NO PREP

Recipe Math

Scaling, Yield, and Conversions

Includes: Student reading, case study, differentiated questions, teacher key

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Name: Period: Date:

Recipe Math: Scaling, Yield, and Conversions

The Number That Runs Every Kitchen

Recipe math starts with yield, which is simply how much a recipe produces. A yield can be a count, such as twenty-four muffins, or a portion size and number, such as six servings at eight ounces. Yield is the anchor for every calculation that follows, because you cannot resize something without knowing its current size. In a school lab this usually means shrinking a recipe written for a family of six down to a two-person tasting portion, or multiplying a single batch to feed a class of twenty-eight. In a restaurant it means producing exactly what a service needs, since food produced beyond demand becomes waste and food produced short becomes a table that does not get fed. Yield also has to be honest about portion size. A recipe claiming eight servings that actually produces eight tiny servings has not really yielded eight, and a cafeteria planning from that number will run out. This is why professional recipes state both the total quantity and the portion: two quarts of chili, twelve six-ounce portions. Written that way, the recipe survives being handed to somebody

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The Conversion Factor Does the Whole Job

Scaling a recipe up or down uses one tool, and it is a single number called the conversion factor. Divide the yield you want by the yield you have, then multiply every ingredient in the recipe by that number. A recipe yields four servings and you

need six, so the factor is six divided by four, which is 1.5. Every quantity gets multiplied by 1.5: two cups of rice becomes three cups, one pound of chicken becomes a pound and a half, one teaspoon of salt becomes a teaspoon and a half. Scaling down works identically. A recipe yields twenty-four cookies but the lab needs twelve, so the factor is twelve divided by twenty-four, which is 0.5, and every ingredient is halved. The method never changes and it does not care whether the factor is a whole number. The one thing that trips students is fractions, since three quarters of a cup multiplied by 1.5 is not obvious in cup form. The fix is to convert awkward volumes into the smallest unit before multiplying. Three quarters of a cup is twelve tablespoons, and twelve times 1.5 is eighteen tablespoons, which converts back to one cup plus two tablespoons. Working in tablespoons or grams turns fraction problems into ordinary multiplication. There is one sanity check worth running after any scaling. Multiply your finished amounts back down by the reciprocal of the factor and see whether you land on the original recipe. It takes about ten seconds and it catches the single most common error, which is scaling most of the ingredients and forgetting one of them.

The Conversions Worth Memorizing

Scaling requires moving between units constantly, so a small set of equivalents is worth knowing cold rather than looking up. Three teaspoons make one tablespoon. Four tablespoons make a quarter cup. Eight tablespoons make a half cup, and sixteen make a full cup. One cup is eight fluid ounces. Two cups make a pint, two pints make a quart, and four quarts make a gallon. For weight, sixteen ounces make a pound. On the metric side, one thousand grams make a kilogram and one thousand milliliters make a liter, and because metric units move by powers of ten, scaling in metric is far less error-prone than scaling in cups. The trap that catches even careful students is the word ounce, which names both a volume and a weight. A fluid ounce measures space and an ounce measures mass, and they are only close for water. Eight fluid ounces of honey weighs about twelve ounces because honey is denser than water. This is why a recipe that says eight ounces of chocolate wants a scale, while eight fluid ounces of milk wants a liquid measuring cup. When a recipe is ambiguous, the ingredient itself usually settles it: solids are almost always specified by weight and liquids by volume. Rounding deserves a rule of its own. Scaled amounts rarely land on numbers a kitchen can actually measure, so cooks round to the nearest practical unit,

and the smaller the quantity the more careful that rounding has to be. Rounding two and a third cups of flour to two and a half is fine; rounding leavening or salt is not.

What the Conversion Factor Cannot Fix

Scaling ingredients is arithmetic, but scaling a recipe is a judgment call, because several things do not scale linearly and multiplying them anyway produces a bad result. Cooking time is the biggest one. Doubling a pot of soup does not double the simmering time, but it does mean the larger volume takes noticeably longer to come up to temperature in the first place. Doubling a cake batter absolutely does not mean doubling the bake time; it usually means using two pans, because a double batch in one pan gets a burned exterior long before the center sets. Pan size has to be recalculated rather than assumed, since a batter designed for one nine-inch round in a doubled batch needs two of them, not one deeper pan. Strong seasonings scale unevenly too. Salt generally does scale, but chile heat, garlic, and spices like clove or cinnamon tend to compound in large batches, so professionals scale them to about seventy-five percent of the calculated amount, taste, and adjust upward. Leavening in baked goods is the least forgiving, since baking soda and powder interact with acid and liquid in fixed ratios and a doubled batch that also doubles leavening can rise fast and collapse. The reliable rule is to scale ingredients by the factor, then reconsider time, pan, and seasoning by hand. Equipment capacity is the limit nobody writes into the recipe. A mixer bowl, a pot, and an oven each have a maximum, and a factor of six can produce a batch that physically will not fit or will not mix properly. Checking capacity before calculating saves recalculating afterward, and the answer is often simply to run two batches.

