Doing What Mathematicians Do!

Investigations in Algebraic Reasoning to Nurture Talent in Elementary Students

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Keep Your Balance Directions

- You may play by yourself or with a partner/team. Each player needs 30 small counters and pp. 45-47 of your *Student Mathematician's Journal*. You also need one set of Keep Your Balance Number Cards.

- Record the scale number. Start with Scale 1 and alternate scales each round.

- Place the Keep Your Balance Number Cards face down in a pile. Turn over the top card. Each player takes this number of counters and records it.

- Arrange all the counters inside the shapes on the scale so there are the **same total number of counters on each side**. Use these rules:

  - Same shapes must have the same value (same number of counters).

  - Each shape must have at least one counter.

- Record the number of counters and a matching equation on your record sheet.

- Try to find new solutions and record these on your record sheet.

- Share and check to make sure everyone's solutions are correct.

- Play another round with a new Keep Your Balance Number Card. Record all your solutions.

- If you like to compete, the winner is the player with the greatest number of correct solutions for all rounds.

10	12	14
16	18	20
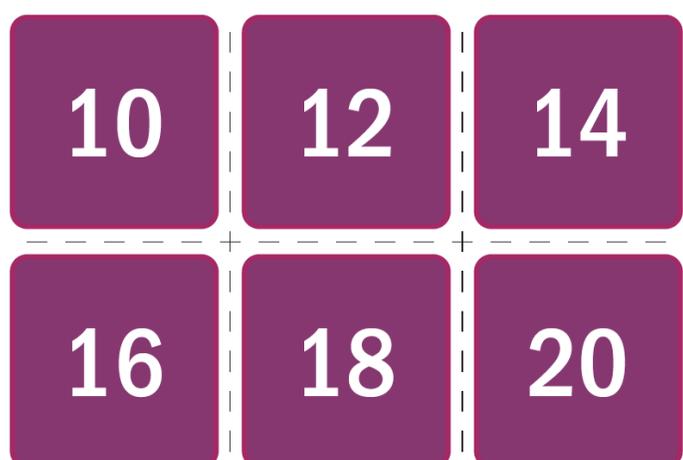
Keep Your Balance Scale #1
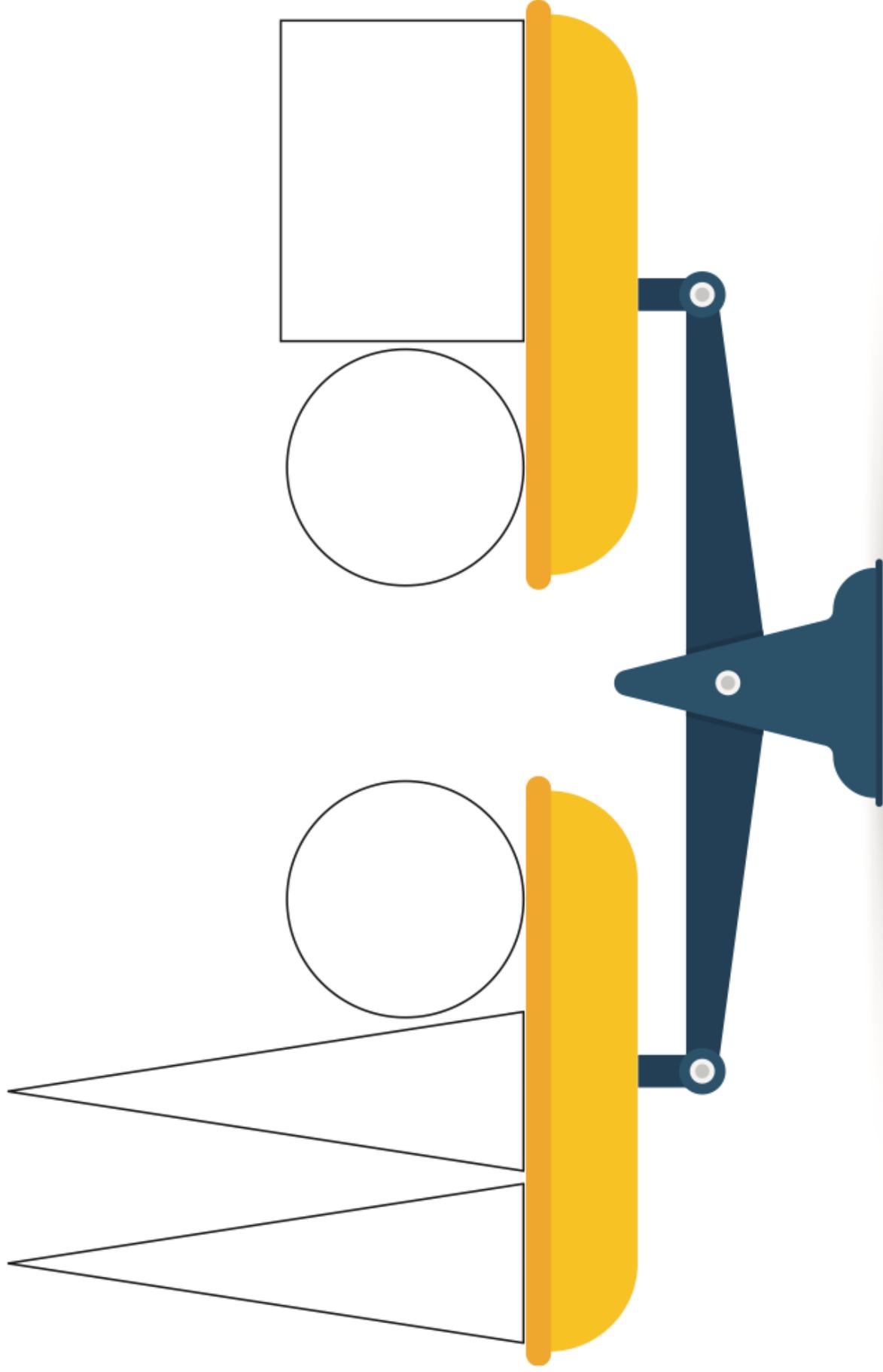
Keep Your Balance Record Sheet

