



# Baking STEAM: Measurements Matter

Temperatures  
Volume and Scale  
Liquid and Dry Ingredients  
Portions and Costs  
Food Labeling and Nutrition Facts  
+ + + + + + +

*For repeatable quality baking outcomes, measurement matters.*

Sharon Davis, FCS Education

[HomeBaking.org](http://HomeBaking.org)

Connie Nieman,

FCS Baking and Culinary Science



# Gracias      Vielen Dank      Merci      Thanks      Grazie

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## Partners:

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The Family Dinner Project  
Wheat Foods Council  
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# Essential Baking Measurements

*Accurate measurements assure **repeatable** quality, controlled costs and customer satisfaction.*

## Temperatures

- Ingredients (room temperature/cold/yeast)
- Oven (preheated; air flow and racks)
- Internal, finished product (Baking Food Safety)
- Storage (Ready to wrap? Ingredients, products)

## Ingredient Quantities – volume, weight (scale)

- Liquid
- Dry
- Pieces

## Portions

- Pre-baking (equal portioning, dividing, shaping)
- Sales (net weight; unit costing)
- Food labels, Nutrition Facts



Browned Butter Pumpkin Chocolate Chip Cookies  
*Baker's Spotlight, Lisa Pluff.*

## Baking Science:

### Why Bakers Condition Raisins

**Question:** What will happen if raisins are added to an Oatmeal Cookie without conditioning them?

**Hypothesis:** Without conditioning the raisins, the cookies will \_\_\_\_\_  
If the raisins are conditioned, the cookies will \_\_\_\_\_

### Lab Supply List:

- Ingredients for recipe, 1 recipe per lab team
- Electronic scales OR standardized dry measuring cups/spoons/level
- Hand-held or stand electric mixer
- Large mixing bowls
- Stirring spoons
- Wire cooling rack
- Spatulas
- Resealable plastic food containers or food bags (to hold 2 dozen cookies)

**Controls:** Each lab group should use the same:

- Ingredients for Oatmeal Raisin Cookies
- Ingredient temperatures (room temperature—68-70° F.)
- Type of mixer, mixing speed and length of mixing time
- Parchment pan liners OR ungreased cookie sheets
- Same type of shiny heavy baking cookie, jelly roll or half-sheet baking pans
- Baking temperature and length of time
- Cooling time and use of wire racks for cooling cookies
- Length of storage time in plastic container or bag
- Raisins purchased, same brand, same time, if possible taken from the same container.

**Variables:** Compare lab group outcomes based on:

1. Use of non-conditioned raisins
2. Use of conditioned raisins (see Oatmeal Cookie Recipe)
3. Adding 1 tablespoon water to recipe (Step #3) in place of conditioning raisins
4. Length of raisin conditioning time—condition, refrigerate overnight

[HomeBaking.org](http://HomeBaking.org)

### Oatmeal Raisin Cookie Freshness Grade

Use the following Freshness Grades to evaluate them:

- 1** = tender and moist   **2** = moderately moist  
**3** = crumbling/somewhat dry   **4** = very crumbly and dry

### Critical Thinking:

1. Cut samples of up to 1/3 of each lab's Oatmeal Raisin Cookies. Store the remainder in a sealed container at room temperature.
2. Sample again in 24 hours and again in 48 hours. Note the changes that you observe in the cookies between Lab #1, #2, #3 and #4 methods.
3. Give the cookies from each lab a Freshness Grade for fresh-baked, 24 hours, 48 hours.
4. What made the cookies begin to crumble if they were stored in a sealed package? (**A:** Unconditioned raisins are greedy for water, since they are only about 16-18% moisture. They continue to pull water from the baked cookie, causing them to dry out and get crumbly.)
5. Did adding the tablespoon of water help as much as conditioning the raisins? (**A:** No—raisins need their surface to be coated with water to begin hydrating.)

