

This task was developed by high school and postsecondary mathematics and health 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: IVY SMITH GROWS UP

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.*

A-CED.1: Create equations and inequalities in one variable and use them to solve problems. *Include equations arising from linear and quadratic functions, and simple rational and exponential functions.**

A-CED.3: Represent constraints by equations or inequalities, and by systems of equations and/or inequalities and interpret solutions as viable or non-viable options in a modeling context. *For example, represent inequalities describing nutritional and cost constraints on combinations of different foods.**

A-REI.3: Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.

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 5. Use appropriate tools strategically.

MP6 Attend to precision.

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

HLC.01.01.02 Use knowledge of diseases and disorders to conduct health care role.

HLPB02.01: Utilize the processes to assess and report patient's/ client's health status in order to monitor and document patient progress.

HLPB05.01.03: Prepare protocols to guide implementation of specific diagnostic requests.

RECOMMENDED COURSE(S):

Algebra I; Human Growth and Development; Clinical and Emergency Care

ADDITIONAL INSTRUCTIONS:

This task can be completed in one class period.

* 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/health.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

- Growth chart
- Length-for-age percentile

IVY SMITH GROWS UP – *The Task*

You are a medical assistant in a pediatrician’s office and one of your responsibilities is evaluating the growth of newborns and infants. Your first patient, a baby girl named Ivy Smith, was 21.5 inches long at 3 months old. At 8 months, you measure her at 24 inches long. For your medical records, all measurements must be given both in inches and in centimeters: 1 inch = 2.54 cm

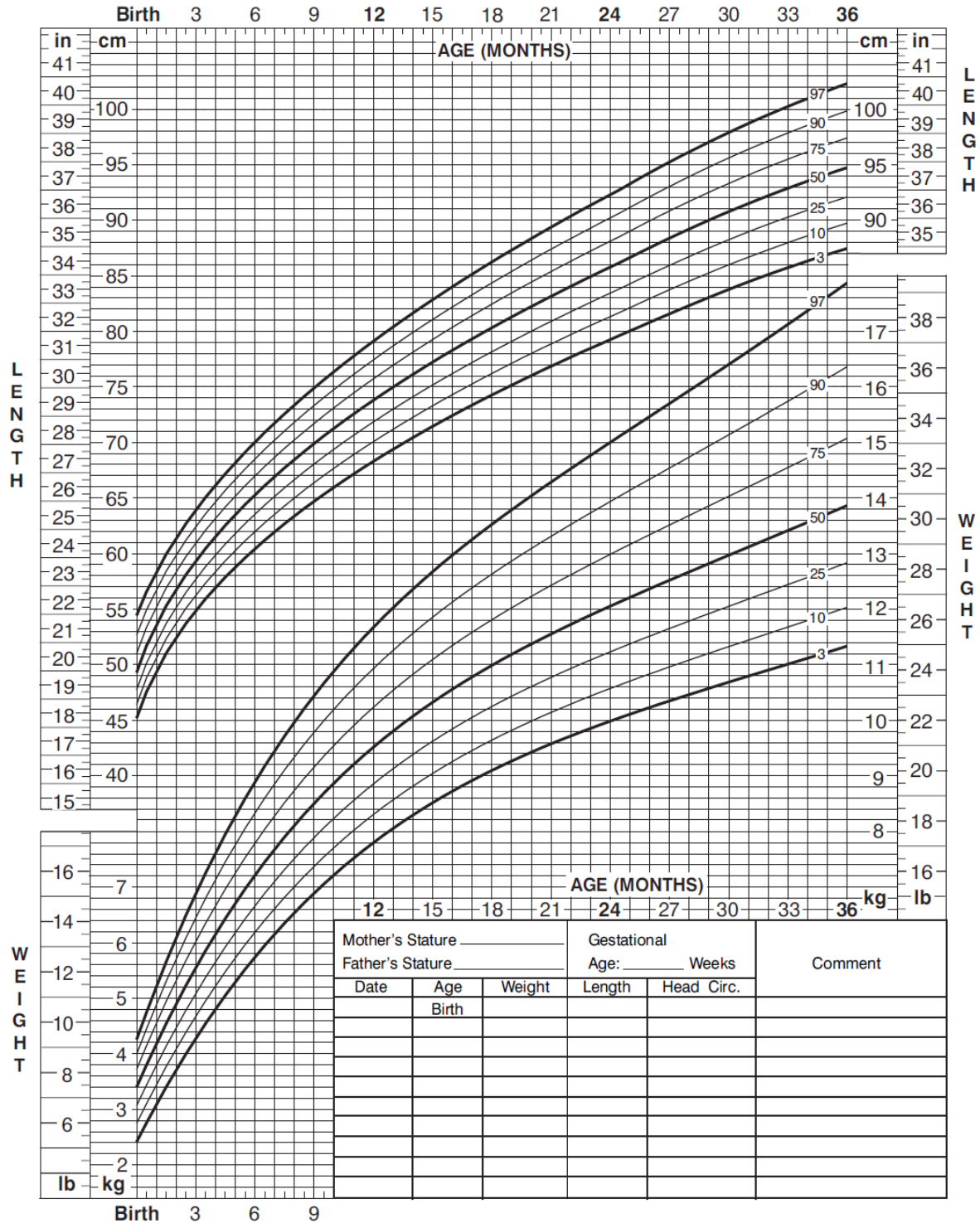
1. Assuming Ivy’s growth is linear, find a linear model for her growth (in inches) over time (in months).
2. Use your model to determine how long Ivy was at birth (in centimeters)? Explain how you know your answer is correct, assuming this model.
3. Use your model to determine approximately how tall Ivy will be at 1 year old. At 3 years old (in centimeters). Show how you know your answers are correct.
4. Use your model to estimate how old Ivy will be (in years and months) when she measures at 48 inches. Show how you know your estimate is accurate.
5. Use the chart and table below to plot Ivy Smith’s growth, based on the calculations above (record number 1234.56).¹
6. What is Ivy’s approximate length-for-age percentile at each of these ages?

