



National Center and State Collaborative

NCSC Math Activities with Scripted Systematic Instruction (MASSI): High School Ratio and Proportion

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National Center and State Collaborative

The National Center and State Collaborative (NCSC) is applying the lessons learned from the past decade of research on alternate assessments based on alternate achievement standards (AA-AAS) to develop a multi-state comprehensive assessment system for students with significant cognitive disabilities. The project draws on a strong research base to develop an AA-AAS that is built from the ground up on powerful validity arguments linked to clear learning outcomes and defensible assessment results, to complement the work of the Race to the Top Common State Assessment Program (RTTA) consortia.

Our long-term goal is to ensure that students with significant cognitive disabilities achieve increasingly higher academic outcomes and leave high school ready for post-secondary options. A well-designed summative assessment alone is insufficient to achieve that goal. Thus, NCSC is developing a full system intended to support educators, which includes formative assessment tools and strategies, professional development on appropriate interim uses of data for progress monitoring, and management systems to ease the burdens of administration and documentation. All partners share a commitment to the research-to-practice focus of the project and the development of a comprehensive model of curriculum, instruction, assessment, and supportive professional development. These supports will improve the alignment of the entire system and strengthen the validity of inferences of the system of assessments.



The contents of this document were developed as part of the National Center and State Collaborative by Keri Bethune and Diane Browder at University of North Carolina at Charlotte and verified by Amy Lehew, math content expert, under a grant from the Department of Education (PR/Award #: H373X100002, Project Officer, Susan.Weigert@Ed.gov). However, the contents do not necessarily represent the policy of the U.S. Department of Education and no assumption of endorsement by the Federal government should be made.

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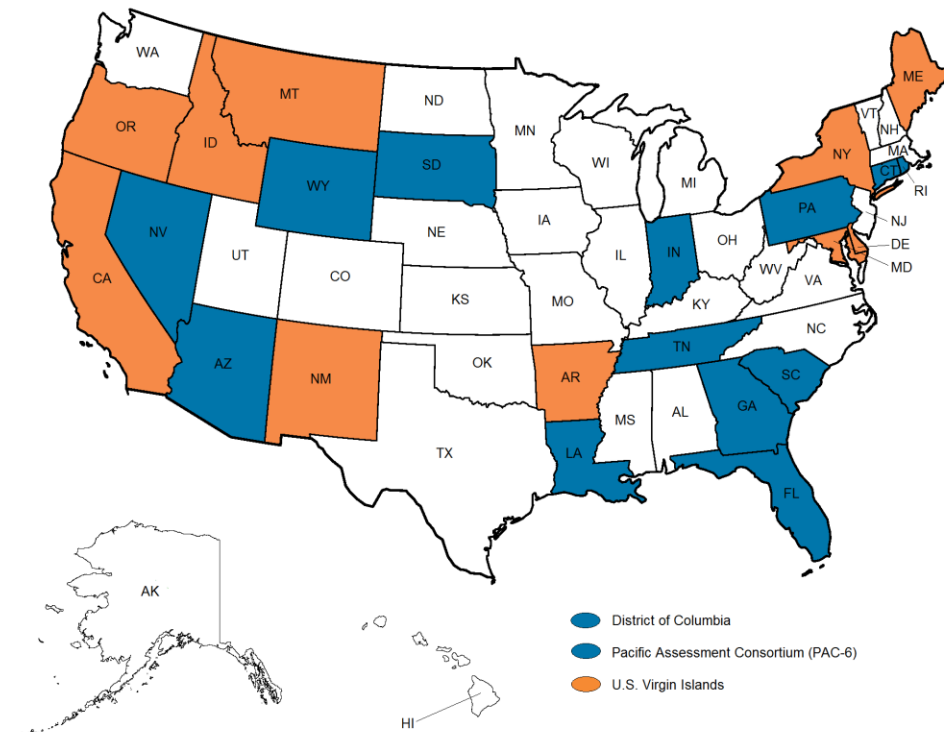


National Center and State Collaborative

NCSC is a collaborative of 15 states and five organizations.