Baking Science Recipe, Lab Instructions page 7

### Oatmeal Raisin Cookies

Yields: 24 (1 oz/27g cookies) Preparation Time: 20 minutes Baking Time: 9-10 minutes

Ingredients	Measurement	Weight
Butter, softened	3/8 cup (6 T.)	3 oz/85g
Brown sugar, packed	1/2 cup	3.75 oz/106g
Granulated sugar	1/4 cup	1.75 oz/50g
Baking powder	1/2 teaspoon	2.5g
Baking soda	1/8 teaspoon	0.75g
Salt	1/8 teaspoon	0.75g
Ground cinnamon	1/8 teaspoon	2.25g
Ground nutmeg (optional)	1/4 teaspoon	1g
Egg, large	1	1.75 oz/50g
Vanilla extract	1/2 teaspoon	1.8g
Whole wheat flour	1/2 cup	2 oz/55g
All-purpose flour	3/8 cup (1/4 c. + 2 T.)	1.75 oz/50g
Rolled oats, quick or old fashioned	1 cup	1.75 oz/50g
Raisins, loosely packed*	1 cup	5.25 oz/140g

\*Condition raisins: Measure out raisins needed for recipe.

Cover raisins in tap water (80° F) for 5 to 10 minutes; drain off water.

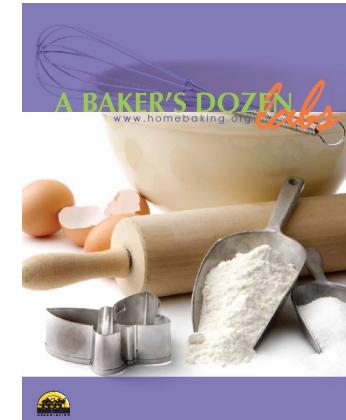
**Directions:**

1. Line baking sheet pans with parchment paper OR leave ungreased. Preheat oven to 375° F.
2. In a large mixing bowl, cream the butter with an electric mixer on medium high speed for 45 seconds. Add the brown and granulated sugars, beating until combined. Add the baking powder, baking soda, cinnamon and optional nutmeg. Beat until well combined.
3. Beat in egg and vanilla for 2 minutes.
4. Stir in flours, oatmeal and conditioned raisins until combined.
5. Drop or scoop in rounded teaspoonsfuls, placing 2 inches apart on the ungreased or parchment-lined baking sheets. Bake at 375° F. for 9 to 10 minutes—until edges are golden.
6. Cool the cookies on the cookie sheet for 2 minutes, placing the pan on a wire cooling rack. Use a spatula to remove the cookies from the pan and onto the wire rack.
7. Cool completely before transferring cookies to a resealable container or plastic food bag. Stack with a sheet of waxed paper between the cookie layers to prevent sticking together.

Recipe courtesy of Kansas State University Extension FNP, [kidsacookin.org](http://kidsacookin.org)

# Critical Thinking:

1. Identify **all** critical measurements in the formula.
2. Ingredients, oven, internal doneness, portion size,?
3. What internal temp is cool enough to wrap?
4. What temperature is best to store baked goods so they don't stale?



# Measuring Temperatures

## Baking Food Safety

- Use thermometers in fridge and oven (cold enough/hot enough)
- Bake fully so there is no raw batter, dough and final products are quality.
- Take out guess work- take internal temperatures– see chart.
- View videos, Flour Food Safety Did You Know? and Quality Baking Temperatures.
- Access great thermometers for refrigerator, oven and temping baked goods!

### Baking Food Safety 101



#### 6 Simple Baking Food Safety Steps

*Find a complete Baking Food Safety Checklist on the back.*

- 1 **STORE** raw flour, baking mixes, dough and eggs separately from ready-to-eat foods.
- 2 **BEFORE BAKING**, tie back long hair, clean counters, assemble ingredients and equipment, wash hands, and apron-up.
- 3 **KEEP SEPARATE** the measuring, mixing and handling of unbaked batter or dough from cooling, serving and packaging of baked products.
- 4 **TEST** baked products with wooden toothpick or cake tester and food thermometer at center to ensure products are completely baked.
- 5 **CLEAN** tools, work surfaces and equipment with hot, soapy water or in dishwasher.
- 6 **WASH HANDS** before you taste, serve or package baked goods.

#### Baked Goods Internal Doneness Temperatures

Maximize quality and confirm products are fully baked by reaching these at-center temperatures:

150°F	160°F	165°F	170°-175°F	190°-210°F	200°-209°F
 Cheesecakes <i>(Remove from oven at 150°F to avoid cracking; temperature should rise to 160°F as it cools)</i>	 Quiche Meringue pies Bread pudding Baked custard Clafouti Molten chocolate cakes	 Stuffing & casseroles Leftovers Chocolate cream pie Meat-, cheese- or poultry-filled breads <i>(Empanadas, pot pies, pasties, catzines, bierocks)</i>	 Custard pies Fruit pies Flan Crème brûlée	 Yeast breads <i>(Soft rolls 190°F Crusty bread 210°F)</i>	 Most cakes <i>(Pound cake 210°F Cupcakes Quick breads Scones Biscuits Pecan pie)</i>

*DING!* When oven timer indicates product is done, take an internal temperature at the center of the product.

