

This task was developed by high school and postsecondary mathematics and agriculture sciences educators, and validated by content experts in the Common Core State Standards in mathematics and the National Career Clusters Knowledge & Skills Statements. It was developed with the purpose of demonstrating how the Common Core and CTE Knowledge & Skills Statements can be integrated into classroom learning – and to provide classroom teachers with a truly authentic task for either mathematics or CTE courses.

TASK: CORN AND OATS

TARGET COMMON CORE STATE STANDARD(S) IN MATHEMATICS:

N.Q.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.*

N.Q.2 Define appropriate quantities for the purpose of descriptive modeling.*

N.Q.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.*

6.RP.3d Use ratio reasoning to convert measurement units; manipulate and transform units appropriately when multiplying or dividing quantities.

7.RP.1 Compute unit rates associated with ratios of fractions, including ratios of lengths, areas, and other quantities measured in like or different units.

7.RP.3 Use proportional relationships to solve multi-step ratio and percent problems.

7.NS.3 Solve real world problems involving the four operations with rational numbers.

7.EE.3 Solve multi-step real life and mathematical problems posed with positive and negative rational numbers in any form, using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies.

TARGET STANDARDS FOR MATHEMATICAL PRACTICES

MP.1 Make sense of problems and persevere in solving them.

MP.2 Reason abstractly and quantitatively.

MP.4 Model with mathematics.

MP.6 Attend to precision.

TARGET COMMON CORE STATE STANDARD(S) IN ELA/LITERACY:

RST.9-10.1 Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.

RST.9-10.2 Determine the central ideas or conclusions of a text; trace the text’s explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.

RST.9-10.3 Follow precisely a complex multi-step procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.

RST.9-10.5 Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy).

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.

RST.11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.

TARGET CAREER AND TECHNICAL EDUCATION (CTE) KNOWLEDGE & SKILLS STATEMENTS:

AGC 04.01 Assess, manage, integrate and create information using information technology tools specific to Agriculture, Food, and Natural Resources (AFNR) in order to facilitate people, machines, and logistics.

AGPB01.01.03 Develop a fertilization plan using the results of an analysis and evaluation of nutritional requirements and environmental conditions.

AGPB01.03.01 Develop a production plan that applies the fundamentals of plant management.

AGPB01.03.03 Handle crops using methods that apply fundamentals of plant management.

AGPE01.01.02 Apply cartographic skills.

AGPE01.01.03 Obtain planting data by monitoring natural resource status.

RECOMMENDED COURSE(S):

Algebra 1; Geometry; Integrated Math I or II; Plant Science; Crop Science; Agribusiness Management

ADDITIONAL INSTRUCTIONS:

This task requires knowledge of the measures of the Public Land Survey System (PLSS). It can be completed in one class period, but could also be extended over multiple days.

* Modeling standards appear throughout the CCSS high school standards and are indicated by a star symbol (*).

About the Common Core State Standards in Mathematics

The Common Core State Standards (CCSS) for Mathematics are organized by grade level in grades K–8. At the high school level, the standards are organized by conceptual category (number and quantity, algebra, functions, geometry, and probability and statistics), showing the body of knowledge students should learn in each category to be college and career ready, and to be prepared to study more advanced mathematics. The Standards for Mathematical Practice describe ways in which developing student practitioners of the discipline of mathematics increasingly ought to engage with the subject matter as they grow in mathematical maturity and expertise throughout the elementary, middle and high school years. www.corestandards.org

About the Common Core State Standards in English Language Arts/Literacy

The Common Core State Standards (CCSS) for ELA/Literacy are organized by grade level in grades K–8. At the high school level, the standards are organized by 9-10 and 11-12 grade bands. Across K-12 there are four major strands: Reading, Writing, Speaking and Listening, and Language. The CCSS also include Standards for Literacy in History/Social Studies, Science, and Technical Subjects, with content-specific (Reading and Writing) literacy standards provided for grades 6-8, 9-10, and 11-12, to demonstrate that literacy needs to be taught and nurtured across all subjects. www.corestandards.org

About the Career Cluster Knowledge and Skill Statements

As an organizing tool for curriculum design and instruction, Career Clusters™ provide the essential knowledge and skills for the 16 Career Clusters™ and their Career Pathways. It also functions as a useful guide in developing programs of study bridging secondary and postsecondary curriculum and for creating individual student plans of study for a complete range of career options. As such, it helps students discover their interests and their passions, and empowers them to choose the educational pathway that can lead to success in high school, college and career. <http://www.careertech.org/career-clusters/resources/clusters/agriculture.html>. Although not included in this template, all Clusters and Pathways have Foundational Academic Expectations and Essential Knowledge & Skills Statements, which, in some cases, overlap with the Common Core State Standards.