The states include (shown in blue on map): Arizona, Connecticut, District of Columbia, Florida, Georgia, Indiana, Louisiana, Nevada, Pacific Assessment Consortium (PAC-6)¹, Pennsylvania, Rhode Island, South Carolina, South Dakota, Tennessee, and Wyoming.

Tier II states are partners in curriculum, instruction, and professional development implementation but are not part of the assessment development work. They are (shown in orange on map): Arkansas, California, Delaware, Idaho, Maine, Maryland, Montana, New Mexico, New York, Oregon, and U.S. Virgin Islands.



*Core partner states are blue in color and Tier II states are orange in color.

¹ The Pacific Assessment Consortium (including the entities of American Samoa, Commonwealth of the Northern Mariana Islands, Federated States of Micronesia, Guam, Republic of Palau, and Republic of the Marshall Islands) partner with NCSC as one state, led by the University of Guam Center for Excellence in Developmental Disabilities Education, Research, and Service (CEDDERS).



National Center and State Collaborative

The five partner organizations include: The National Center on Educational Outcomes (NCEO) at the University of Minnesota, The National Center for the Improvement of Educational Assessment (Center for Assessment), The University of North Carolina at Charlotte, The University of Kentucky, and edCount, LLC.



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NCSC Math Activities with Scripted Systematic Instruction (MASSI): High School Ratio and Proportion

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MASSI: Math Activities with Scripted Systematic Instruction

Activity: Analyzing and Comparing Job Wages

Grade Band: High School

Concept: Ratio and Proportion

Common Core State Standard	Core Content Connectors	MASSI OBJECTIVES
F.LE.1 Distinguish between situations that can be modeled with linear functions and with exponential functions. 1. Prove that linear functions grow by equal differences over equal intervals, and that exponential functions grow by equal factors over equal intervals. 2. Recognize situations in which one quantity changes at a constant rate per unit interval relative to another. 3. Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another.	HS H.PRF.1c1 Select the appropriate graphical representation of a linear model based on real world events.	Students will identify graphs which match wages for jobs and then compare the wages.

Be sure to provide specific practice to students on the skills that correspond to their grade level.

Teaching Materials: Minimum wage graph, minimum wage graph with outliers, \$/hour job chart, job pictures, job wage graphs, non-example wage graphs.

Worksheets: There are student worksheets to review each component of the lesson.

Assessments: Progress Monitoring for taking data during the lesson; Skills Test

TEACHING OVERVIEW: First students will learn to identify points that are part of a linear data set. In the second part of the lesson students will learn to identify graphs demonstrating proportional relationships. Finally students will briefly compare wages and discuss the types of employment they might like to participate in.

SCRIPT FOR LESSON

BUILDING ESSENTIAL UNDERSTANDING: Discriminating if points are or are not part of a linear data set.

(Skip this section for students who understand these relationships and can identify these concepts).

INTRODUCE THE ACTIVITY: Today we will learn about wages. A wage is the amount a person makes working a job. Display minimum wage graph (no outliers). We can graph wages to help us find out how much money we would make if we worked some hours. This graph says if I work 1 hour I make \$8. If I work 2 hours I make \$16. If I work 3 hours I make \$24 dollars. These numbers are my data set. This graph shows the proportional relationship of making \$8 an hour. It is a straight line.

INTRODUCE PROBLEM: Display minimum wage graph with outliers. Here is another graph. The line shows the proportional relationship of making \$8 an hour. Point to the points on the line. These points are part of the \$8 an hour data set. Point to an outlier (point not on the line). There are other points on the graph not on the line. These are not part of the \$8 an hour data set. Let's practice identifying points on the \$8 an hour data set.



MODEL THE PROCESS: Use the EXAMPLE/NON EXAMPLE script to teach students to identify points on the data set. Use statements: **This is part of the data set. This is NOT part of the data set.**



STUDENT PRACTICE: Now it's your turn. Use the EXAMPLE/NON EXAMPLE script to teach students to identify points on the data set.

****Note:** For students who are non-verbal create visuals or program communication devices to say "data set" and "not data set" and have them point, gaze, or gesture to the answer.