**After baking:** Cool product on wire rack. Wash hands before handling products. Refrigerate egg-rich, cream- or meat-filled baked goods within two hours of baking. Yeast breads are best stored at room temperature or frozen if not eaten in one day.



**Baker's Bottom Line for Food Safety:** Raw flour, baking mixes, batter and dough are not ready-to-eat. Flour, as well as eggs, must be thoroughly cooked or baked before eating to prevent illness from bacteria in the flour. Wash hands, utensils, and surfaces after mixing and handling batter or dough.

**HomeBaking.org**



# Quality Baking Temperatures

Chef Martin Earl, [Thermoworks.com](https://Thermoworks.com)



# Ingredient Measurement: Volume or Scale?

How MUCH Difference Does it Make?

Teaching strategy: Scoop, Spoon, Scale.



**Subject:** Baking Measurements

**Activity:** Scoop, Spoon, Scale — Compare and evaluate dry measuring methods for accuracy.

**Resources Required:** One 5-lb bag flour—half left in bag, half in large bowl  
Stirring spoon; straight-edged scraper; electronic scale; mixing bowl  
Two, 1-cup dry measuring cups; one, 1-cup liquid measuring cup

**Introduction:** To get the same great product each time, how you measure matters. Compare and evaluate dry ingredient measuring methods for accuracy and impact on results.

**Directions:** Have three volunteers each measure 1 cup of the same flour, each using a different method.  
Weigh each cup of flour in a zero-balanced bowl on the scale.

Volunteer #1: Large bowl, spoon: Stir flour with spoon to loosen; lightly spoon flour into the 1-cup dry measuring cup until heaping full. Level off the flour using straight edge.

Volunteer #2: Scoop flour out of bag with 1-cup dry measuring cup; shake to "level"

Volunteer #3: Large bowl: Scoop flour with 1-cup liquid measuring cup, shake to level

**Evaluate:** What are the differences in weights between the three methods? What method do test kitchens and professional bakers use? (A: Method #1 and/or scales; 1 cup all-purpose or whole wheat flour = 4.25 oz)

**Extra Minute?** How much extra flour will you have if you use the method to measure 3 cups flour for bread?  
How will the extra flour impact the recipe's result? (A: heavy, dry, crumbly)

View "How to Measure Flour"  
1-minute video at [HomeBaking.org](http://HomeBaking.org)  
Glossary, Flour.



MINUTE ACTIVITIES

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# Scaling is more accurate than measuring cups



There are 6 ounces of water in each.  
The cup on the left looks fairly accurate.  
The one on the right? Not so much.  
By weight, there is no guessing.



Levelheaded Measurement

A 5-Minute liquid measurement activity.



# Measuring tools, methods and skill vary.



King Arthur Picture

**Dry measuring cups** more likely to be accurate than liquid measuring cups.

- Use the correct type for measuring dry ingredients.

**Method matters.** Do you scoop and tamp? Level off the top, or just give it a shake?

- Difference: 2 tablespoons between cocoa in cup on left, and one on right.  
How much does 2 T. weigh? What difference will it make in outcome?

# Teach Both Accurately

...but weighing ingredients saves time, more accurate.

## By Volume: (Test Kitchen method)

1. Dry: Spoon lightly-fill required *DRY* measuring cups with ingredients. Level off.  
Exception: Brown sugar is packed (like a sand for sand castles).  
Liquids: *LIQUID* cup on flat surface, eye-level fill
2. Scrape or pour contents into mixing bowl.

## By Weight:

1. “Zero” out (tare) bowl weight.
2. Scoop ingredient directly from container into mixing bowl.
3. Zero out; add next ingredient by weight...zero, etc.

