



Lesson Plan

Unit 4: Lesson 1 of 1

Math in Food Science

Created: 08/2022 by the National FFA Organization

The purpose of this lesson is to introduce students to the mathematical concepts used in food science. The lesson will provide students with knowledge on how to complete the “math practicum” portion of the National FFA Food Science and Technology CDE.

Student Learning Objectives:

After completing these activities, students will ...

1. Identify conversion factors in food science.
2. Describe the importance of conversion factors in food science.
3. Calculate conversions in food science.

Suggested Grade Level:

Grades 9 and 10 (This lesson is written so instructors can scale up or down based on class needs.)

Suggested Time: 90 to 120 minutes (*Time requirements may vary based upon student understanding and class schedule.)

Resources/References:

1. Website: Extended Learning Reference, <https://www.youtube.com/watch?v=qzr82EuiJu0&t=56s>
2. Textbook: *Principles of Food Science*, 4th Edition, Janet D. Ward (Facts/information in this lesson were obtained from the textbook.)

Related Resources:

1. PDF: “[USDA Food Safety Inspection Manual](#)” (Provides mathematical conversion chart as approved by the USDA.) Also, included [here](#).

Equipment and Supplies Needed:

1. “Measuring, Reference Chart and Terminology” handout (found at the end of this lesson)
2. Activity 1:
 - a. Various sizes of graduated cylinders and beakers; balance/scale in grams; rulers/tape measures in metric units
 - b. It is recommended to create stations for this activity and allow students to move station to station. Determine how much of what equipment is needed to circulate students for the activity. Items needed: pencils, drinking mugs, refrigerated beverage, access to hot tap water, student shoes
 - c. One copy of the “Estimating Metric Measurements” worksheet per student (found at the end of this lesson)
3. Follow-up:
 - a. One copy of the “Metric Units and Converting Recipes” worksheet per student
4. Exit Ticket: “Unit 4 Assessment” exam (attached to this lesson)
5. One copy of the “Unit 4 Assessment” per student
6. Calculators, one/student for use on the Unit 4 Assessment

Lesson Preparation:

1. Before the lesson: Be sure to have all items needed for Activity 1: Estimating Metric Measurements (see Equipment and Supplies Needed section).

Vocabulary:

1. International System of Units
2. Replicable
3. Mass
4. Gram (g)
5. Kilogram (kg)
6. Weight
7. Length
8. Meter
9. Volume
10. Liter (L)
11. Celsius
12. Fahrenheit

Cross-Curricular Connections:

Science	English/Language Arts	Technology	Mathematics
Students will determine scientific weights and measures.	Students will practice proper grammar and writing through Activity 1, the Follow-up and the Exit Ticket/Assessment.	Students will utilize the internet and electronic devices with internet to seek information needed in Activity 1.	This entire lesson is math focused. Students will be challenged to practice math skills in Activity 1, the Follow-up and the Exit Ticket/Assessment.

Virtual Instruction Ideas:

This entire lesson could be taught virtually. The teacher needs to make sure students have access to the common materials listed in the Equipment and Supplies Needed section of the lesson plan. All worksheets can be shared electronically with students, if needed. It is recommended to require virtual-learning/online students to use a camera on their computer when completing this lesson to prevent cheating behavior.

Student Activity Sheets:

Direct access to student activity sheets without lesson plan or answer key for easy upload to a learning management system or printing for classwork.

<https://ffa.box.com/s/lheuyfkwbbsu5otne3bnalliv3lwwsewh> (Word)

<https://ffa.box.com/s/es3d3dunuxnfx180x12yx6kffyuf052w> (PDF)

<https://ffa.box.com/s/qpl5q3kvmipikzkwj750zavpn2pm03wp> (Non-Designed)

<https://docs.google.com/document/d/1TxIfPhBWUJqV8H-5IAMjgWMYt99NGWw239-50ayDnWs/copy> (Google)

These Activities are Aligned to the Following Standards:

FFA Precepts

- FFA.PL-A.Action: Assume responsibility and take the necessary steps to achieve the desired results, no matter what the goal or task at hand.
- FFA.PL-C.Vision: Visualize the future and how to get there.
- FFA.PG-J.Mental Growth: Embrace cognitive and intellectual development relative to reasoning, thinking and coping.
- FFA-CS-M.Communication: Effectively interact with others in personal and professional settings.
- FFA-CS-N.Decision Making: Analyze a situation and execute an appropriate course of action.