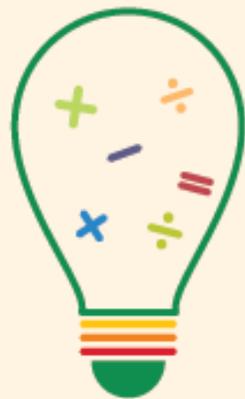| Round	Total Counters	Scale Number	▲	●	▬	Equation
1 **Score** for the Round (number of equations) _____						
2 **Score** for the Round (number of equations) _____						
3 **Score** for the Round (number of equations)						

Equation Creations

In this game, you use all four operations (+, −, ×, and ÷), parentheses, and exponents to create equations. Play it with two, three, or four people.

Equation Creations Directions

- You need Digit Cards, or a 10-sided die, and a timer.
- One player selects four cards from the Digit Cards deck or rolls the die four times. Digits can repeat. Zeros are not allowed. Digits cannot be combined to make two-digit numbers. Record the digits on the score sheet.
- Each player uses 2, 3, or 4 of the digits selected to write equations that are equal to **20** on the score sheet. Play four rounds. Each round lasts 10 minutes.
- For example, if the digits selected are: 2, 4, 5, and 8, the following equations could be created:
  - $4 \times 5 = 20$
  - $(8 \times 5) \div 2 = 20$
  - $(8 \times 2) + 4 = 20$
  - $2^5 - 4 - 8 = 20$
- When time is up, players share their equations and check that they all are true.
- Players calculate their score for the round using the following rules:
  - Add 1 point for each digit used (maximum 4).
  - Add 1 point for each operation used. The same operation can be used more than once in an equation.
  - Subtract 3 points for each incorrect equation. This may be due to the incorrect placement of parentheses or not following the order of operations. No other points are awarded.
  - Scores for some equations are shown.
    - $5 \times 4 = 20$ +3 points (2 digits, 1 operation)
    - $(8 \times 5) \div 2 = 20$ +5 points (3 digits + 2 operations)
    - $2^5 - 4 - 8 = 20$ +7 points (4 digits, 3 operations)
    - $8 \div (2 \times 5) = 20$ −3 points (this equation ≠ 20)
- The sum of the number of points for all correct equations is each player's score for that round.
- Play again using new digits. Pick a new target number between 20 and 40 for the next round. Talk to your teacher about using different target numbers.