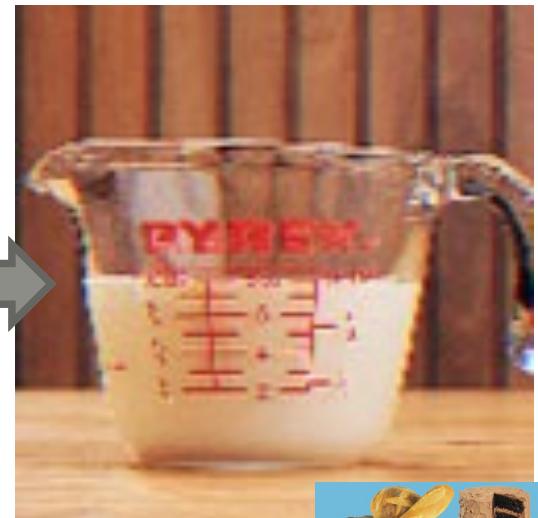


Photo: King Arthur Baking

Access chart of [weights for ingredients](#).

# Teach Accurate Liquid Measurement Methods

- Volume method AND scale
- Use a *liquid* measuring cup
- Test cup for accuracy- Scale 8 oz water
  - Place measuring cup on flat surface
  - Fill measuring cup to appropriate mark on cup
  - Does it = 1 cup?



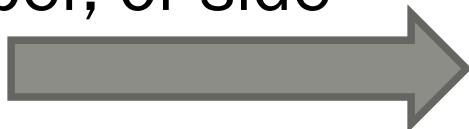
# Accurate dry measuring(spoons)

- Dip spoon into ingredient and aerate(stir)
- Level off spoon with offset spatula or side of container



# Accurate dry measuring (cups)

- Use dry measuring cup
- Stir flour with spoon or whisk to aerate
- Use a scoop or spoon and lightly fill dry cup to heaping
- Level off with offset spatula  
baker's scraper, or side  
of container



View how: HomeBaking.org; chsugar.com; dominosugar.com;  
KingArthurFlour.com

# Best: Digital scale use



- Place bowl on scale
- Press tare button to zero out the scale
- Be sure scale is set to measure oz not g (or as needed)
- Place item to be weighed in the bowl
- Watch digital read out for desired weight

Identify Tare button



HBA, Bakers Dozen Labs; Smart Snack recipes  
Provide both home and culinary measurements  
[KingArthurFlour.com](http://KingArthurFlour.com), both options

# Become an R&D Test Kitchen

- Students need to measure in ways so can bake at home to save food costs, contribute to family.
- Support skills that explore new recipes, ideas, ingredients.
- Do R&D lab work...quantify recipes in weights; create a control recipe, then R&D one ingredient change at a time.
- Accurate measurement skills in all three categories builds bridge from consumer and career skills.



## Oatmeal Jam Bars

Prep: 15 minutes | Cook: 35-40 minutes | Servings: 12

### Ingredients

- ½ cup packed brown sugar
- ¾ c. to 1 cup whole wheat flour
- ¼ teaspoon baking soda
- 1/8 teaspoon salt
- 1 cup rolled oats
- ½ cup butter, softened
- Use scant 2/3 cup seedless raspberry jam, or other jam of choice

### Nutrition Facts

Serving Size (53g)	Calories from Fat 70
Total Fat 8g	12%
Saturated Fat 5g	25%
Trans Fat 0g	
Cholesterol 20mg	7%
Sodium 55mg	2%
Total Carbohydrate 32g	11%
Dietary Fiber 2g	8%
Sugars 20g	
Protein 3g	
Vitamin A 6% • Vitamin C 0%	
Calcium 2% • Iron 6%	
*Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs.	
Calories: 2,000	2,500
Total Fat Less than 65g	80g
Saturated Fat Less than 20g	25g
Cholesterol Less than 300mg	400mg
Sodium Less than 2,400mg	2,400mg
Total Carbohydrate 300g	375g
Dietary Fiber 25g	30g
Calories per gram:	
Fat 9 • Carbohydrate 4 • Protein 4	

### Directions

1. Preheat oven to 350 °F, grease one 8-inch square pan.
2. Combine brown sugar, flour, baking soda, salt and rolled oats. Rub in the butter using your hands or a pastry blender to form a crumbly mixture.
3. Press 2 cups of the mixture into the bottom of the prepared pan. Spread jam over the mixture to within ¼ inch of the pan edge.
4. Sprinkle the remaining crumb mixture over the top, and lightly press it into the jam.
5. Bake for 35 to 40 minutes or until lightly browned. Allow to cool before cutting into bars.
6. Cut the bars into the number of servings (12) on the recipe to meet the net weight (53g/2oz) on the Nutrition Facts Label.