¹ <http://www.cdc.gov/growthcharts/charts.htm#Set1>

Birth to 36 months: Girls
Length-for-age and Weight-for-age percentiles

NAME _____

RECORD # _____



Published May 30, 2000 (modified 4/20/01).
SOURCE: Developed by the National Center for Health Statistics in collaboration with the National Center for Chronic Disease Prevention and Health Promotion (2000).
<http://www.cdc.gov/growthcharts>



IVY SMITH GROWS UP – Possible Solutions

1. Assuming Ivy's growth is linear, find a model for her growth (in inches) over time (in months).

Let x = time in months

Let y = length in inches

Two points are given: (3, 21.5) (8,24)

To find an equation the student must first find slope. Students should know that slope (m) is rise over run or:

$$m = \frac{y_1 - y_2}{x_1 - x_2} = \frac{24 - 21.5}{8 - 3} = \frac{2.5}{5} = \frac{1}{2}$$

Using the slope in the y-intercept form for the line, we can use either pair of the above points to solve for the intercept.

Using (3, 21.5)

$$y = \frac{1}{2}x + b$$

$$21.5 = \frac{1}{2}(3) + b$$

$$21.5 = 1.5 + b$$

$$20 = b$$

Or using (8, 24)

$$y = \frac{1}{2}x + b$$

$$24 = \frac{1}{2}(8) + b$$

$$24 = 4 + b$$

$$20 = b$$

Ivy's growth is modeled by the equation: $y = \frac{1}{2}x + 20$

2. Use your model to determine how long Ivy was at birth (in centimeters)? Explain how you know your answer is correct.

Substitute 0 months for x in the equation to find the length at birth:

$$y = \frac{1}{2}(0) + 20$$

$$y = 20 \text{ inches}$$

Ivy was 20 inches at birth.

Using 1 inch = 2.54 centimeters:

$$20 \text{ inches} \times 2.54 \text{ cm/in} = \mathbf{50.8 \text{ centimeters}}$$

Using the attached growth chart we might also estimate the number of centimeters in 20 inches: from looking at the vertical scale, which is in inches and centimeters, we see that 20 inches corresponds with just over 50 cm. This validates our answer.

3. Use your model to determine approximately how tall Ivy will be at 1 year old. 3 years old (in centimeters). Show how you know your answers are correct.

To find Ivy's height at 1 year, substitute 12 months into the equation for x:

$$y = \frac{1}{2} (12) + 20$$

$$y = 6 + 20$$

$$y = 26 \text{ inches}$$

Ivy will be 26 inches at 1 year old (12 months).

$$26 \text{ in} \times 2.54 \text{ cm/in} = \mathbf{66.04 \text{ centimeters}}$$

Ivy will be approximately 66 centimeters tall at 1 year old (12 months).

To find Ivy's height at 3 years, substitute 36 months into the equation for x:

$$y = \frac{1}{2} (36) + 20$$

$$y = 18 + 20$$

$$y = 38 \text{ inches}$$

Ivy will be 38 inches at 3 years (36 months).

$$38 \text{ in} \times 2.54 \text{ cm/in} = \mathbf{96.52 \text{ centimeters}}$$

Ivy will be almost 97 centimeters tall at 3 years old (36 months).

For both parts of this question, the vertical scale on the attached growth chart might also be used to estimate the conversion of inches to centimeters since the vertical scale is given in both units.

4. Use your model to estimate how old Ivy will be (in years and months) when she measures at 48 inches. Show how you know your estimate is accurate.

