

# PROBLEM SCAPE

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# OVERVIEW

**ProblemScape** for introductory algebra is an adaptive role-playing adventure game designed to be used as a course over a period of 12 weeks. It follows along with the 6th-grade Expressions and Equations strand of the Common Core State Standards.

It is an integrated learning environment that includes multi-modal content for learning (videos, visualizations, worked examples), guided practice, spaced reviews, exercises for developing metacognition and self-efficacy, as well as applications of math - all integrated with the storyline in the adventure game.

The game is divided into chapters with each chapter covering one or two concepts/standards. It is meant to be played sequentially as both the narrative and the math content flow forward, and each chapter presupposes that the student is proficient in the math content of earlier chapters.

## Each Chapter Has:

- A **narrative** and game elements to engage students (XPs to be earned, gems that can be mined, sniffer eggs that can be bought and hatched to get sniffers that follow players, etc)
- A **main activity**/application of a concept or math content standard
- **Learning content** for the concept which can be any combination of:
  - **Xpert Learn** - Video/Animation developed with guidance from research on what trips students and common mistakes that students do
  - **Xpert Observe** - Worked out examples
  - **Xpert Practice** - Guided adaptive practice towards mastery. This challenges students to estimate their knowledge correctly while practicing concepts learned in earlier chapters (to reinforce memory with spaced retrieval and develop metacognition)
  - **Ypert Diary** - Videos animation to help students understand the why of certain math concepts
  - Teach Pad Research-based components like Teachpad that ask the student to teach characters in the virtual world
  - **Chapter Review** - in-game that require the student to think more deeply about what they've learned. This challenges students to estimate their knowledge correctly while practicing concepts learned in earlier chapters (to reinforce memory with spaced retrieval and develop metacognition)

## To get the most out of ProblemScape

To get the most out of ProblemScape, students should **complete one chapter per week**, playing 20 - 40 minutes per day over the course of 5 days. There are a total of 8 chapters. The time to complete a chapter varies from student to student, but a guide that offers a rough outline of a pace for progressing in the game to maximize learning and retention will be provided on request.



# RESEARCH TO PRACTICE: EXAMPLES



## Learning Science

Students are asked to teach virtual characters because when they know they have to teach someone, they put more effort into learning.



## Cognitive Science

Tasks extraneous to what needs to be learned that puts a detrimental load on the working memory are avoided.



## Psychology

Self-efficacy has been shown to have a significant effect in learning outcome and is addressed in feedback.



## Math Education

Instructional content addresses and clarifies common mistakes and misconceptions.

# CHAPTER 1: MYSTERY OF THE MISSING MAYOR

## OVERVIEW

The player made it to arithma, the twin came here looking for someone called lenser to get a new camera lens made, but has gone missing and the player is worried. Maybe some of the locals can help the player find out where the twin is. The player is waiting to explore, ask around and find the twin.

In chapter one, the player will practice writing and evaluating exponent expressions, and evaluating expressions in the proper order of operations.

## STANDARDS ADDRESSED

- [CCSS.MATH.CONTENT.6.EE.A.1](#)  
Write and evaluate numerical expressions involving whole-number exponents.
- [CCSS.MATH.CONTENT.6.EE.A.2.C](#)  
Perform arithmetic operations, including those involving whole-number exponents, in the conventional order when there are no parentheses to specify a particular order (Order of Operations). For example, use the formulas  $V = s^3$  and  $A = 6s^2$  to find the volume and surface area of a cube with sides of length  $s = 1/2$ .



# CHAPTER 2: ALL MINE

## OVERVIEW

No one in arithma can do math, it turns out not only is the twin missing but anyone that can do math. The player got the mayor to come out of hiding but he seemed helpless too and did not know where they want. Mayor suggested asking the paintball shopkeeper but she was very rude and will not help unless the player purchases a paintball launcher first. So here we are heading to the mining village in this chapter to get more gems.

In chapter two, the player will practice writing arithmetic and algebraic expressions.

## STANDARDS ADDRESSED

- [CCSS.MATH.CONTENT.6.EE.A.2](#)  
Write, read, and evaluate expressions in which letters stand for numbers.
- [CCSS.MATH.CONTENT.6.EE.A.3](#)  
Apply the properties of operations to generate equivalent expressions. For example, apply the distributive property to the expression  $3(2 + x)$  to produce the equivalent expression  $6 + 3x$ ; apply the distributive property to the expression  $24x + 18y$  to produce the equivalent expression  $6(4x + 3y)$ ; apply properties of operations to  $y + y + y$  to produce the equivalent expression  $3y$ .
- [CCSS.MATH.CONTENT.6.EE.A.4](#)  
Identify when two expressions are equivalent (i.e., when the two expressions name the same number regardless of which value is substituted into them). For example, the expressions  $y + y + y$  and  $3y$  are equivalent because they name the same number regardless of which number  $y$  stands for..





