Transition to Algebra Dialogues:

Research-Based Strategies for Strengthening Written and Verbal Communication in Mathematics

transition to **algebra**

make algebra make sense

Curriculum information and presentation documents: **ttalgebra.edc.org**

Sample materials and ordering information: **transitiontoalgebra.com**

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- Transition to Algebra Webinars and PD: transitiontoalgebra.com
- Implementing the Mathematical Practice Standards: mathpractices.edc.org
- Mathematical Practices Institute — professional development opportunities, curriculum support, and technical assistance for schools: mpi.edc.org

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Reading Dialogues

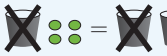
Thinking Out Loud

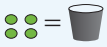
If  , then what number(s) can the  represent?

Lena: I never thought about it before, but that statement uses an equals sign even though the two sides don't look the same!

Jay: They aren't the same, but they do have the same value.

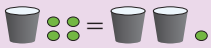
Michael: That's why it says "equals." So the question is, *when* do they have the same value? When will it be true?

Lena: We need to figure out what has to be in a bucket for the two sides to be the same. Since each bucket holds the same amount, I can remove the matching buckets because that won't affect the balance. *(Lena crosses out two buckets:*  *and Jay writes the new equation*  *.)*

Jay: That leaves us with  and we remove the matching ones. *(Lena draws*  *)*

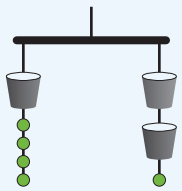
Michael: So  = 3. That makes sense! If  = 3, then  = 7 and  = 7. So they're equal!

Discuss & Write What You Think

If  = 2, would the statement "  " be true? Why or why not?

Thinking Out Loud

Jay: I started in a completely different way! I knew that 1 bucket plus 4 is the same number as 2 buckets plus 1. So, I pictured them balancing on a mobile. *(Jay draws a mobile.)*



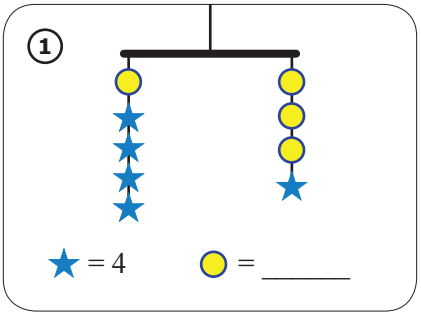
Michael: Oh, and because they're equal, the two sides have to balance!

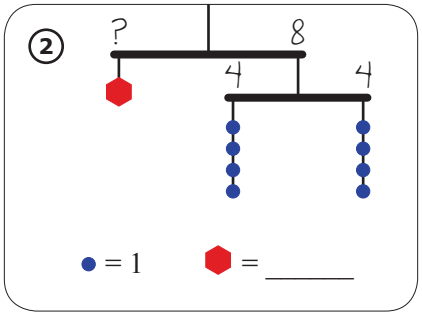
Jay: Yeah! We can imagine the buckets and ones hanging from the strings. Just like before, the bucket holds my original number, but we can't see inside. Anyway, I saw that the top of each side is a bucket and the bottoms both have ones, so the middles have to match up too! *(Jay draws arrows.)*

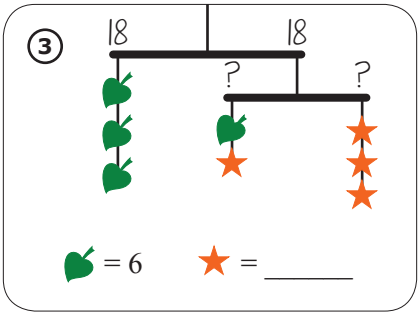
Michael: I get it! To make it balance, that bucket on the right has to weigh the same as the 3 ones on the left. That's how the chunks of stuff match up!

Solving and Creating Mobile Puzzles

Every beam in the mobiles below is balanced. The strings and the beams weigh nothing. Find the weight of each shape.

① 

② 

③ 

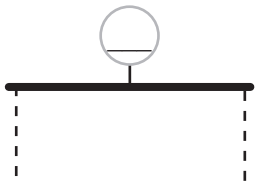
④ Make up a mobile with two shapes and one beam.

(a) Start by picking your own shapes and making up the solutions first:

= _____

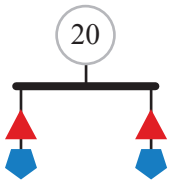
= _____

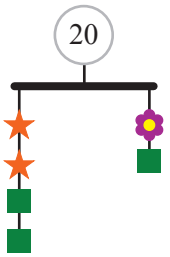
(b) Now make up a balanced mobile, and write in the total weight at the top:



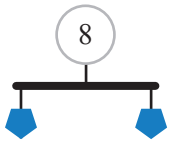
(c) Before you share your mobile, make sure that the solutions you started with are the *only possible solutions*. Cover your solutions and try solving it yourself first. Then trade with someone and solve each other's puzzles.