Texas Wheat Producers Board and Association  
5405 W I-40, Amarillo, TX 79106  
www.texaswheat.org  
www.facebook.com/texaswheat



**A Baker's  
Dozen  
Smart Snack  
Baking  
Recipes**



Child Nutrition & Wellness, Kansas State Department of Education  
in collaboration with the non-profit Home Baking Association



## Oatmeal Whole Wheat Fruit Bars

Ingredients	12 Servings		48 Servings		Directions
	Weight	Measure	Weight	Measure	
Flour, whole wheat	4.25 oz	1 cup	14.8 oz	3 ½ cups	1. Preheat conventional oven to 350° F or convection oven to 325° F.
Rolled oats	3 oz	1 cup	10.5 oz	3 ½ cups	2. Line pan(s) with parchment (or spray/grease pan). Use one 8 X 8" square pan for 12 servings or one 13 X 18 X 1" half sheet pan for 48 servings.
Sugar, brown, packed	3.8 oz	½ cup	13.3 oz	1 ¼ cups	3. In large bowl, thoroughly combine flour, oats, brown sugar, baking soda, and salt.
Baking soda		¼ tsp		1 tsp	4. Stir in vegetable oil, melted butter, and milk. Mix to form a crumbly mixture.
Salt		½ tsp		½ tsp	5. Press about ⅓ of the crumb mixture (about 1 ½ cups for 12 servings or about 6 cups for 48 servings) evenly and firmly into the bottom of the prepared pan(s).
Oil, vegetable	1.9 oz	¼ cup	6.25 oz	¾ cup	6. Spread fruit spread on top of the crumb base in pan(s). (*IF using substitute option of a pureed fruit mixture instead of fruit spread, bake the base 5 minutes before spreading fruit on top.)
Butter, unsalted, melted	1 oz	2 Tbsp	3.5 oz	7 Tbsp	7. Sprinkle remaining crumb mixture evenly over fruit spread. Lightly press the crumbs into the spread.
Milk, 1%		1 Tbsp	2 oz	¼ cup	8. Bake for 35-40 minutes or until lightly browned.
100% Fruit Spread*	7.5 oz	Scant ⅔ cup	1 lb 8 oz	2 ¼ cup	9. Allow to cool on wire rack before cutting into bars or squares.
					10. Cut 8 x 8" pan into 12 pieces (3x4) or 13 x 18" pan into 48 pieces (6x8)

\*Substitute options – Dried fruit simmered in minimal water until soft enough to puree; cool or refrigerate until used.

Download at [www.HomeBaking.org/recipes/](http://www.HomeBaking.org/recipes/)



# Weighing = Less Clean-up



**Weighing = no cleanup of messy  
measuring cups.  
None.**



# Portion Measurements: Accurate food scoops help... Weighing batter or dough ensures consistent size



Critical Thinking: Do your students nail the size of each muffin every time?  
(Who does? ☺)

Do you end up with some pitiful and dry muffins and some mushroom-capped and spilling over in the same pan?

- Name 3 to 5 reasons this matters.

# Weigh Batter or Dough for Number of Portions

1. Know **the weight of your mixing bowl** before you start.
2. Once you've mixed up your batter, **put the bowl on the scale** and weigh it.
3. Subtract the weight of the bowl, to **establish the weight of the batter**.
4. Do some simple arithmetic: **divide the weight of the batter by the number of portions the recipe calls for** (e.g., 12 muffins; 24 cupcakes; 2 round cake layers).
5. **Scoop out that amount of batter** for each muffin (or cake layer, etc.)

# Results = Consistent Size, Nutrient Facts, Cost, Baking Time/Temperature

Bakers cannot afford to give away product.