Equation Creations Score Sheet

Digits: _____   Target Number: _____

Write one equation on each row.

Equations	Points
Total Score	

Variable Puzzles

The same variables (letters) have the same value everywhere in an individual puzzle, but the value may change from one puzzle to another. Different variables in a puzzle have different values. The numbers at the end of each row and column are the sums of all the values in that row or column. Find the value for each variable.

1	Column 1	Column 2	Column 3	Row Total
Row 1	D	9	C	17
Row 2	D	D	10	22
Row 3	3	C	C	7
Column Total	15	17	14	

C = _____
D = _____

2	Column 1	Column 2	Column 3	Row Total
Row 1	7	F	8	24
Row 2	E	F	3	16
Row 3	F	F	E	22
Column Total	20	27	15	

E = _____
F = _____

3	Column 1	Column 2	Column 3	Row Total
Row 1	4	G	H	27
Row 2	G	G	H	34
Row 3	G	7	H	30
Column Total	26	29	36	

G = _____
H = _____

4	Column 1	Column 2	Column 3	Row Total
Row 1	6	J	J	12
Row 2	8	K	K	16
Row 3	N	N	K	18
Column Total	21	14	11	

J = _____
K = _____
N = _____

5	Column 1	Column 2	Column 3	Row Total
Row 1	L	3	M	22
Row 2	5	M	9	27
Row 3	P	P	7	27
Column Total	21	26	29	

L = _____
M = _____
P = _____

6	Column 1	Column 2	Column 3	Row Total
Row 1	R	Q	S	12
Row 2	S	R	9	20
Row 3	S	S	8	26
Column Total	20	12	26	

Q = _____
R = _____
S = _____

7	Column 1	Column 2	Column 3	Row Total
Row 1	Z	8	W	11
Row 2	7	Z	W	10
Row 3	X	Y	Z	9
Column Total	13	13	4	

W = _____
X = _____
Y = _____
Z = _____

8	Column 1	Column 2	Column 3	Row Total
Row 1	A	4	B	16
Row 2	B	13	2	25
Row 3	7	C	A	15
Column Total	19	23	14	

A = _____
B = _____
C = _____

Seasonal Symbols

Find the number that goes inside each symbol to make the equations true and write it in the white square. Same symbols have the same number value in each problem. Be sure to check your answers in both equations.
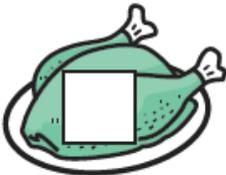
1. $\square + \square = 19$

$\square + \square = 24$
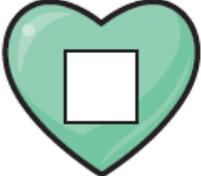
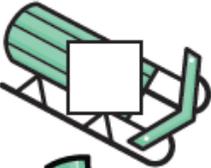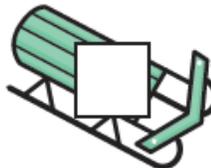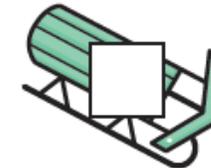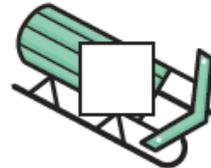2. $\square \div 2 = 5 \times 5$
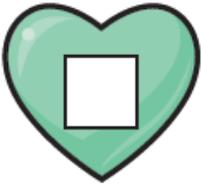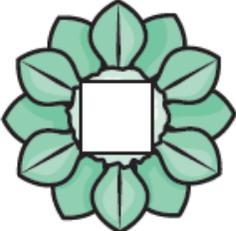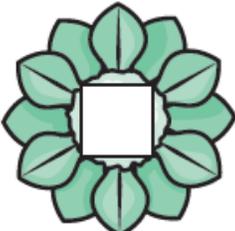
$\square + \square + \square = 100$