KEY TERMS

- Parcel, Section, Township, Range
- Quarter Section, Half Section
- Fertilizer, dry granular fertilizer
- Nitrogen (N), Phosphorus (P), Potassium (K)
- Hundred Weight /Centum Weight (cwt)
- Bulk see tenders
- Germination
- Calibrating
- Plant population

CORN AND OATS¹ – *The Task*

You are asked to assist Producer Bob with some of the management decisions he faces. Bob is a dry land farmer (no irrigation) and has the following information available for you to use.

Show all your work as you answer the questions below:

LAND OWNERSHIP

Bob owns the following parcels of land. (One section = 640 acres)

Using the Public Land Survey System (PLSS), calculate how many acres are in the following parcels:

- Parcel A: S1/2 Section 25, Township 13, Range 14 W
- Parcel B: NW1/4 Section 24, Township 13, Range 14 W
- Parcel C: NW1/4NE1/4 Section 23, Township 13, Range 14 W
- Parcel D: Lot 1A Section 23, Township 13, Range 14 W (triangle plot with a 1240 ft. long base and a height of 660 ft.)

1. Use shading to graph parcels A, B, and C on the grids below.

Parcel A	Parcel B	Parcel C

2. How many total cropland acres does Bob have?

FERTILIZATION

Bob is planning to plant 80% of his acres to corn and the remainder of his acres to oats. His fertilization plans for his corn acres will be to apply 60 pounds of Nitrogen (N) per acre in the fall and side dress 50 pounds of Nitrogen per acre post emergent (after the corn emerges). Bob will use the fertilizer Anhydrous Ammonia (which is 60% N) for his corn crops. Additionally, Bob is planning to apply 80 pounds of Nitrogen per acre to his oat crop at planting time using a dry granular product that is a 20-10-5 (Nitrogen (N) – Phosphorus (P) – Potassium (K)) fertilizer.

3. How many tons of Anhydrous Ammonia will Bob need to contract for his corn?
4. How many tons of dry, granular fertilizer will Bob need to purchase for his oats?
5. How many lbs of Potassium will Bob be applying to his oats crop through the application of the dry granular fertilizer?

¹ Adapted from items on the Iowa FFA CDE – Agronomy Examination
<http://www.agiowa.org/sitebuildercontent/sitebuilderfiles/agronomy2005.pdf> and the FFA Blue Book
http://www.agiowa.org/cde_rules.html

PLANTING

Bob purchases his seed corn from a local dealer in bulk seed tenders with a weight of 1500 pounds. There are 120,000 seeds per cwt (centum weight or hundred weight) for his seed corn variety. His goal is to have a plant population of 26,000 per acre. Bob assumes a germination rate of 96%.

6. How many full bulk seed tenders and 50 lb bags of seed corn will Bob need to order from the local dealer in order to have minimum excess seed corn? (Tender dimensions: 4'x4'x4')

Bob needs assistance with setting his drilling equipment. He will be drilling his oat crop at a rate of 30 seeds per square foot. His oat drill has six-inch row spacing and his oat variety has 12,000 seeds per pound. To calibrate his equipment he is planning on driving 25 feet and collecting from four rows of his drill and then with your assistance he will be measuring the oats planted. His scale only measures in grams (454 grams per lb).