To find Ivy's age at 48 inches tall, substitute 48 inches into the equation for y:

$$48 = \frac{1}{2} x + 20$$

$$28 = \frac{1}{2} x$$

$$x = 56 \text{ months}$$

Dividing 56 by 12 months per year: $56 / 12 = 4 \text{ years and } 8 \text{ months}$

When Ivy is 48 inches tall she will be 4 years 8 months old.

5. Use the chart and table below to plot Ivy Smith's growth, based on the calculations above (record number 1234.56).

Length (in)	Length (cm)	Age (months)
20	50.8	0
21.5	54.61	3
24	60.96	8
26	66.04	12
38	96.52	36
48	121.92	56

6. *What is Ivy's approximate length-for-age percentile at each of these ages?*

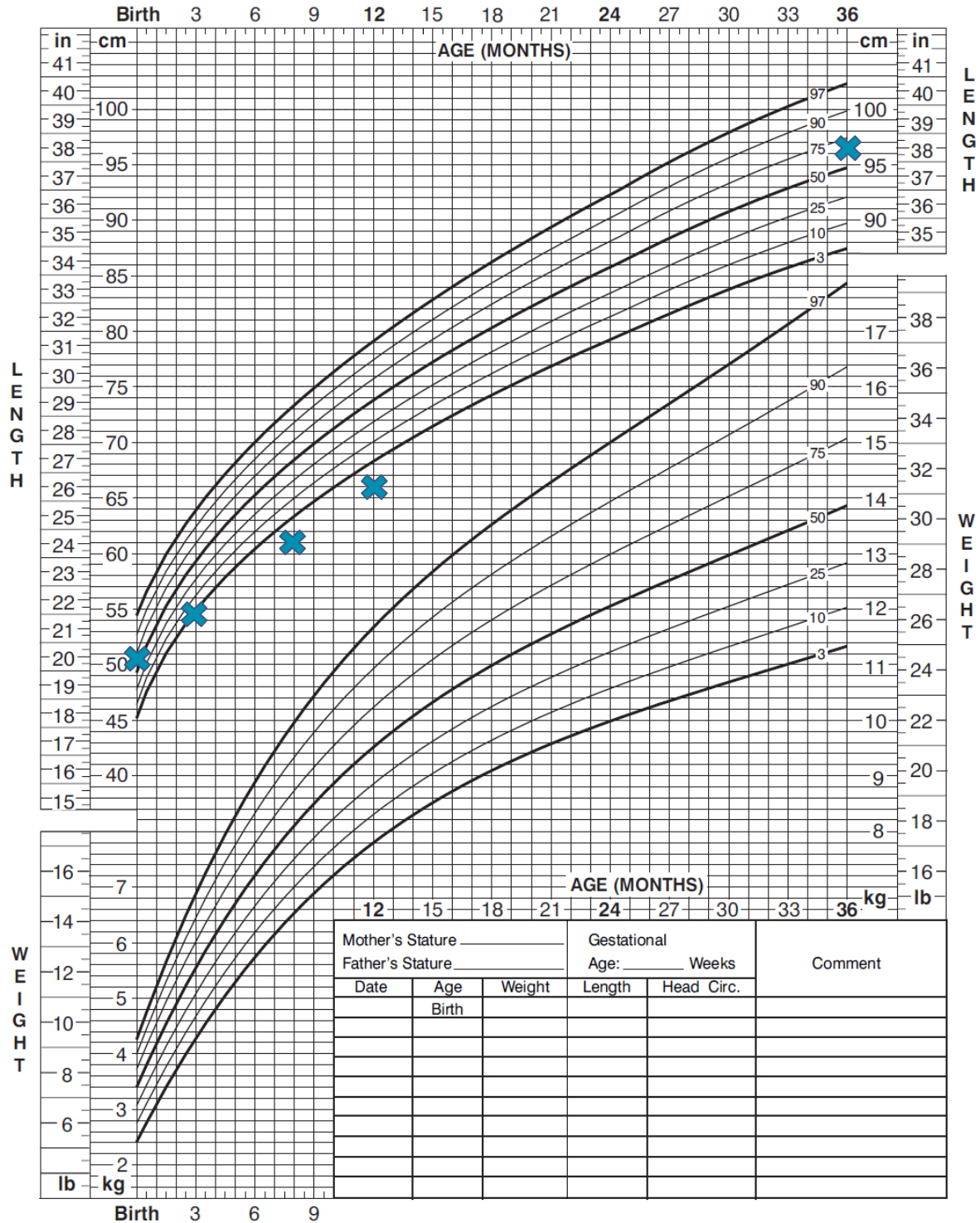
The table below shows the length, as either given in this task or as calculated as part of the solution of this task. Age percentiles are estimated from the attached chart:

