask students to start with the Polar Ice Cap exhibit. Pose questions like, "What information do we know?" or "Could you start by modeling the length using square tiles?"	Provide a word bank for students to use to complete the "Think About It" section. These words include area, length, rectangle, and width.	Ask students to build on their responses in the "Explain It" section by using grid paper to determine another way to represent each exhibit (using different lengths and widths).

Once all groups finish, bring the class together. Display or draw the table from Section A on the board.

- Ask students who have created different dimensions for the same exhibit to share. As they share, fill in the information on the table. Be sure to ask students to explain their thinking.
- Conclude by posing the question, "Why can the same exhibit have different measurement, but still have the same area?"

Tell students they will work on the remainder of the task in their small groups tomorrow.

Day 2: Explore (continued) (30 minutes)

Begin by reviewing what students worked on yesterday. Discuss how the table in Section A will now help them create two floor plans for their museum.

Students will work with their groups to complete Sections B, C, and D. As students work, stop at different groups to facilitate discussion. Make note of their conversations, strategies, questions, and possible misconceptions.

Teachers' use of probing questions challenges students to explain and clarify their thinking, which supports a deeper understanding of math concepts.[xiv]

Groups will work at their own pace. After finishing Section B, groups will complete Section C, followed by Section D. Groups that finish early can complete the Extend prompt.

SECTION B

On their Application Task, students will draw two floor plans for their museum. For each plan, explain how they will use the information in their table to arrange the rectangles for the exhibits. Remind students to answer the "Explain It" prompt before moving on to the remaining sections.

- If you notice a student is struggling, they may benefit from using square tiles or grid paper to model one of their exhibits before they begin to draw.

As you walk around, ask students to explain what patterns they noticed in their exhibits.

SECTIONS C AND D

As students complete the sentences in Section C and D, clarify any confusion with Section D. Explain that students will first find the total area of the exhibits in Plan A, then the area of the empty spaces in that same exhibit, followed by the area of the passageway. Then, they will do the same for Plan B.

Ask students to explain how they found the total area of the museum and what strategies they used to find the sum of the area of each plan.

Try it!

Check out books from the library or have students read e-books about different climates. Incorporating children's literature fosters a greater understanding of science concepts.[xv]

CONNECT TO SCIENCE

In this section, students will answer questions related to climates found in different regions of the world. Before students begin writing, encourage them to discuss what they know about climate in their group. Display the following prompts on the board to help guide their conversation.

- What does climate mean?
- What are the different types of climates? What region of the world do you find these climates?
- How would you describe what these climates look like? What types of plants and animals would you find in each climate?
- How is climate different from weather?

Then, students can respond to the questions in this section.

EXTEND PROMPT

Students who finish early can work independently on this prompt: “If a rectangular waterfall feature with a length of 2 units and a width of 2 units is installed in the rainforest exhibit, how much space is left?” Encourage students to draw their revised exhibit on grid paper and explain, in writing, how they determined how much space is left.

If students have additional time, challenge them to work on the “Extend” recommendation below.

Extend!

Encourage students to select a climate to enclose in their exhibit. Ask them to draw what this climate would look like if they were to visit this region of the world.

Day 2: Summarize (10–15 minutes)

Bring students together to facilitate a whole-group discussion. Begin by asking a student to summarize the task they worked on over the past two days.

Discourse communities highlight the diversity of students’ reasoning.[xvi] Students can ask questions and listen to others’ ideas, deepen their own understanding, and develop confidence as learners.

Have students turn and talk to a new partner and discuss the following.

- Why should we study climate?
- How would you describe the different climates featured in your exhibits?

Then, ask 2–3 students to share.

Have students turn and talk to another partner and discuss the following.

- How did you use math to develop your climate museum?
- What patterns did you notice in your floor plans?

Then, have 2–3 students share.

Now, discuss students’ museum exhibits. Predetermine which groups will share, and in what order, based on the strategies students used and answers they provided during their small group work.