7. When calibrating Bob's drill, how much seed should be collected to reach the target oat crop-seeding rate?

Corn and Oats – Possible Solution(s)

The following table indicates some distance and area conversions in the PLSS. Those indicated in yellow highlighting are used in this task:

	dimensions (miles)	(mile ²)	area (acres)	(m ²)	(km ²)	notes
Quadrangle	24 by 24	576	368,640		1,492	Usually 16 townships
Township	6 by 6	36	23,040		93	Usually 36 sections
Section	1 by 1	1	640		2.6	
Half-section	1 by 1/2	1/2	320	1,294,994	1.3	
Quarter-section	1/2 by 1/2	1/4	160	647,497		
Half of quarter-section	1/2 by 1/4	1/8	80	323,749		
Quarter of quarter-section	1/4 by 1/4	1/16	40	161,874		

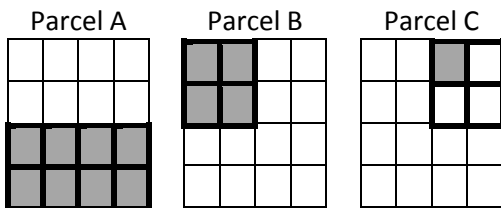
LAND OWNERSHIP

Parcel A: S1/2 Section 25, Township 13, Range 14 W: $\frac{1}{2} \times 640 = \mathbf{320 \text{ acres}}$ (since this is a half-section)

Parcel B: NW1/4 Section 24, Township 13, Range 14 W: $\frac{1}{4} \times 640 = \mathbf{160 \text{ acres}}$ (since this is a quarter-section)

Parcel C: NW1/4NE1/4 Section 23, Township 13, Range 14 W: $\frac{1}{4} \times \frac{1}{4} \times 640 = \mathbf{40 \text{ acres}}$ (since this is one quarter of a quarter-section)

1.



2. Parcel D: Lot 1A Section 23, Township 13, Range 14 W (triangle plot measuring 1240 ft. long and 660 ft. wide): **9.4 acres (see below)**

$$\text{Area} = \frac{1}{2} bh$$

$$A = \frac{1}{2} 1240 \text{ ft} \times 660 \text{ ft} = \mathbf{409,200 \text{ ft}^2} \quad (1 \text{ acre} = 43,560 \text{ ft}^2)$$

$$409,200 \text{ ft}^2 \div 43,560 \text{ ft}^2 \text{ per acre} = \mathbf{9.39 \text{ acres}}$$

$$\text{Total Acres: } A + B + C + D = 320 + 160 + 40 + 9.4 = 529.4 \text{ acres}$$

Bob has a total of 529.4 cropland acres

FERTILIZATION

3. First determine how many acres are planted to corn:

$$0.8(529.4 \text{ acres}) = 423.52 \text{ acres are corn}$$

Then determine how many pounds of nitrogen (N) will be needed to cover all of the corn crops:

For each acre, Bob will need:

$$60 \text{ lbs/acre (in the fall)} + 50 \text{ lbs/acre (post-emergent)} = 110 \text{ lbs/acre of N}$$

Bob plans to plant 423.52 acres to corn, so $110 \text{ lbs/acre} \times 423.52 \text{ acres} = \mathbf{46,587.2 \text{ lbs of N}}$ needed to cover all of the corn crops.

Since the fertilizer Anhydrous Ammonia is only 60% N, the next step is set up a proportion to find out the total amount of fertilizer needed:

$$46,587.2 / x = 60 / 100$$

$$60x = 4,658,720$$

$$x = \mathbf{77,645.33 \text{ lbs. of fertilizer}}$$

Then convert from lbs to tons (2000 lbs per ton):

$$77,645.33 \text{ lbs}/2000 \text{ lbs per ton} = \mathbf{38.8 \text{ tons Anhydrous Ammonia}}$$

4. Determine how many acres are planted to oats:

$$529.4 - 423.52 = 105.88 \text{ acres are oats}$$

Bob needs 80 lbs of N for each acre of oats, therefore:

$$105.88 \text{ acres of oats} \times 80 \text{ lbs/acre} = \mathbf{8,470.4 \text{ lbs of N}}$$

Since the granular fertilizer is 20% N, the next step is to set up a proportion to find out the total amount of fertilizer needed:

$$8,470.4 / x = 20 / 100$$

$$20x = 847,040$$

$$= \mathbf{42,352 \text{ lbs of fertilizer}}$$

Then convert from lbs to tons (2000 lbs per ton): $42,352/2000 = \mathbf{21.18 \text{ tons granular fertilizer}}$