Common Core – Reading: Informational Text

- CCSS.ELA-Literacy.RI.9-10.1 Cite strong and thorough textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text.

Common Core – Writing

- CCSS.ELA-Literacy.W.9-10.2 Write informative/explanatory texts to examine and convey complex ideas, concepts, and information clearly and accurately through the effective selection, organization, and analysis of content.

Common Core – Speaking and Listening

- CCSS.ELA-Literacy.SL.9-10.1.C Propel conversations by posing and responding to questions that relate the current discussion to broader themes or larger ideas; actively incorporate others into the discussion; and clarify, verify, or challenge ideas and conclusions.
- CCSS.ELA-Literacy.SL.9-10.4 Present information, findings, and supporting evidence clearly, concisely, and logically such that listeners can follow the line of reasoning and the organization, development, substance, and style are appropriate to purpose, audience, and task.

Common Core – Science & Technical Subjects

- CCSS.ELA-Literacy.RST.9-10.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.
- CCSS.ELA-Literacy.RST.9-10.7 Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.

Common Core – Literacy in Science & Technical Subjects: Writing

- CCSS.ELA-Literacy.WHST.9-10.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
- CCSS.ELA-Literacy.WHST.9-10.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes

Common Core – Math Practices

- CCSS.MATH.PRACTICE.MP1 Make sense of problems and persevere in solving them.
- CCSS.MATH.PRACTICE.MP3 Construct viable arguments and critique the reasoning of others.
- CCSS.MATH.PRACTICE.MP6 Attend to precision.

AFNR Career Ready Practices

- CRP.02. Apply appropriate academic and technical skills. Career-ready individuals readily access and use the knowledge and skills acquired through experience and education to be more productive.
- CRP.04. Communicate clearly, effectively, and with reason. Career-ready individuals communicate thoughts, ideas and action plans with clarity, whether using written, verbal and/or visual methods.
- CRP.05. Consider the environmental, social and economic impact of decisions. Career-ready individuals understand the interrelated nature of their actions and regularly make decisions that positively impact and/or mitigate negative impact on other people, organizations and the environment.
- CRP.06. Demonstrate creativity and innovation. Career-ready individuals regularly think of ideas that solve problems in new and different ways, and they contribute those ideas in a useful and productive manner to improve their organization.
- CRP.07. Employ valid and reliable research strategies. Career-ready individuals are discerning in accepting and using new information to make decisions, change practices or inform strategies.
- CRP.08. Utilize critical thinking to make sense of problems and persevere in solving them. Career-ready individuals readily recognize problems in the workplace, understand the nature of the problem, and devise effective plans to solve the problem.
- CRP.09. Model integrity, ethical leadership and effective management. Career-ready individuals readily recognize problems in the workplace, understand the nature of the problem, and devise effective plans to solve the problem.
- CRP.11 Use technology to enhance productivity. Career-ready individuals find and maximize the productive value of existing and new technology to accomplish workplace tasks and solve workplace problems.

Partnership for 21st Century Skills

- Critical Thinking and Problem Solving
- Flexibility and Adaptability
- Implement Innovations
- Information Literacy
- Productivity and Accountability
- Think Creatively

Lesson Plan:

1. Bell Ringer:

- As students enter the room, have the following written on the board/overhead: "You are making a cake that is required to bake at 425 degrees Fahrenheit. What is this in degrees Celsius? You cannot use your computer or electronic device to search the answer."
- Once all students are in the classroom and the bell rings, read the question out loud and ask for a student volunteer to answer.
- Share with students: " $32^{\circ}\text{F}=0^{\circ}\text{C}$ " therefore " $425^{\circ}\text{F}=218^{\circ}\text{C}$."
- Lead into a discussion on why it is important to know how to convert metric units.