- Select three groups that have drawn a floor plan with at least one exhibit with different dimensions (e.g., tropical rainforest: 6 units × 2 units; 2 units × 6 units; 3 units × 4 units).
- Ask the first group of students to
  - share their floor plan;
  - explain how they created their exhibit; and
  - identify the dimensions of the exhibit and what strategy they used to find the area of the exhibit.
- Then, ask the second and third groups to share the same information.

Connect

Use this opportunity to help students make connections between multiplication, arrays, and the commutative property of multiplication ($a \times b = b \times a$).

In this conversation, take note of the students' ability to make connections between multiplication, area, and their museum exhibits.

Pose the following questions to the class.

- How is it possible to have an exhibit with different dimensions but the same area?
- What strategies did you use to find the total area of the floor plan? The exhibits? The empty space?
  - Based on your notes and observations during the student exploration, purposefully select 2–3 groups that used different strategies when solving the task.
- How is your strategy like/different from ____'s strategy?

In the Summarize phase of the lesson, ask questions that help students connect strategies and concepts and generate ideas that reinforce the learning goal.[xvii] For instance, "Was there something in the task that reminded you of another problem we've done?"

This discussion should make one idea explicit—how area is related to operations of addition and multiplication.

Conclusion

As policymakers, legislators, and educators strive to improve STEM education, students need access to high-quality instruction to achieve and maintain STEM proficiency.[xviii] Imagine+ Math's Application Tasks provide students with opportunities to engage in rigorous instruction, participate in meaningful discourse, and make connections across disciplines. These tasks help students develop a conceptual understanding of mathematics as they explore real-world problems that encourage them to reason about relationships, apply a variety of strategies, and explain their thinking. These tasks also promote discourse—students make their thinking visible by collaborating with their peers to complete tasks, respond to questions, and discuss engaging prompts. Relatedly, a glossary of academic and mathematics vocabulary helps facilitate language development. While mathematics vocabulary words reinforce concepts in the lesson, domain-specific words help students make connections to science, technology, and engineering. This allows students to make sense of science concepts (such as climate) and apply their understanding, while simultaneously strengthening their reading, writing, and speaking skills. Imagine Learning is deeply committed to providing engaging STEM instruction that incorporates opportunities to collaborate, communicate, and think critically and creatively. Imagine+ Math's Application Tasks provide educators with a multifaceted tool to support students' STEM knowledge and proficiency.

List of Imagine+ Math Application Tasks

Application Task	Lesson Name
Develop a Bird-Counting Plan	Relate Multiplication and Division
Weigh a Box with a Pan Balance	Visual Models of Equivalent Fractions
Find Math Facts in Petroglyphs	Division as an Unknown-Factor Problem
Plan a Holiday Celebration	Multiplication and Division Equations
Find Dinner for a Bat	Multiply by Multiples of Ten
Build Your Own Museum	Recognize Area as Additive
Measure Areas of Craters on the Moon	Area of Basic Composite Figures
Design a Dinosaur Bone Exhibit	Equivalent Fractions on Number Lines
Design an Insect Exoskeleton	Multiply Fractions by Whole Numbers
Analyze a Science Experiment	Compare Fractions and Decimals
Compare Manganese Levels in Water	Fraction and Decimal Equivalents
Manage a Database of Costumes	Generate Equivalent Fractions
Describe Hurricane Winds	Multiplicative Comparison
Use Sonar for Deep Sea Exploration	Multiply Whole Numbers
Plan a Volunteer Schedule	Word Problems: Multiplication
Prepare for a Wagon Train Rest Stop	Add and Subtract Fractions in Context
Measure Beach Erosion	Add/Subtract Mixed Numbers: Like
Create Your Own Toothpaste Flavor	Divide Whole Numbers by Unit Fractions
Design a Constellation Mural	Multiply with Fractions/Mixed Numbers
Prepare a Magic Trick	Volume of Rectangular Prisms I
Distribute Supplies to Space Expeditions	Multiply Fractions by Whole Numbers II
Write Your Own Tall Tales	Multiply by Powers of Ten
Analyze a Swimming Competition	Add/Subtract Decimals: Word Problems
Build a Tropical Rainforest Greenhouse	Volume of Rectangular Prisms II
Optimize High-Speed Rail Travel	Write and Solve One-Step Equations
Understand the Mathematics of a Piano	Solve Problems with Unit Rates