## CHAPTER 3: THE SHADY SHOPKEEPER

### OVERVIEW

Arithma really is in trouble! We saw in chapter two the shopkeeper and banker in the mining village could not do any math at all. The player helped them learn enough to keep the shop and bank open and got a mining pickaxe and a bigger money bag. The player can now get plenty of gems, even enough for the paintball launcher. The player hopes to get to know from the shopkeeper where the lenser is. Jinga keeps remarking that something seems off about her though - will see what awaits us in this chapter.

Learn about parts of an expression using mathematical terms and how to evaluate

### STANDARDS ADDRESSED

- [CCSS.MATH.CONTENT.6.EE.A.2.B](#)  
Identify parts of an expression using mathematical terms (sum, term, product, factor, quotient, coefficient); view one or more parts of an expression as a single entity. For example, describe the expression  $2(8 + 7)$  as a product of two factors; view  $(8 + 7)$  as both a single entity and a sum of two terms.
- [CCSS.MATH.CONTENT.6.EE.A.2.C](#)  
Evaluate expressions at specific values of their variables. Include expressions that arise from formulas used in real-world problems. Perform arithmetic operations, including those involving whole-number exponents, in the conventional order when there are no parentheses to specify a particular order (Order of Operations). For example, use the formulas  $V = s^3$  and  $A = 6s^2$  to find the volume and surface area of a cube with sides of length  $s = 1/2$ .



# CHAPTER 4: INTO THE WOODS

## OVERVIEW

The shopkeeper was an impostor! The player did not notice that he ran away when he was playing paintball, but the shopkeeper bonked Jinga and took all the gems! But it seems like the imposter headed into the emerald forest, if we can catch up maybe we will find the missing xperts in the crooks hideout, hoping the twin will be there too

In chapter four, the player is running through the woods chasing the fake shopkeeper while simplifying expressions with like terms and simplifying them.

## STANDARDS ADDRESSED

- [CCSS.MATH.CONTENT.6.EE.A.3](#)  
Apply the properties of operations to generate equivalent expressions. For example, apply the distributive property to the expression  $3(2 + x)$  to produce the equivalent expression  $6 + 3x$ ; apply the distributive property to the expression  $24x + 18y$  to produce the equivalent expression  $6(4x + 3y)$ ; apply properties of operations to  $y + y + y$  to produce the equivalent expression  $3y$ .



- [CCSS.MATH.CONTENT.6.EE.A.4](#)  
Identify when two expressions are equivalent (i.e., when the two expressions name the same number regardless of which value is substituted into them). For example, the expressions  $y + y + y$  and  $3y$  are equivalent because they name the same number regardless of which number  $y$  stands for..

# CHAPTER 5: A HEALING HAND

## OVERVIEW

The player followed the imposter into the forest and faced the PiRates! But the real paintball shopkeeper is sleeping and won't wake up! The player needs to get to the healer's hamlet to get some help waking her up. Then she can tell us where the player's twin is.

## STANDARDS ADDRESSED

- [CCSS.MATH.CONTENT.6.EE.B.5](#)  
Understand solving an equation or inequality as a process of answering a question: which values from a specified set, if any, make the equation or inequality true? Use substitution to determine whether a given number in a specified set makes an equation or inequality true.

The screenshot shows a game interface with a patient chart and a math problem. The patient chart for 'Oogle' lists: Name: Oogle, Age: 4 Cycles, Weight: 24 Stones, Height: 4 Sticks, and Condition: Hatted Head. The symptom is 'CAN'T SEE WHERE I AM GOING!' and the patient story is 'I pulled the hat down to cover my ears, and now I can't pull it out!'. The 'Shrinking Potion Recipes' section contains the following text: 'You'll be surprised by how many Arithmen get this problem! They sure like to pull their hats down. I have a potion that shrinks their head just a tad! The paste to make the potion will be in one of these four boxes! I have developed a rather clever strategy to find the box - all you have to do is find which of the four box numbers make this equation true! If the patient's height is H sticks, the equation to find the box is:  $B - 7 = H$ . B can be one of these values: 10, 11, 12, or 13. First substitute the patient's # from the patient chart to simplify the equation. Next substitute a value for B from the given values to check if the equation is true.' Below the text is an input field labeled 'Enter Box Number:' and a 'Check' button. To the right is a numeric keypad with buttons for 0-9 and a 'DEL' button. The player's XP is 1050.