2. Introduction:

- Ask students, *Why would conversion from Fahrenheit to Celsius be important?* Allow time for students to respond. *In food science, we use the metric system. Anyone know why?* (Wait for responses.) *It is commonly recognized across the world. Scientists working all over the world share information and data. We need a common method that everyone knows.*
- Tell students: *All units in the metric system are divisible by 10. The international version of the metric system is called the International System of Units, which may be written as SI.*
- Say to students: *Raise your hand if you really enjoy doing math. You may enjoy a career in food science research because researchers and scientists use math daily in their lab work. Remember, any lab they conduct must be replicable, which means someone else is able to perform the same lab and obtain the same results. This makes it important that they record every step of their process. For an experiment to be scientific, it must be replicable.*
- Tell students: *In today's food science lesson, we are going to learn how food scientists conduct experiments and what units of measure they use, and we are going to practice converting measurements. Before we get started on the fun part, we need to know a bit of information first.*
- Give each student the worksheet titled "Measuring Reference Charts and Terminology." Have students take turns reading the information.
- Tell students: *Now we are going to get some practice using the terminology and figures!*
- Give each student a copy of the worksheet "Estimating Metric Measurements."

3. Activity: Estimating Metric Measurements

- Share with students: *This activity will allow you to practice your estimating skills. It is important to have a rough idea of what result to expect when conducting experiments because it can alert you to errors along the way. For science, we have to convert our English measurements to metric. You will use all metric units for this activity.* Read directions with students. Be sure to ask for any questions prior to students starting. Allow students a few minutes to complete their estimates before getting out of their seats to conduct accurate readings.
- Allow students to conduct measurements. Be sure to move about the classroom while students are moving to ensure that everyone is on task.
- Teachers may wish to review results/findings with students at the conclusion of the activity. This activity may be collected for participation points as well.

- Follow-up:** Give each student the worksheet titled "Metric Units and Converting Recipes." Read directions with students. Allow students to use the internet to complete the worksheet. It is recommended to review the correct answers with students when all students are finished. Direct students to work on the Extended Learning Opportunities, as listed below, once they finish the worksheet. This worksheet may be collected as participation points; be sure students get it back so they have it as a study reference.

5. Optional – Extended Learning Opportunities (Not factored into time requirement):

- How to measure wet and dry ingredients:
<https://www.youtube.com/watch?v=qzr82FuiJu0&t=56s> (4:35 min)
- Have students select a recipe of their choice and convert the measurements into metric. Then have them make the recipe.

6. Exit Ticket/Unit Assessment:

- The Unit 4 Assessment will serve as the exit ticket for this lesson. Be sure to allow students at least 20 minutes to complete the unit assessment. Distribute the assessment to students when finished with this lesson plan (if time allows in the same class period).

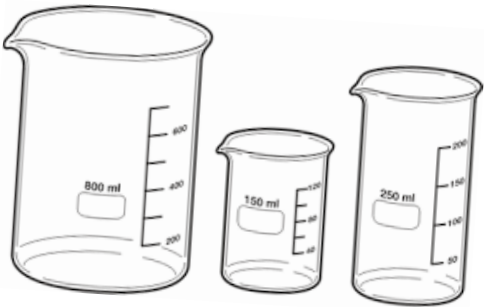
Aligned to the following standards: FFA.PL-A; FFA.PL-C; FFA.PG-J; FFA-CS-M; FFA-CS-N; CCSS.ELA.RI.9-10.1; CCSS.ELA.W.9-10.2; CCSS.ELA.SL.9-10.1.C; CCSS.ELA.SL.9-10.4; CCSS.ELA.RST.9-10.3; CCSS.ELA.RST.9-10.7; CCSS.ELA.WHST.9-10.4; CCSS.ELA.WHST.9-10.2; MP1; MP3; MP6; CRP.02; CRP.04; CRP.05; CRP.06; CRP.07; CRP.08; CRP.09; CRP.11

Estimating Metric Measurements

Directions:

Estimate the value requested for each item listed. Once you have recorded your estimate, you will measure the actual value using the appropriate equipment. Be sure to include the proper measurement symbol (Ex. g=gram, L=liter).

Item	Estimated Value	Actual Value
Length of your arm and hand		
Length of a pencil		
Mass of 1 pencil		
Mass of your shoe		
Volume of a mug		
Volume of a soup spoon		
Temperature of a cup of hot tap water		
Temperature of a beverage from the refrigerator		



Directions:

Answer the following reflection questions.