Application Task	Lesson Name
Measure Gravitational Waves	Calculations with Percent
Create 3-D Mythology Figurines	Use Ratios to Solve Problems
Compare Costs of Gas-Only and Hybrid Cars	Read Expressions with Real Numbers
Design a Mural of the Mayflower	Distance on the Coordinate Plane II
Plan a Boat Trip on the Nile River	Proportional Relationships in Tables and Equations
See a White Alligator in New Orleans	Generate and Understand Expressions and Equations
Analyze Aloe Vera Growth and Gel Production	Model, Evaluate, and Graph Two-Step Inequalities in One Variable
Explore Animal Life at Different Ocean Depths	Use Proportions to Solve Problems
Make Adjustments for Australia's Movement	Solve and Model Two-Step Problems
Analyze Data About Deer Populations	Proportions in Scale Drawings
Design Your Own Skyscraper	Composition of Transformations
Apply Moore's Law	Understand Properties of Integer Exponents
Calculate Spaceship Trajectories	Equation for a Line in Slope-Intercept Form
Investigate DNA Exonerations	Point-Slope Form
Create a Roller Coaster Ride	Introduction to Sketching Graphs of Real-World Situations
Cross the Darien Gap	Solve a System of Linear Equations: Applications

References

[i] Tekkumru-Kisa, M., Stein, M. K., & Doyle, W. (2020). Theory and research on tasks revisited: Task as a context for students' thinking in the era of ambitious reforms in mathematics and science. *Educational Researcher, 49*(8), 606–617. https://doi.org/10.3102/0013189X20932480

[ii] National Council of Teachers of Mathematics. (2014). *Principles to actions: Ensuring mathematical success for all.* NCTM.

[iii] Anderson-Pence, D. (2017). Techno-mathematical discourse: A conceptual framework for analyzing classroom discussions. *Education Sciences, 7(*1), 1–17. https://doi.org/10.3390/educsci7010040

[iv] Smith, M. S., & Stein, M. K. (2018). *5 practices for orchestrating productive mathematics discussions* (2nd ed.). NCTM.

[v] Matthews, J. S. (2018). When am I ever going to use this in the real world? Cognitive flexibility and urban adolescents' negotiation of the value of mathematics. *Journal of Educational Psychology, 110*(5), 726–746. http://dx.doi.org/10.1037/edu0000242; Ottmar, E., Rimm-Kaufman, S., Larsen, R., & Berry, R. (2015). Mathematical knowledge for teaching, standards-based mathematics teaching practices, and student achievement in the context of the responsive classroom approach. *American Educational Research Journal, 52*(4), 787–821. https://doi.org/10.3102/0002831215579484; Walkowiak, T., Berry, R., Meyer, J. P., Rimm-Kaufman, S., & Ottmar, E. (2014). Introducing an observational measure of standards-based mathematics teaching practices: Evidence of validity and score reliability. *Educational Studies in Mathematics, 85*(1), 109–128. https://doi.org/10.1007/s10649-013-9499-x

[vi] National Science Board & National Science Foundation. (2021). Elementary and secondary STEM education. *Science and Engineering Indicators 2022*. https://ncses.nsf.gov/pubs/nsb20211/

[vii] Eckert, J., & Butler, J. (2021). Teaching and leading for exemplary STEM learning: A multiple-case study. *The Elementary School Journal, 121*(4), 674–699.

