

Chestnut & Acorn Challenge Cards

Hands-on puzzles for grades 4–7 — chestnuts, about 15 acorns and paper leaves

Card 1 Squirrel Nim

You need: 15-21 chestnuts, 2 players

Set up: Put all 15 chestnuts in a pile between you.

Rules: Take turns. On your turn take 1, 2 or 3 chestnuts. The player who takes the last chestnuts wins.

Play: Play five games. Swap who goes first. Keep a tally of who wins.

Think: Is there a way to win every time? Hint: what should the pile look like after YOUR turn? Try it with a pile of 4 first, then 8, then 12.

Bigger pile: Start with 21 (add 6 chestnuts). Does the first player still have a winning move? What is it?

Extra: Change the rule to "take 1, 2, 3 or 4". Does your strategy still work? What is the new magic number? Try it with 15 and with 21.

Card 2 Lines of chestnuts

You need: chestnuts, a flat table, a ruler or a stick

What counts: A "line of 3" means three chestnuts that a straight stick can touch at the same time. One chestnut may belong to several lines — that is the trick!

Puzzle A: Place 6 chestnuts so that they make 3 straight lines with exactly 3 chestnuts in each line. Clue: start by placing 3 chestnuts as the corners of a triangle.

Puzzle B: Place 7 chestnuts to make 6 lines of 3. Clue: keep your answer to A and add ONE chestnut in a clever spot.

Puzzle C: Place 10 chestnuts to make 5 lines of 4. Clue: draw a five-pointed star with one stroke, then look at where the lines cross.

Check: Lay the stick along each line and count: does every line have the right number? Did you find all the lines?

Extra: Place 9 chestnuts to make 8 lines of 3. (Famous and hard — take it home!)

Card 3 Three hungry squirrels

You need: 15 acorns, 3 paper leaves

Set up: The three leaves are three squirrels' nests. Share ALL 15 acorns between them. In every puzzle each nest gets a different number of acorns. Move the acorns around until every rule is true.

Puzzle A: The biggest nest has exactly 4 more acorns than the smallest nest.

Puzzle B: Two nests have an even number of acorns and one has an odd number. The biggest nest is divisible by 4. The smallest nest is divisible by 3.

Puzzle C: Every nest has an odd number of acorns. The biggest nest is divisible by 3. The middle nest has more than 3.

Puzzle D: The first nest has twice as many acorns as the second. The third nest has 5 fewer acorns than the first.

Think: For each puzzle, which rule did you use first? Is there only one answer?

Extra: Make up your own three rules so that there is exactly one answer. Test them on a friend.

Card 4 The great chestnut count

You need: the whole pile of chestnuts, 10 paper leaves

Estimate: Before counting, everyone writes a guess: how many chestnuts are in the pile? _____

Count: Use the leaves as trays. Put exactly 10 chestnuts on each leaf. How many full leaves? How many left over? Total = _____

Solid square: Arrange chestnuts in a FILLED square — rows and columns completely filled, like a chessboard (3 rows of 3, 4 rows of 4, ...). What is the biggest filled square you can make from the pile? How many chestnuts are left over?

Solid rectangle: Can you arrange ALL the chestnuts in a filled rectangle with no leftovers? Find every rectangle that works and write it as rows $\times$ columns. Which numbers of chestnuts give only one rectangle ($1 \times$ itself)?

Extra — hollow square: Now make a square with chestnuts only on the border (the inside is empty). How many chestnuts does a hollow square with 5 chestnuts on each side need? Not 20 — why? Find a rule for a side of n chestnuts.

Card 5 The magic leaf triangle

You need: 6 paper leaves, 21 chestnuts

Set up: Lay the 6 leaves in a triangle: one at each corner and one in the middle of each side. Each side of the triangle has 3 leaves.

Puzzle: Put chestnuts on the leaves so that the leaves hold 1, 2, 3, 4, 5 and 6 chestnuts (each number once), and every side of the triangle has the SAME total.

Think: Which total did you get? There are four possible totals: 9, 10, 11 and 12. Can you find an arrangement for each? Which numbers must go in the corners for the smallest total?

Extra: Use 9 leaves (4 per side) and the numbers 1 to 9. Can you make every side add to 17? To 20?