- For which items were your estimates most accurate? Least accurate?
- Why do you think some measurements were easier than others?

Name: _____

Metric Units and Converting Recipes

Directions:

Using the information below, and the internet, fill in the blanks with the correct unit (grams or lbs, etc.):

Measurement	Metric System	English System
Mass		
Volume		
Temperature		
Length		

- Calculate the temperature conversions below using the following equations. Round answers to the nearest whole number. Do not use the internet. You must calculate these with a calculator only!
 - How to convert °C to °F: $^{\circ}\text{C} = (^{\circ}\text{F} - 32) \times \frac{5}{9}$
 - How to convert °F to °C: $^{\circ}\text{F} = (\frac{9}{5} \times ^{\circ}\text{C}) + 32$

- Boiling point of water: $100^{\circ}\text{C} = \underline{\hspace{1cm}}^{\circ}\text{F}$
- Normal body temperature: $98.6^{\circ}\text{F} = \underline{\hspace{1cm}}^{\circ}\text{C}$
- Average room temperature: $68\text{--}72^{\circ}\text{F} = \underline{\hspace{1cm}}^{\circ}\text{C}$
- Freezing point of water: $0^{\circ}\text{C} = \underline{\hspace{1cm}}^{\circ}\text{F}$
- Common baking temperature: $350^{\circ}\text{F} = \underline{\hspace{1cm}}^{\circ}\text{C}$
- The food "Danger Zone:" $40\text{--}140^{\circ}\text{F} = \underline{\hspace{1cm}}^{\circ}\text{C}$

*Using the "Measuring Reference Charts and Terminology" worksheet you were given, complete the following. Do not Google or otherwise use the internet!

Ingredient	Metric Equivalent (ml)
2 tablespoons milk	
2 cups chocolate chips	
2 $\frac{1}{4}$ cups flour	

Aligned to the following standards: FFA.PL-A; FFA.PL-C; FFA.PG-J; FFA-CS-M; FFA-CS-N; CCSS.ELA.RI.9-10.1; CCSS.ELA.W.9-10.2; CCSS.ELA.SL.9-10.1.C; CCSS.ELA.SL.9-10.4; CCSS.ELA.RST.9-10.3; CCSS.ELA.RST.9-10.7; CCSS.ELA.WHST.9-10.4; CCSS.ELA.WHST.9-10.2; MP1; MP3; MP6; CRP.02; CRP.04; CRP.05; CRP.06; CRP.07; CRP.08; CRP.09; CRP.11



Name: _____

Unit 4 Assessment: Math in Food Science

DIRECTIONS:

Carefully read each question and select the best answer from the options given. Show your work where needed.

- 160°F is considered safe for humans to eat. What would 160°F be in Celsius?
 - 71.1°
 - 75°
 - 69.8°
 - 70.3°
- One gram of fat contains how many kcalories?
 - 10
 - 9
 - 4
 - 6
- A pizza company printed a new package for frozen pizza, and the consumer cooking instructions on the package states that the pizza should be reheated to a final temperature of 77 degrees Celsius. The cooking instructions should have listed the final cooking temperature in degrees Fahrenheit instead of degrees Celsius. You have been asked to convert 77 degrees Celsius into degrees Fahrenheit. What should the final cooking temperature be in degrees Fahrenheit on the label?
 - 135
 - 350
 - 160
 - 171
- To estimate the basal metabolic rate of a women weighing 130 pounds and how much energy she needs to consume for breathing, digesting food, growing new cells and other basic process, first convert her mass to kilograms. Then, calculate the kcalories she would use per hour by multiplying her mass by a BMR factor of 0.9 to learn her BMR. Finally, multiply her BMR by 24 since there are 24 hours/day to find her estimated daily basal kcalorie needs. Her estimated daily basal kcalorie needs would be _____ kcalories/day.
 - 2,808
 - 1,276
 - 1,106
 - 2,071
- You are baking cookies and the recipe calls for the following measurements. You do not have metric measuring devices in your kitchen so you must convert them. Convert the following measurement from ml to U.S. measurements: 120 ml=_____oz.
 - 2
 - 4
 - 6
 - 8
- Thawing a turkey in the refrigerator will take 24 hours for every 4 pounds. If you bought a 19-pound turkey, how many hours/days before Thanksgiving do you need to move the turkey from the freezer to the fridge?
 - 114 hours
 - 4 days
 - 4.75 days
 - 5.66 days