5. Since the ratio in the fertilizer is 20%N, 10%P, 5%K:

$$x / 42,352 = 5 / 100$$

$$100x = 5(42,352) = 211,760$$

$$x = \mathbf{2,117.6 \text{ lbs of Potassium}}$$

PLANTING

6. In order to find how many seeds Bob needs, the first step is to answer the question "26,000 is 96% of what number?", since the germination rate is 96%:

$$26000 / x = 96 / 100$$

$$96x = 26000(100) = 2,600,000$$

$$x = \mathbf{27,084 \text{ seeds}}$$

Therefore, 27,084 seeds will need to be planted per acre to realize 26,000, given the germination rate.

Then multiply the number of seeds per acre by the number of acres of corn:

$$27,084 \text{ seeds/acre} \times 423.52 \text{ acres of corn} = \mathbf{11,470,616 \text{ seeds needed}}$$

How many seeds are in each tender? There are 120,000 seeds per cwt, with a cwt = 100 lbs. Each tender weighs 1500 lbs. To convert the weight of each tender to cwts, divide by 100:

Weight of a tender in cwt: $1500 \text{ lbs}/100 \text{ lbs per cwt} = 15 \text{ cwt}$.

To find the seeds per tender, multiply the number of seeds per cwt by the number of cwts:

$120,000 \text{ seeds/cwt} \times 15 \text{ cwt} = 1,800,000 \text{ seeds per tender}$

To determine the numbers of tenders needed and the number of 50 pound bags needed (in order to have minimum excess seed), perform the following calculations:

$11,470,616 \text{ seeds needed} / 1,800,000 \text{ seeds per tender} = 6.37 \text{ tenders}$

Therefore, Bob should buy 6 tenders, which account for 10,800,000 seeds.

Since 11,470,615 seeds are needed that means that $(11,470,615 - 10,800,000 \text{ seeds}) = 670,615 \text{ seeds}$ still need to be purchased. Excess seed will be minimized by purchasing these in 50 lb bags. If there are 120,000 per cwt (100 lbs) then there are 60,000 seeds in a 50-lb bag.

$670,615 \text{ seeds} / 60,000 \text{ seeds per bag} = 11.177 \text{ bags}$. This means that Bob will also need to purchase 12 50-lb bags of corn seed.

Bob needs to order 6 tenders and 12 50-lb bags.

7. First find the area the drill covers:

6 inches = .5 ft

Therefore: Area to be covered during calibration = $.5 \text{ ft} \times 4 \text{ rows} \times 25 \text{ ft} = 50$

Then multiply the area by the number of seeds per square foot: $50 \times 30 \text{ seeds/} = 1500 \text{ seeds}$.

To find how many pounds: $1500 \text{ seeds} / 12,000 \text{ seeds per lb} = 0.125 \text{ lbs}$.

Then convert to grams: $454 \text{ grams per lb} \times 0.125 \text{ lbs} = 56.75 \text{ grams of seed}$

Corn & Oats – Appendix: Alignment Ratings

The rating system used in the following charts is as follows:

3 EXCELLENT ALIGNMENT:

The content/performance of the task is clearly consistent with the content/performance of the Common Core State Standard.

2 GOOD ALIGNMENT:

The task is consistent with important elements of the content/performance of the CCSS statement, but part of the CCSS is not addressed.

1 WEAK ALIGNMENT:

There is a partial alignment between the task and the CCSS, however important elements of the CCSS are not addressed in the task.

N/A:

For Mathematical Practices a content rating does not apply.