Card 6 The hidden cache

You need: 15 acorns, 5 paper leaves

Set up: Lay 5 leaves in a row: these are five trees. A squirrel hid all 15 acorns under the leaves, but forgot how many are under each one. Here are its notes:

Clues: • Tree 1 has twice as many acorns as Tree 2. • Tree 3 has 2 acorns. • Tree 4 has as many as Trees 1 and 2 together. • Tree 5 has 1 acorn.

Puzzle: Place the acorns under the leaves so that all the notes are true. Check: did you use exactly 15?

Extra: Write your own set of notes for a friend. Test them: do the notes give exactly one answer? Use letters if it helps (Tree 2 = n , so Tree 1 = $2n$, ...).

Teacher notes and answers

Card 1 — Squirrel Nim. Whoever leaves a multiple of 4 (20, 16, 12, 8, 4, 0) after their turn wins: whatever the opponent takes (1, 2 or 3), you take the rest of a 4. From 15 the first player takes 3; from 21 the first player takes 1. With "take 1 to 4" the magic number is 5: from 21 take 1 (leave 20), but from 15 the first player is already on a multiple of 5 and loses against perfect play — a nice surprise. Good discussion: play backwards from the end.

Card 2 — Lines. A: a triangle with a chestnut at each corner and one in the middle of each side (3 sides). B: the same triangle plus one chestnut in the centre: 3 sides + 3 lines from each corner through the centre to the opposite midpoint = 6 lines. C: a five-pointed star (pentagram): chestnuts at the 5 points and the 5 inner crossings, 5 lines of 4. Extra: 9 points, 8 lines of 3 exists but is hard; 9 points in 10 lines is the classic Sylvester problem — offer it as a take-home.

Card 3 — Three squirrels. All 12 ways to split 15 into three different numbers: 1-2-12, 1-3-11, 1-4-10, 1-5-9, 1-6-8, 2-3-10, 2-4-9, 2-5-8, 2-6-7, 3-4-8, 3-5-7, 4-5-6. **A:** biggest = smallest + 4 → only 3, 5, 7. **B:** two even and one odd, biggest divisible by 4 (4, 8 or 12), smallest divisible by 3 → only 3, 4, 8. **C:** all odd → 1-3-11, 1-5-9 or 3-5-7; middle more than 3 → 1-5-9 or 3-5-7; biggest divisible by 3 → 1, 5, 9. **D:** second = 4, first = 8, third = 3. (If the second nest is n , the first is $2n$ and the third is $2n - 5$; $n + 2n + 2n - 5 = 15$ gives $5n = 20$, $n = 4$.)

Each puzzle has exactly one answer; listing all 12 splits is a good strategy to show.

Card 4 — The count. Depends on the pile. The filled rectangle question leads to factor pairs; a pile that only makes $1 \times N$ is a prime number of chestnuts. If the pile is prime, ask: what is the smallest number of chestnuts to add or remove to get a square, or a rectangle with many shapes (24, 36)? Hollow square: the four corners are shared, so a side of 5 needs $4 \times 5 - 4 = 16$ chestnuts; in general $4n - 4$ (or $4(n - 1)$). Students who say 20 have counted the corners twice.

Card 5 — Magic triangle. Corners c_1, c_2, c_3 and sides: each side total $S = (21 + \text{corners}) \div 3$, so the corner sum must be 6, 9, 12 or 15 → $S = 9, 10, 11, 12$. Total 9: corners 1, 2, 3 (sides 1-6-2, 2-4-3, 3-5-1). Total 10: corners 1, 3, 5 (1-6-3, 3-2-5, 5-4-1). Total 11: corners 2, 4, 6 (2-5-4, 4-1-6, 6-3-2). Total 12: corners 4, 5, 6 (4-3-5, 5-1-6, 6-2-4). Extra: with 1–9 on a 4-per-side triangle, the possible side totals are 17, 19, 20, 21 and 23. Examples (going round the triangle, corners in bold): 17: 1, 4, 9, 3, 5, 7, 2, 6, 8 (corners 1, 3, 2). 20: 1, 3, 7, 9, 2, 4, 5, 6, 8 (corners 1, 9, 5). A systematic approach: 45 + corner sum must be divisible by 3.

Card 6 — Hidden cache. Tree 2 = n , Tree 1 = $2n$, Tree 4 = $3n$, Tree 3 = 2, Tree 5 = 1: $6n + 3 = 15$ → $n = 2$. Answer: 4, 2, 2, 6, 1. Students usually find it by trial; the algebra makes a good bridge to writing expressions.