Name: _____

7. One serving of Sour Cream and Onion Potato Chips is equivalent to 1 ounce. Each serving contains 3 grams of fat, 2.0 grams of saturated fat, 10 mg of cholesterol, 220 mg of sodium, 18 grams of carbohydrates, 1 gram of dietary fiber, 8 grams of sugar and 1 gram protein. One serving is equivalent to how many calories?
 - a. 103
 - b. 93
 - c. 196
 - d. 106
8. There is a pizza in the oven. If the oven is set at 200°Celsius, what is its temperature in Fahrenheit?
 - a. 93.33°
 - b. 255°
 - c. 392°
 - d. 450°
9. A food product developer was asked to develop a ready-to-eat product that would be 6.2 inches long, 1.5 inches wide and 0.5 inches thick. Management wants the volume measurement of the product in metric units, so this would be _____ cm³.
 - a. 4.65
 - b. 23.6
 - c. 11.81
 - d. 76.20
10. For most people, 30% of their calories should come from fat. If Ellen has eaten 2,456 calories today, how many of those calories should have come from fat?
 - a. 81.8 calories
 - b. 736.8 calories
 - c. 1.22 calories
 - d. 73.6 calories
11. How many grams are in a 1 lb. package of Chex Mix?
 - a. 719 g
 - b. 454 g
 - c. 327 g
 - d. 208 g
12. Consumers typically purchase milk in 1-gallon containers, weighing 8.34 lbs. per gallon. If a dairy has 225 cows producing an average of 95 lbs. of milk per day per cow, and cows are milked 2x/day, how many gallons does the farm produce in 1 day?
 - a. 5,126 gallons
 - b. 1,975 gallons
 - c. 2,563 gallons
 - d. 1,139 gallons
13. The mass percent of 15 g of sugar in a solution with 85 g of water is equal to:
 - a. 17.6%.
 - b. 21.4%.
 - c. 4.7%.
 - d. 15%.
14. You are baking a cake that is required to bake at 425°Fahrenheit. What is this in degrees Celsius?
 - a. 118°C
 - b. 200°C
 - c. 218°C
 - d. 325°C
15. Your cake recipe calls for 20 fluid ounces of milk. How many cups of milk do you need?
 - a. 1 cup
 - b. 1 ½ cups
 - c. 2 cups
 - d. 2 ½ cups

Name: _____

Measuring Reference Charts and Terminology:

*All measurements in food science use metric units.

Metric Base Units		
Type	Name	Symbol
Mass	gram	g
Length	meter	M
Volume	liter	L
Time	second	s
Temperature	degrees Celsius	°C

Metric Prefixes			
Prefix	Symbol	Meaning	Multiplier
Kilo	k	thousand	1,000
hecto	h	hundred	100
deka	da	ten	10

Mass= measure of the quantity of matter

Gram (g)= mass of 1 cubic centimeter of water at 4°C

Kilogram (kg)= mass of 1 liter of water at 4°C; 1 kg=1,000 g

Weight= measure of the force of gravity between two objects; weight changes with location (Example: sea level — Items will weigh less when above sea level.) Mass stays the same regardless of location.

Length= type of measurement; distance between two points; allows you to evaluate the size of objects

Meter= standard unit of length, 1 meter=39.37 inches

Volume= measurement derived from length; amount of space occupied by an object

Liter (L)= metric unit for measuring fluid volume; 1 L=slightly more than 1 quart or 4 cups

degree Celsius (°C)= most commonly used unit in the food science laboratory; is based on the boiling and freezing points of pure water; water freezes at 0°C, boils at 100°C; a Celsius degree is 0.01 of the difference between the boiling and freezing points of water

*How to convert °C to °F: $^{\circ}\text{C} = (^{\circ}\text{F} - 32) \times 5/9$

*How to convert °F to °C: $^{\circ}\text{F} = (9/5 \times ^{\circ}\text{C}) + 32$.