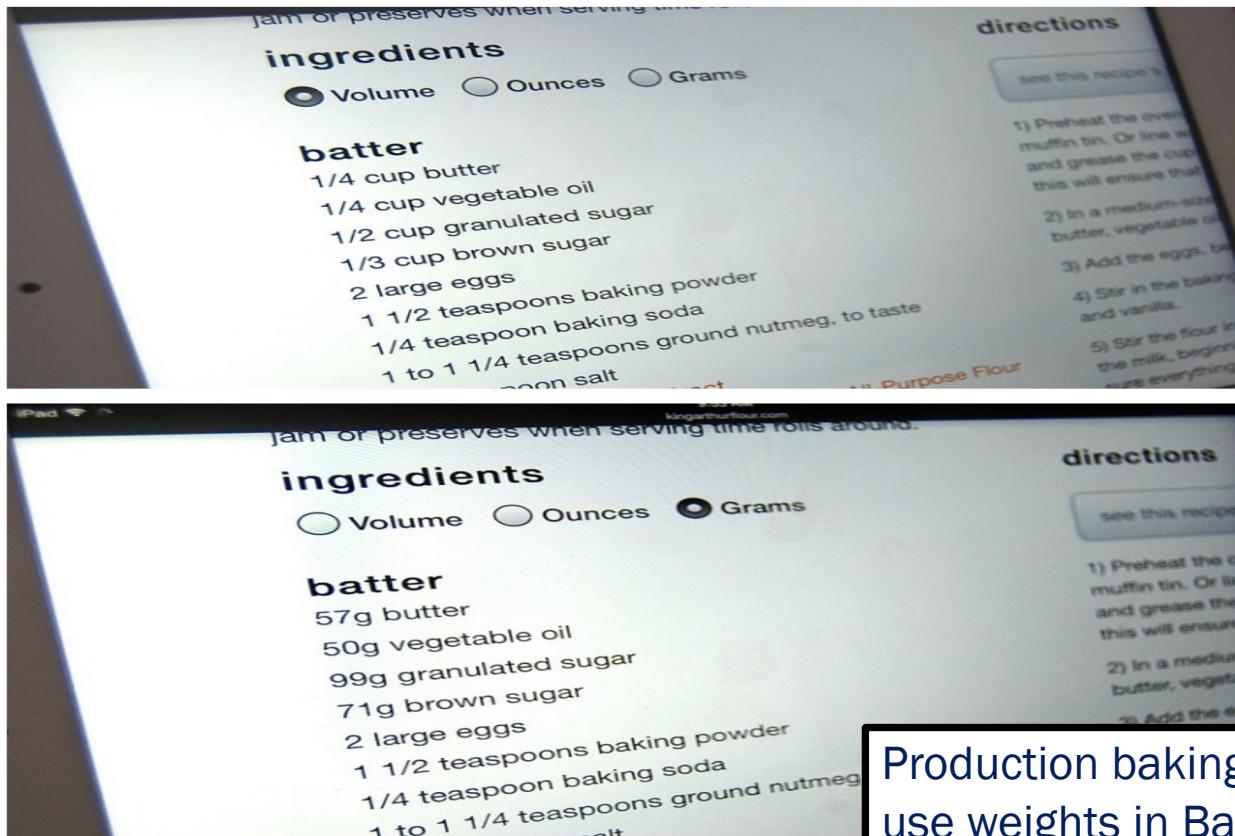
Scrape bowls.

Determine # of sellable products per batch.

Evaluate customer's price point for size.



# Weighing Makes It Easier To Increase Or Decrease Recipe Size



King Arthur Flour Picture (above)

Production baking formulas use weights in Baker's Percentages.

[View video What is Baker's Percentage? | King Arthur Baking](#)

# Measurement = Value-added Baking

*Scale dough for repeatable shaping and sales.*

## Dough Sculpting 101

Check out this new online resource directly from the HBA!

Featuring many fantastic recipes and resources!

more info ➔

The Tortoise and the Hare Youth Educator Award Winner

**HOME BAKING ASSOCIATION**  
HomeBaking.org

Free Downloadable Lesson [HomeBaking.org](http://HomeBaking.org)



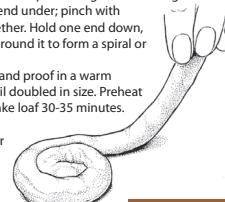
Demonstration DVD. [HomeBaking.org/shop/](http://HomeBaking.org/shop/)

### Loaves and Braids

For these shapes, use a one to 1 1/4 lb/565g piece of the Refrigerator Potato Dough or a favorite sweet yeast dough recipe.