In the charts **C = Content Rating** and **P = Performance Rating**

COLOR KEY

- **Black** = Part of CCSS/K&S Statement aligned to task
- **Gray** = Part of CCSS/K&S Statement *not* aligned to task

Task-to-Mathematical Practice Alignment Recording Sheet

Task Name	Aligned CCSS Mathematical Practice Standards	C	P	Alignment Comments (Standards selection, partial alignments, reasons for rating, etc)	Task Comments (Strengths, weaknesses, possible improvements, effectiveness, etc)
CORN & OATS	MP.1 Make sense of problems and persevere in solving them.	N/A	3	This task requires multi-step problem solving, sense making, and understanding of relationships.	This is a multi-stage problem with real life applications and considerations. Students must identify quantities and other measures to determine costs, using practical situations, and accurate quantitative calculations.
	MP.2 Reason abstractly and quantitatively.	N/A	2	This task requires a great deal of quantitative reasoning but no abstract reasoning is required.	
	MP.4 Model with mathematics.	N/A	2	This task calls for students to apply mathematics to the everyday workplace. It requires students to employ mathematics and to interpret their results in the content of the situation. Students are not required, however to come up with particular formulations such as equations or graphic displays.	
	MP 6 Attend to precision.	N/A	3	The quantitative demands of this task are high, and students need to pay careful attention to units and unit conversions. They need to calculate accurately and express numerical answers with a degree of precision appropriate for the problem context.	

Task-to-Common Core State Standards Alignment Recording Sheet

Task Name	Aligned CCSS Content Standards	C	P	Alignment Comments (Standards selection, partial alignments, reasons for rating, etc.)	Task Comments (Strengths, weaknesses, possible improvements, effectiveness, etc.)
CORN & OATS	N.Q.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.*	2	2	This task does not ask students to choose and interpret the scale or use graphs or data displays. In Part 1 the graph is provided and the student must only shade the correct unit squares.	This complex real-world task combines calculation with reporting on the results.
	N.Q.2 Define appropriate quantities for the purpose of descriptive modeling.*	3	3		
	N.Q.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.*	3	3	The task requires rounding to whole tenders and seed bags, as well as general rounding of other calculations.	
	6.RP.3d Use ratio reasoning to convert measurement units; manipulate and transform units appropriately when multiplying or dividing quantities.	3	3	This task requires extensive use of ratios to convert units and to manipulate and solve equations.	
	7.RP.1 Compute unit rates associated with ratios of fractions, including ratios of lengths, areas, and other quantities measured in like or different units.	3	3	Students must compute unit rates and use them to answer questions.	
	7.RP.3 Use proportional relationships to solve multi-step ratio and percent problems.	3	3	Proportional relationships exist throughout the task. Parts 2, 3, and 4 include equations using percentages.	
	7.NS.3 Solve real world problems involving the four operations with rational numbers.	3	3		
	7.EE.3 Solve multi-step real life and mathematical problems posed with positive and negative rational numbers in any form, using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies.	2	3	Students are not required to use negative rational numbers.	

* Modeling standards appear throughout the CCSS high school standards and are indicated by a star symbol (*).

Task-to-National Career Cluster Knowledge & Skills Statements Alignment Recording Sheet

Task Name	Aligned National Career Cluster Knowledge & Skills Statements	C	P	Alignment Comments	Task Comments
CORN & OATS	AGC 04.01 Assess, manage, integrate and create information using information technology tools specific to Agriculture, Food, & Natural Resources (AFNR) in order to facilitate people, machines, and logistics.	3	3	The task provides a comprehensive experience that integrates the assessment and management creating a crop production plan given the described variables.	The task provides a comprehensive experience for students to apply mathematics through the planning of crops and crop management.
	AGPB01.01.03 Develop a fertilization plan using the results of an analysis and evaluation of nutritional requirements and environmental conditions.	3	2	The nutritional analysis is provided in the task, but the performance could rating would be increased if the students actually collect and analyze soil samples, possibly through an extension.	
	AGPB01.03.03 Handle crops using methods that apply fundamentals of plant management.	3	2	The performance rating does not include harvesting component aspects of the problem, but does provide the fundamental planning experiences for plant management in the context of crop production.	
	AGPE01.01.02 Apply cartographic skills to natural resources activities.	2	2	The task requires application of land survey and coordinate systems through mapping exercise, but does not extend to integrate the topographic, photo, image, or other geospatial data aspects	
	AGPE01.01.03 Obtain planting data by monitoring natural resource status.	2	1	The task provides an opportunity to use planning data provided and could be enhanced by requiring students to identify and collect data from sources and resources and indicating the long term impacts of production management.	