English Measure	Metric Equivalent (These will need to be memorized for the food science CDE)
¼ teaspoon	1 ml
½ teaspoon	2 ml
1 teaspoon	5 ml
1 tablespoon	15 ml
¼ cup	50 ml
1/3 cup	75 ml
½ cup	125 ml
2/3 cup	150 ml
¾ cup	175 ml
1 cup	250 ml

Name: _____

KEY: Estimating Metric Measurements

NOTE: Answers will vary among students depending on the items used.

Key features to look for when evaluating student work:

- Did students make a realistic estimate?
- Did students use the correct unit of measure for each problem?
- Did students answer reflection questions with thought?

KEY: Metric Units and Converting Recipes

Measurement	Metric System	English System
Mass	Gram	lbs/oz
Volume	liter	oz, cup, pint, quart, gallon
Temperature	°C	°F
Length	meter	inches, feet, yard, mile

*Calculate the temperature conversions below using the following equations. Round answers to the nearest whole number. Do not use the internet. You must calculate these with a calculator only!

*How to convert °C to °F: $^{\circ}\text{C} = (^{\circ}\text{F} - 32) \times 5/9$

*How to convert °F to °C: $^{\circ}\text{F} = (9/5 \times ^{\circ}\text{C}) + 32$.

1. Boiling point of water: $100^{\circ}\text{C} =$ 212 $^{\circ}\text{F}$
2. Normal body temperature: $98.6^{\circ}\text{F} =$ 37 $^{\circ}\text{C}$
3. Average room temperature: $68-72^{\circ}\text{F} =$ 20-22 $^{\circ}\text{C}$
4. Freezing point of water: $0^{\circ}\text{C} =$ 32 $^{\circ}\text{F}$
5. Common baking temperature: $350^{\circ}\text{F} =$ 177 $^{\circ}\text{C}$
6. The food "Danger Zone:" $40-140^{\circ}\text{F} =$ 60 $^{\circ}\text{C}$

*Using the "Measuring Reference Charts and Terminology" worksheet you were given, complete the following. Do not Google or otherwise use the internet!

Ingredient	Metric Equivalent (ml)
2 tablespoons milk	30 ml
2 cups chocolate chips	500 ml
2 $\frac{1}{4}$ cups flour	550 ml



Name: _____

KEY: Unit 4 Assessment: Math in Food Science

DIRECTIONS:

Carefully read each question and select the best answer from the options given. Show your work where needed.

1. 160°F is considered safe for humans to eat. What would 160°F be in Celsius?
 - a. 71.1°
 - b. 75°**
 - c. 69.8°
 - d. 70.3°

2. One gram of fat contains how many kcalories?
 - a. 10
 - b. 9**
 - c. 4
 - d. 6

3. A pizza company printed a new package for frozen pizza, and the consumer cooking instructions on the package state that the pizza should be reheated to a final temperature of 77 degrees Celsius. The cooking instructions should have listed the final cooking temperature in degrees Fahrenheit instead of degrees Celsius. You have been asked to convert 77 degrees Celsius into degrees Fahrenheit. What should the final cooking temperature be degrees Fahrenheit on the label?
 - a. 135
 - b. 350
 - c. 160
 - d. 171**

4. To estimate the basal metabolic rate of a women weighing 130 pounds and how much energy she needs to consume for breathing, digesting food, growing new cells and other basic process, first convert her mass to kilograms. Then, calculate the kcalories she would use per hour by multiplying her mass by a BMR factor of 0.9 to learn her BMR. Finally, multiply her BMR by 24 since there are 24 hours/day to find her estimated daily basal kcalorie needs. Her estimated daily basal kcalorie needs would be _____ kcalories/day.
 - a. 2,808
 - b. 1,276**
 - c. 1,106
 - d. 2,071

5. You are baking cookies and the recipe calls for the following measurements. You do not have metric measuring devices in your kitchen so you must convert them. Convert the following measurements from ml to U.S. measurements: 120 ml=_____oz.
 - a. 2
 - b. 4**
 - c. 6
 - d. 8

6. Thawing a turkey in the refrigerator will take 24 hours for every 4 pounds. If you bought a 19-pound turkey, how many hours/days before Thanksgiving do you need to move the turkey from the freezer to the fridge?
 - a. 114 hours
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 - c. 4.75 days**
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b. 93
c. 196
d. 106
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