Length (in)	Length (cm)	Age (months)	%-ile
20	50.8	0	50th
21.5	54.61	3	3rd
24	60.96	8	< 3rd
26	66.04	12	< 3rd
38	96.52	36	< 75th
48	121.92	56	Not available

Birth to 36 months: Girls
Length-for-age and Weight-for-age percentiles

NAME _____

RECORD # _____



Mother's Stature _____			Gestational Age: _____ Weeks		Comment
Father's Stature _____			Length	Head Circ.	
Date	Age	Weight	Length	Head Circ.	
	Birth				

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SOURCE: Developed by the National Center for Health Statistics in collaboration with the National Center for Chronic Disease Prevention and Health Promotion (2000).
<http://www.cdc.gov/growthcharts>



IVY SMITH GROWS UP - *Possible Extensions*

The extensions below represent potential ways in which mathematics and/or CTE teachers can build on the task above. All of the extensions are optional and can be used in the classroom, as homework assignments, and/or as long-term interdisciplinary projects.

1. Re-create/replicate the problem using Ivy's weight rather than her length, assuming she was 12 lbs., 2 oz. at 3 months old and 17 lbs. at 8 months). Ask students to answer in kilograms. *Note: The chart used for this length-for-age task also provides information on weight-for-age percentiles.*
2. Ivy's twin brother – Herb – was 10% shorter in length at birth, but is growing at a 15% faster rate. At what age, will Ivy and Herb be the same length? At what age will Herb be 4 inches taller than his sister?
3. Model the proper procedure for measuring the height, weight, and head circumference of a newborn.

IVY SMITH GROWS UP – *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)
IVY SMITH GROWS UP	MP 1. Make sense of problems and persevere in solving them.	N/A	3	For this task students analyze givens, constraints, relationships, and goals. They must make conjectures about the form and meaning of the solution and plan a solution pathway. They must check the reasonableness of their solution, continually asking themselves, “Does this make sense?” While the task requires routine math, the student must persevere to answer all the questions.	This is a multi-stage problem with real-life applications and considerations. Students must define and apply a mathematical model and read a complex chart that depicts length-for-age percentiles. They must support their reasoning at various steps in the process.
	MP.2 Reason abstractly and quantitatively.	N/A	2	This task involves quantitative relationships. It requires that students make sense of quantities and their relationships in the problem situation. They must attend to the meaning of the quantities and pay attention to units as they represent the quantities in their solution pathway. While strong quantitative reasoning is required, the task lacks expectations for abstraction.	
	MP 4. Model with mathematics.	N/A	3	This task requires that students translate constraints into equations and extract information from both the algebraic solution and the graphic display.	
	MP 5. Use appropriate tools strategically.	N/A	3	The use of the website, calculator, and the attached chart provides an opportunity to integrate a variety of tools with this activity. The task may be weakened in performance if tools are not used. The task would also be expedited with the use of tools.	
	MP6 Attend to precision.	N/A	3	Students must use precise units of measure, convert units, and perform calculations precisely. Rounding and estimation are a key part of the thinking that students must use to accurately answer the questions. Students need to calculate accurately and express answers with a degree of precision appropriate for the problem.	

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.)
IVY SMITH GROWS UP	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*	3	3	Throughout the task students must use units to reach conclusions and to support their results. They are also called upon to understand the scales in a complex chart/graphical display.	This real-world task combines calculation, modeling, and data analysis and interpretation. Students are expected to show/explain how they know their answers are correct or reasonable.
	A-CED.1: Create equations and inequalities in one variable and use them to solve problems.	2	3	Students must create and use linear equations throughout problem. There is no requirement to use inequalities.	
	A-CED.3: Represent constraints by equations, interpret solutions in a modeling context.	3	2	In this task students must represent the situation with a linear model. However there is no requirement to interpret the solutions.	
	A-REI.3: Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.	2	3	Solving linear equations is a major focus of this task. The task does not include coefficients represented by letters, nor does it include inequalities.	

* 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
IVY SMITH GROWS UP	HLC.01.01.02: Use knowledge of diseases and disorders to conduct health care role.	1	1	The task provides an opportunity to compare the aging process among the body systems in the application of the growth chart and normalcy.	The instructional task provides an application of mathematics in the context of evaluating and diagnosing growth patterns of the human body.
	HLPB02.01: Utilize the processes to assess and report patient's/ client's health status in order to monitor and document patient progress.	2	2	The task would be increased in performance rating if there was an opportunity for students to measure a mannequin.	
	HLPB05.01.03: Prepare protocols to guide implementation of specific diagnostic requests.	1	2	The protocols are developed, but the process of calculating and determining specific diagnostic results provides reasonable practice.	