

Krypto!

Make your own cards:

Numbers 1 - 10	Make 3 cards of each
Numbers 11 - 17	Make 2 cards of each
Numbers 18 - 25	Make 1 card of each

Rules:

1. Deal 5 cards plus one target card.
2. Use all five cards (in any order) along with the operations of +, -, x, or ÷ to get the value of the target card.
3. When you have a solution, call "Krypto!"

Example hand: 20 15 17 3 9 Target card = 4

Solution: $20 \div [(17-15) + (9 \div 3)]$
 $= 20 \div [2 + 3]$
 $= 20 \div [5]$
 $= 4$

Variations:

- Students may want to use paper and pencil while learning but move quickly to a mental arithmetic game.
- Solitaire—a great aid to concentration.
- Play in teams.
- Use only the numbers 1-10 with very young students.
- Let primary students solve the hand using fewer than five cards.
- Deal only 5 cards and make the target card a variable. Try to generate solutions for each of the targets 1 through 25. Require correct order of operations notation to record solutions.

Websites of interest

- The Story of Krypto and a Solver program: http://nostreet.com/krypto_solve/
- Mathematical discussion of Krypto:
<http://www.math.niu.edu/~rusin/uses-math/games/krypto/>

Preparation for algebra:

Mental computation and looking for patterns. This game promotes the kind of number juggling used in factoring quadratic trinomials.

Order of operations. Ask students to write their solutions in correct notation, using rules for order of operations or “algebraic logic.”

Concept of variable. By letting the target card or one of the other 5 cards in the hand be a variable, students see how “n” can be different for different solutions.

Commutative and Associative Properties. In comparing solutions, students will see that variations in grouping and order produce the same result.

Multiplication by zero. If you can make a zero from two of the cards you can eliminate other numbers that you don’t need.

- Example: 6 4 3 6 22 Target card is 7.

$$\text{Solution: } (3 + 4) + (6 - 6)(22) = 7$$

Identity elements. If you can get the target number with one or two cards, then try to get a zero or 1 with the remaining cards. Multiply by one or add zero.

Example: 7 9 2 15 20 Target card is 8.

Notice that $15 - 7 = 8$. Can you get a zero or 1 from the other three cards?

Levels of Challenge in Krypto

- 1) Paper and pencil
Use any subset of the cards
Compete against yourself
- 2) Mental arithmetic
Use all 5 cards to find a solution
Competition: first to get solution calls “Krypto”
- 3) No target card dealt; find solutions for all 25 targets
Write correct mathematical notation for solutions
- 4) Write a computer program to generate hands
Watch for unsolvable hands. One publisher of the deck claims about 1 in 3000 hands is unsolvable. Where did this figure come from?