#### Snail – Traditional Pao Doce shape

1. Grease one, 9 x 1 1/2-inch round baking pan per 1 to 1 1/4 lb. dough piece.
2. Roll one dough piece into a 25 x 1 1/2-inch dough rope. Starting in center of pan, twist the rope of dough while coiling it into a snail shape. Tuck the end under; pinch with fingers to seal together. Hold one end down, then wind the other around it to form a spiral or snail shape.
3. Cover shaped dough and proof in a warm (95°–105° F) place until doubled in size. Preheat oven to 350° F. and bake loaf 30–35 minutes.



Options: Tuck currants or snipped raisins into the snail while shaping.

#### Wreath

1. Pinch three 7 oz., 25-inch ropes of dough together at one end, and lay out as shown.
2. Take the left outside rope and lay it at the inside of the right two strands. Next take the right outside rope and move it to the inside left. Repeat the process, moving the outside piece of dough to the inside of the opposite side, until all dough is braided.
3. Pinch ends together to seal. Cover and proof; bake at 350° F., 25–30 minutes.



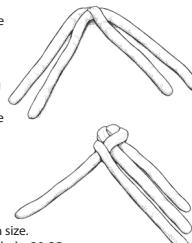
#### EGG WASH

Just before baking, whisk 1 egg + 1 Tablespoon cold water and brush over surface for a shiny coat.



#### Four-Strand Braid

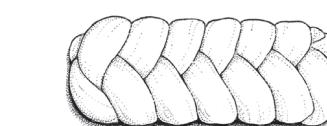
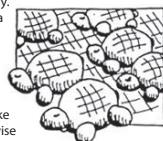
1. Divide 1 1/4 lb/565g piece of dough into four equal (4-5 oz.) ropes, each 14 inches long.
2. Pinch the four ropes of dough together at one end and lay out as shown.
3. Take the left outside rope and lay it at the inside of the right two strands. Next take the right outside rope and move it to the inside left. Repeat the process, moving the outside piece of dough to the inside of the opposite side, until all the dough has been used. Pinch ends together to seal.
4. Place on a greased or lined baking sheet pan. Cover lightly with sprayed plastic wrap. Proof until doubled in size. Preheat oven to 350° F. and bake 30–35 minutes until golden and 210° F. at center.



#### Critters

##### Turtles

1. For each turtle: form a large egg-sized piece of dough into a smooth ball.
2. Place on a lightly greased baking sheet and flatten slightly with hand.
3. Add a small piece of dough for head, four smaller pieces for legs, and an even smaller piece for a tail. Tuck the pieces slightly under the edge of the body.
4. Pinch end of tail and legs to form a point. Press well to seal into position.
5. With kitchen scissors, clip into head dough piece to form eyes and mouth. Insert raisins for eyes.
6. With a serrated or sharp knife, make shallow cuts lengthwise and crosswise across "shell" to form the turtle's markings.
7. Cover and let proof until double. Preheat oven to 400° F. Brush with egg wash if desired. Bake for 15–18 minutes or until golden. The turtle should sound hollow when tapped.



*Snail, Four-Strand Braid and Wreath illustration source: The King Arthur Flour Baker's Companion, The Countryman Press, 2003, kingarthurflour.com  
How-to-shape these breads is found on Dough Sculpting 101 DVD*

*Critters illustration source and how-to videos for turtles and alligators, Fleischmann's Yeast, breadworld.com/education/Recipe-Videos*

# Demonstrate: Volume and Scale



1. Teach **test kitchen methods** for both volume and scaling ingredients, portioning, product net weight.
2. Use standard, affordable, measuring tools—thermometers, digital scale and volume tools- to *not discourage students to bake on their own.*
3. Skill Strategy- Using test kitchen volume measurement, define weights for a favorite recipe (standardize/quantify). Test these weights; re-test.

## Max's Banana Nut Bread

Makes One 8 X 4 ½ in loaf

OR One dozen medium muffins

### Ingredients

½ cup (4 oz/113g) butter  
1 cup (7 oz/200 g) granulated sugar  
2 large eggs (2 oz/56g)  
3 large bananas (weight? volume?)  
1 teaspoon vanilla  
1 teaspoon soda  
¼ teaspoon salt (if butter is unsalted)  
2 cups (8.25 oz/235g) whole white wheat flour  
1 cup (4 oz/120g) toasted pecans, break in pieces  
Bowl weight: \_\_\_\_\_  
Total batter weight: \_\_\_\_\_

# Accurate Measurements=Customer Satisfaction



Thank YOU! Visit us for much more at [HomeBaking.org](http://HomeBaking.org)