From Grocery Store to Plate: Yield Percentage and Cost

There is a second kind of yield that matters the moment money enters the picture, and it explains why a recipe calling for two cups of chopped onion requires buying more than two cups of onion. As purchased weight, abbreviated AP, is what you bring home from the store, skin and stem and all. Edible portion weight, or EP, is what remains after trimming, peeling, and coring. The relationship between them is the yield percentage: divide EP by AP and multiply by one hundred. Onions run roughly ninety percent, meaning a pound of whole onions gives about fourteen and a half ounces of usable onion. Pineapple runs closer to fifty percent, so half of what you pay for goes in the trash. To find how much to buy, you divide rather than multiply:

needing one pound of trimmed pineapple at fifty percent yield means purchasing two pounds. Cost per portion follows the same logic. Total the cost of every ingredient as purchased, divide by the number of portions the recipe actually yields, and that is what one plate costs to make. Restaurants price from that number, generally aiming to keep ingredient cost near a quarter to a third of the menu price, because the rest has to cover labor, rent, and everything else. Portion control is the enforcement side of all this arithmetic. Scoops, ladles, and portion scales exist so that the twelve six-ounce servings a recipe promises are actually twelve six-ounce servings. Without them the first plates go out generous and the last person in line gets whatever happens to be left in the pan.

Key Information: Recipe Math

Detail	Information
Yield	How much a recipe produces; state quantity and portion size
Conversion Factor	Desired yield divided by original yield
Scaling Rule	Multiply every ingredient by the conversion factor
Fraction Fix	Convert to tablespoons or grams before multiplying
Key Equivalents	3 tsp = 1 Tbsp; 16 Tbsp = 1 cup; 1 cup = 8 fl oz
Does Not Scale	Cook time, pan size, leavening, and strong spices
AP vs EP	As purchased is before trimming; edible portion is after
Yield Percentage	EP divided by AP times 100; divide by it to know what to buy

Case Study: Bianca Scales the Cornbread

Bianca's recipe yields one eight-inch pan of cornbread, eight servings, and her class needs twenty-four. She calculates the conversion factor correctly as twenty-four divided by eight, which is three, and triples every ingredient. Then she pours all of it into the largest pan in the lab, a single deep casserole dish, and sets the timer for the thirty minutes the recipe lists. At thirty minutes the top is dark brown and firm. She pulls it out, cuts into the middle, and finds raw batter. Her instructor asks what number she tripled besides the ingredients. "None," Bianca says. "I thought the factor covered everything." They talk through it and she rebakes the second attempt in three separate eight-inch pans, keeping the depth the same as the original recipe. All three come out done in thirty-two minutes with a clean toothpick. Her instructor writes two numbers on the board afterward: the conversion factor, which was three and correct, and the batter depth, which nobody had calculated at all.

1. Bianca's conversion factor was correct. Explain why her first cornbread still failed.

2. Using the reading, explain why three eight-inch pans worked when one deep pan did not.

Multiple Choice

1. A recipe yields 4 servings and you need 10. What is the conversion factor?

    a) 2.5, found by dividing 10 by 4

    b) 0.4, found by dividing 4 by 10

    c) 14, found by adding 4 and 10

    d) 6, found by subtracting 4 from 10

2. Which of these does the conversion factor NOT reliably scale?

    a) The number of eggs the recipe requires

    b) The amount of chicken stock called for

    c) The baking time and the pan size needed

    d) The amount of flour called for in the recipe

3. Pineapple yields about 50 percent. How much do you buy for 1 lb trimmed?

    a) 1 pound, because yield percentage applies only to cost

    b) Half a pound, because you multiply by the yield percentage

    c) 1.5 pounds, because you add half the yield percentage

    d) 2 pounds, because you divide by the yield percentage

Matching

Write the letter of the correct definition on the line next to each term.

Term	Definition
1. ___ Yield	A) The usable weight that remains after an ingredient has been trimmed
2. ___ Conversion factor	B) The weight of an ingredient before any trimming, peeling, or coring
3. ___ As purchased	C) Desired yield divided by original yield, multiplied across ingredients
4. ___ Edible portion	D) Edible portion divided by as purchased, expressed as a percentage
5. ___ Yield percentage	E) How much finished food a recipe produces, by count or by portion

Fill-in-the-Blank

1. Divide desired yield by original yield to get the _____.

2. Convert cups to _____ to avoid multiplying fractions.

3. Cooking time and _____ size must be rethought by hand.

Short Answer

Answer each question in 2-4 complete sentences.

1. Explain how to find the conversion factor and what you do with it once you have it.

_____

_____

_____

2. Explain why doubling a cake recipe does not mean doubling the baking time.

3. Explain why a recipe needing 2 cups of chopped pineapple requires buying more.