[viii] Hunter, J., Hunter, R., & Anthony, G. (2020). Shifting towards equity: Challenging teacher views about student capability in mathematics. *Mathematics Education Research Journal, 32*(1), 37–55. https://doi.org/10.1007/s13394-019-00293-y

[ix] Buchheister, K., Jackson, C., & Taylor, C. (2019). "Sliding" into an equitable lesson. *Teaching Children Mathematics, 25*(4), 224–231; McDuffie, A., Foote, M., Drake, C., Turner, E., Aguirre, J., Bartell, T., & Bolson, C. (2014). Use of video analysis to support prospective K–8 teachers' noticing of equitable practices. *Mathematics Teacher Educator, 2*(2), 108–140; Van de Walle, J., Lovin, L., Karp, K., & Bay-Williams, J. (2018). *Teaching student-centered mathematics: Developmentally appropriate instruction for grades 3–5* (3rd ed.). Pearson.

[x] Jackson, K., Shahan, E., Gibbons, L., & Cobb, P. (2012). Launching complex tasks. *Mathematics Teaching in the Middle School, 18*(1), 24–29.

[xi] Murphy, P. K., Greene, J. A., Firetto, C. M., Li, M., Lobczowski, N. G., Duke, R. F., Wei, L., & Croninger, R. M. V. (2017). Exploring the influence of homogeneous versus heterogeneous grouping on students' text-based discussions and comprehension. *Contemporary Educational Psychology, 51*, 336–355. https://doi.org/10.1016/j.cedpsych.2017.09.003; van Dijk, A., Eysink, T., & de Jong, T. (2020). Supporting cooperative dialogue in heterogeneous groups in elementary education. *Small Group Research, 51*(4), 464–491. https://doi.org/10.1177/1046496419879978

[xii] Agrawal, J., & Morin, L. L. (2016). Evidence-based practices: Applications of concrete representational abstract framework across math concepts for students with disabilities. *Learning Disabilities Research & Practice, 31*(1), 34–44. https://doi.org/10.1111/ldrp.12093

[xiii] Smith, M. S., & Stein, M. K. (2018). *5 practices for orchestrating productive mathematics discussions* (2nd ed.). NCTM.

[xiv] Jacobs, V. R., Lamb, L. C., & Philipp, R. A. (2010). Professional noticing of children's mathematical thinking. *Journal for Research in Mathematics Education, 41*(2), 169–202; Nabb, K., Hofacker, E., Ernie, K., & Ahrendt, S. (2018). Using the 5 practices in mathematics teaching. *Mathematics Teacher, 111*(5), 366–373.

[xv] Mahzoon-Hagheghi, M., Yebra, R., Johnson, R., & Sohn, L. (2018). Fostering a greater understanding of science in the classroom through children's literature. *Texas Journal of Literacy Education, 6*(1), 41–50.

[xvi] Murata, A., Siker, J., Kang, B., Baldinger, E., Kim, H-J., Scott, M., & Lanouette, K. (2017). Math talk and student strategy trajectories: The case of two first grade classrooms. *Cognition and Instruction, 35*(4), 290–316. https://doi.org/10.1080/07370008.2017.1362408

[xvii] McDuffie, A., Foote, M., Drake, C., Turner, E., Aguirre, J., Bartell, T., & Bolson, C. (2014). Use of video analysis to support prospective K–8 teachers' noticing of equitable practices. *Mathematics Teacher Educator, 2*(2), 108–140; Nabb, K., Hofacker, E., Ernie, K., & Ahrendt, S. (2018). Using the 5 practices in mathematics teaching. *Mathematics Teacher, 111*(5), 366–373; Van de Walle, J., Lovin, L., Karp, K., & Bay-Williams, J. (2018). *Teaching student-centered mathematics: Developmentally appropriate instruction for grades 3–5* (3rd ed.). Pearson.

[xviii] National Science Board & National Science Foundation. (2021). Elementary and secondary STEM education. *Science and Engineering Indicators 2022*. https://ncses.nsf.gov/pubs/nsb20211/

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