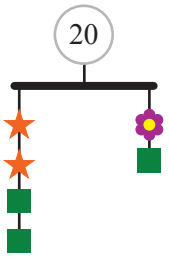
These two mobiles aren't "wrong," but they're not good puzzles because there is more than one way to make them balance.



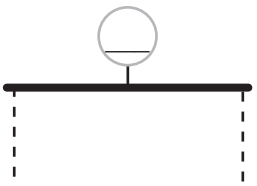


Did you make a mobile with more than one possible solution? If so, it may be possible to fix it by giving more information or using fewer variables. For example, the two mobiles above can be fixed like this:





⑤ Copy your partner's mobile, draw their shapes in below, and solve it.



= _____

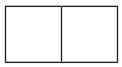
= _____

To complicate a mobile, try:

- Strings with more than one kind of shape
- More shapes
- More beams
- Not giving the top weight
- Middle weights

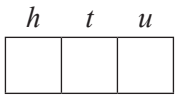
Solving Who Am I? Puzzles

Who Am I?



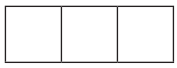
- The product of my digits is 7.
- The sum of my digits is 8.
- My units digit is greater than my tens digit.

Who Am I?



- I am even.
- My tens digit is 1.
- The product of my three digits is 12.
- h is four less than my units digit.

Who Am I?

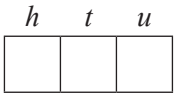


- I am odd.
- $u > t$
- My hundreds digit is prime.
- $t = 2h$
- Two of my digits are square numbers.

Who Am I?

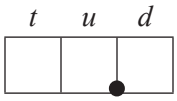
- The product of my digits is 16.
- The sum of my digits is 8.

Who Am I?



- I am a multiple of 10.
- My hundreds digit is one more than my tens digit.
- The sum of my three digits is 7.

Who Am I?



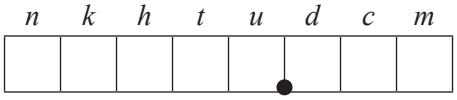
- I am in the thirties.
- $d < t$
- My units digit is twice my tens digit.
- d is four less than u.
- The product of d and t is u.

You can make up problems like these using clues with relevant content.

Creating Who Am I? Puzzles

Puzzle Building Steps:

1. **Choose the final answer & construct clue boxes.**
2. **Create clues to help identify the answer.**
3. **Check that the clues lead to a unique solution.**



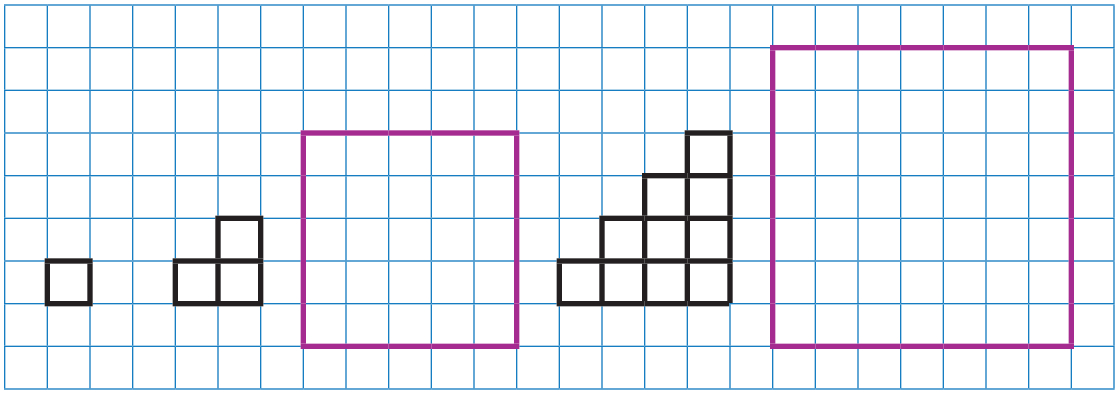
These variables were selected to match place values and metric system prefixes (n for thousands, k for kilo-, h for hundreds, t for tens, u for units, d for deci-, c for centi-, and m for mili-).

Who Am I?

Who Am I?

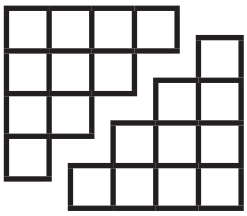
Creating Dialogues

Observe this growing staircase pattern, and fill in the missing stages.



Stage 1 Stage 2 Stage 3 Stage 4 Stage 5

Part of this problem strand is omitted here to help us focus writing about the problem. In *TTA*, students consider patterns in the number of squares when two identical staircases are combined.



Write a dialogue about students discovering an expression for the number of squares in a Stage *n* staircase.

Thinking Out Loud