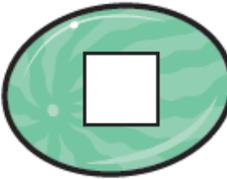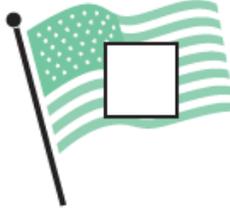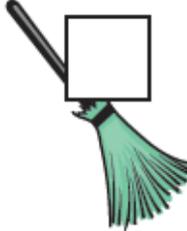Which value did you find first in problem 2 — heart or flower? Explain why you started with this variable.

_____

_____

_____

3. $\boxed{} + \boxed{} + \boxed{} + 10 = 37$

$\boxed{} + \boxed{} = 14$

4. $\boxed{} + \boxed{} = 25$

$\boxed{} - \boxed{} = 11$

$\boxed{} \times 4 = 36$

5. witch $\boxed{}$ $+$ broom $\boxed{}$ $=$ broom $\boxed{}$ $+$ **5**

witch $\boxed{}$ $+$ broom $\boxed{}$ $=$ **87**

6. Lincoln $\boxed{}$ $+$ Lincoln $\boxed{}$ $=$ Washington $\boxed{}$
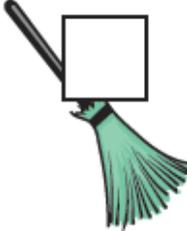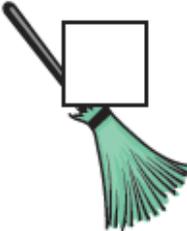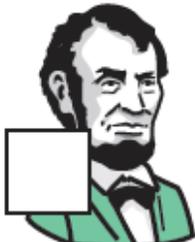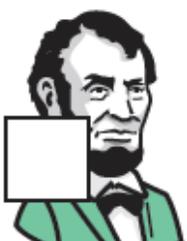
Washington $\boxed{}$ $+$ Lincoln $\boxed{}$ $=$ **15**

Visual Equations

In each problem below, symbols that are identical in the same problem have the same value. Different symbols in a problem have different values. When symbols are next to each other without an operation sign, such as 🌭🌭🍩, the values of the symbols are to be multiplied together (🌭 × 🌭 × 🍩).

1. If ⭐ = ❤️ ❤️

   Then ⭐ ⭐ = _____

2. If 😌✌️ = 😌 😌

   Then ✌️ = _____

3. If 💻🎧 = 🎧 🎧 📶

   Then 💻 = _____

4. If 🏀🏀🏀 = 🏆🏆🏆🏆🏆🏆

   Then 🏀 = _____

5. ☀️ + ☀️ + 🕶️ + 🕶️ = 36

   ☀️ + 🕶️ + 🕶️ = 25

   What number is: 🕶️ = _____   ☀️ = _____

Visual Equations

6. 12 = 🎓 + 🎓

   🎓 + 🎉 + 🎓 + 🎉 = 18

   What number is: 🎉 = _____   🎓 = _____

7. If 😎 = 🪣 + 🍉

   And 🪣 = 🍫 – 🍉

   Then 🍫 = _____

8. ☮ + 📷 + 📷 = 11

   ✏ + ✏ – ☮ = 7

   📷 + ☮ = 10

   💬
   What number is: ☮ = _____   ✏ = _____   📷 = _____

9. 🧮 + 🕐 + 🧮 + 🕐 = 24

   🧮 – 🕐 = 6

   What number is:

   💬 🧮 = _____   🕐 = _____

Visual Equations

10. 📱 + 📖 = 11

    👍 + 👍 + 📱 = 23

    📖 + 👍 + 📱 = 18

    What number is:

    📱 = _____   👍 = _____   📖 = _____

11. 🔥 + 🌹 = 11

    💡 + 🔥 + 💡 = 26

    🔥 + 🌹 + 💡 = 21

    What number is: 🔥 = _____   🌹 = _____   💡 = _____

12. Sophia claims that 🙂🙂 is the same as 🙂 + 🙂. Do you agree or disagree with Sophia? Why?

    _____

    _____

    _____

    _____

    _____

Wacky World Record Situations

a. Name some of the things that vary in each situation.

b. Explain how the variables change in relation to one another (for example, the distance increases as the time increases).