# CHAPTER 6: LOCATING THE LENSER

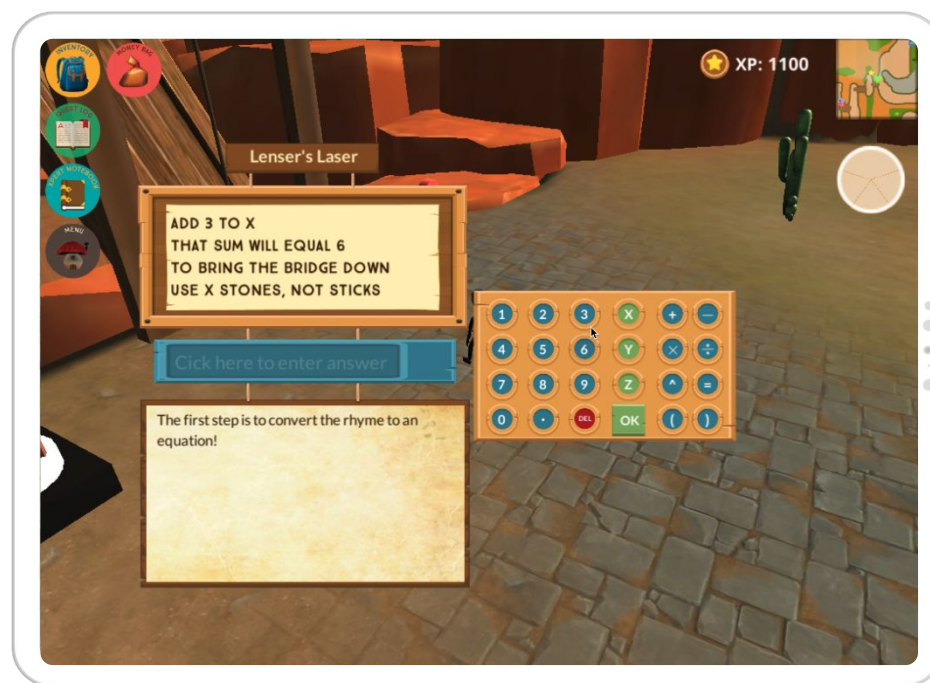
## OVERVIEW

The healer wasn't there, but the player helped the assistant with the sick patients. Arithma has weird diseases! When the shopkeeper woke up, she said the player's twin went to the Lenser's hut on the outskirts. We're hot on the trail!

Practice writing and solving equations with variables.

## STANDARDS ADDRESSED

- [CCSS.MATH.CONTENT.6.EE.B.6](#)  
Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set.
- [CCSS.MATH.CONTENT.6.EE.B.7](#)  
Solve real-world and mathematical problems by writing and solving equations of the form  $x + p = q$  and  $px = q$  for cases in which  $p$ ,  $q$  and  $x$  are all nonnegative rational numbers.



# CHAPTER 7: SOLUTIONS IN THE SWAMP

## OVERVIEW

Crossing the canyon was pretty dangerous, with falling boulders and bridges! But at the end, the player meets the lenser and finds out where the PiRates are hiding everyone. You must go through the opal swamp to make it to the diamond peak!

## STANDARDS ADDRESSED

- [CCSS.MATH.CONTENT.6.EE.B.8](#)  
Write an inequality of the form  $x > c$  or  $x < c$  to represent a constraint or condition in a real-world or mathematical problem. Recognize that inequalities of the form  $x > c$  or  $x < c$  have infinitely many solutions; represent solutions of such inequalities on number line diagrams.
- Write and Solve inequalities with variables and plot the solution on a number line.



# CHAPTER 8: TWIN'S PEAK

## OVERVIEW

We caught up to one of the PiRates just as he was leaving with my sister! we will have to pursue them with my sister! We will have to pursue them to diamond peak and find their hideout so we can rescue everyone.

## STANDARDS ADDRESSED

- [CCSS.MATH.CONTENT.6.EE.C.9](#)  
Use variables to represent two quantities in a real-world problem that change in relationship to one another; write an equation to express one quantity, thought of as the dependent variable, in terms of the other quantity, thought of as the independent variable. Analyze the relationship between the dependent and independent variables using graphs and tables, and relate these to the equation. For example, in a problem involving motion at a constant speed, list and graph ordered pairs of distances and times, and write the equation  $d = 65t$  to represent the relationship between distance and time.





# THANK YOU

Want to learn more about ProblemScape? Go to [Roundedlearning.com](https://roundedlearning.com) or reach out to us directly at [info@roundedlearning.com](mailto:info@roundedlearning.com)