1. A LEGO® tower built by children in Tallinn, Estonia took four days to build, from August 18–21, 1998, and grew in height to a maximum of 82 feet. In this very successful fund-raising project for the Tallinn Children's Hospital, the children used 391,478 plastic brick pieces to construct the tower.
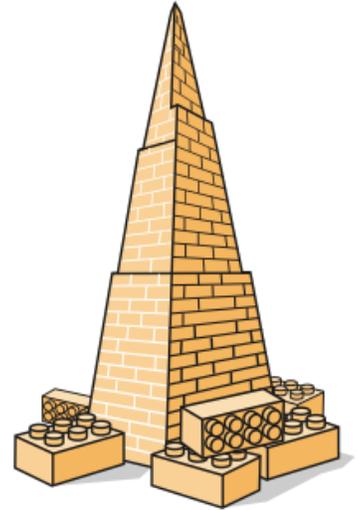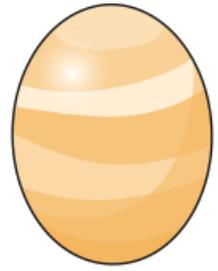
    a.

    b.

2. The greatest distance walked by a person continuously balancing a milk bottle on his head is 80.96 miles by Ashrita Furman. (You'll see his name again!) It took him 23 hours, 35 minutes to complete the walk around Victory Field Track in Queens, New York.
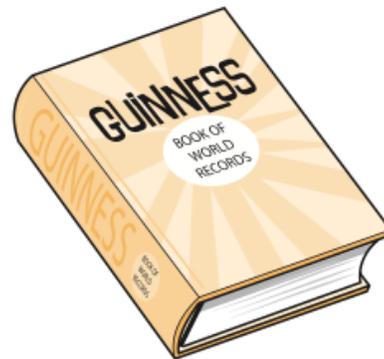
    a.
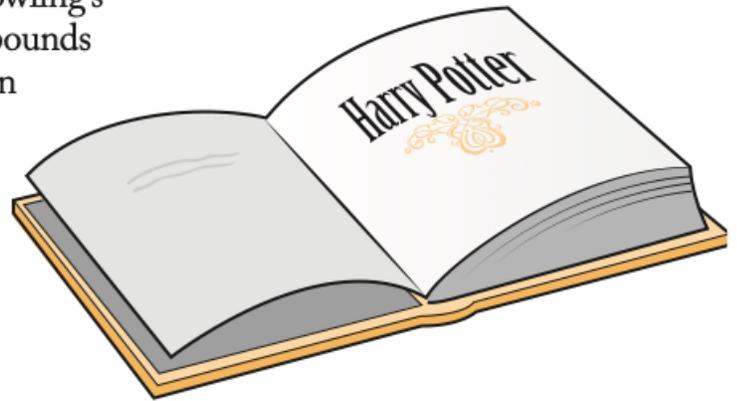
    b.

Wacky World Record Situations

3. On April 4, 1996, the Rotary Club of Piet Retief, KwaZulu-Natal, South Africa made an Easter egg that was approximately 25 feet high. It was made of marshmallow and chocolate and weighed 8,968 pounds. They needed to support it by an internal steel frame.

   a.

   b.

4. According to the *London Sunday Times* Rich List 2002, Harry Potter author J. K. Rowling's net worth increased from 65,000,000 pounds (or $93,000,000) in 2001 to 226 million pounds (or $325,000,000) in 2002. This increase was the result of royalties she received from the hit film *Harry Potter and the Sorcerer's Stone*, sales of her books, and other merchandising related to Harry Potter. This made her the world's first billion dollar author in 2004.

   a.

   b.