CHECK AND SCORE

Step	Teacher Says/Does	Student Response
1.	Point to outlier, "Is this part of the data set or NOT part of the data set?"	Student says/indicates "NOT data set."
2.	Point to outlier, "Is this part of the data set or NOT part of the data set?"	Student says/indicates "NOT data set."
3.	Point to point in data set, "Is this part of the data set or NOT part of the data set?"	Student says/indicates "data set."
4.	Point to outlier, "Is this part of the data set or NOT part of the data set?"	Student says/indicates "NOT data set."
5.	Point to point in data set, "Is this part of the data set or NOT part of the data set?"	Student says/indicates "data set."
6.	Point to outlier, "Is this part of the data set or NOT part of the data set?"	Student says/indicates "NOT data set."
7.	Point to outlier, "Is this part of the data set or NOT part of the data set?"	Student says/indicates "NOT data set."

8.	Point to point in data set, “Is this part of the data set or NOT part of the data set?”	Student says/indicates “data set.”
9.	Point to point in data set, “Is this part of the data set or NOT part of the data set?”	Student says/indicates “data set.”



This may be a good stopping point. Pull up different data sets on a computer or on an interactive whiteboard. There is a generalization worksheet with this level. You can use this for additional guided practice or to send home as homework.

INDEPENDENT PRACTICE: Ratio and Proportions Skills Test	Teacher Says/Does	Student Response	Error Correction
	Give each student the <i>Ratio and Proportion Skills Test 1</i> . Read directions for each problem and have student select response. Record whether response is correct or incorrect.	Only provide praise for completing assessment (if student needs encouragement). Do not provide specific praise for correct answers while student is testing.	Once the student has completed the test, review missed problems with the student.
<i>NOW</i> Stop the lesson here and repeat tomorrow if student is not yet getting at least 5 independent correct responses. Score responses 1-9 on the Ratio and Proportion Progress Monitoring Sheet if you did not do so while teaching.		<i>NEXT</i> Remember the goal is for students to be able to select a graph that demonstrates a proportional relationship, move into the second half of the lesson to hit the target CCC for this grade level. You can skip this Conceptual Foundation section to move on.	

HS BUILD A GRADE ALIGNED COMPONENT: Identify graphs which match wages for jobs.

INTRODUCE THE ACTIVITY/PROBLEM: Now that we can identify points on the proportional wage data set, let’s practice identifying graphs that match wages.

MODEL THE PROCESS: Remember a proportional relationship is always a straight line. Display Minimum wage graph. Run your finger along the line starting at the origin (0,0). **Here is a graph that matches wages. The line always starts at the bottom here and moves up to this top corner.** Display Job Pay chart and point to hairdresser. **This chart says that hairdressers make \$12 an hour.** Display hairdresser graph and a non-linear graph. **One of these graphs matches the hairdresser’s wages and one does not. Remember a proportional relationship is always a straight line.** Pause. Point to hairdresser graph. **This is a straight line; it starts at the bottom here and moves up to this top corner. This chart matches the hairdresser’s wage.**



STUDENT PRACTICE: Now it’s your turn to identify graphs that match wages. Use TIME DELAY script as needed to help students with each step.

**Notes:

- Cover the top part of the graphs if students are likely to read or match print to select correct answer (titles are to assist teachers in selecting correct graph to display).

- If students do not understand concept of straight line, use Example-Non Example script to teach this concept before teaching this part of the lesson.

CHECK AND SCORE

STEP	Teacher Says/Does	Student Response
10.	Display Job Pay chart and point to File clerk. This chart says that file clerks make \$13 an hour. Display file clerk graph and a non-linear graph. Point to the graph that matches the file clerks wages.	Student indicates file clerk graph.
11.	Display Job Pay chart and point to cook. This chart says that cooks make \$13 an hour. Display cook and a non-linear graph. Point to the graph that matches the cooks' wages.	Student indicates cook graph.
12.	Display Job Pay chart and point to teacher assistant. This chart says that teacher assistants make \$13 an hour. Display file teacher assistant and a non-linear graph. Point to the graph that matches the teacher assistants' wages.	Student indicates teacher assistant graph.
13.	Display Job Pay chart and point to auto mechanic. Okay, now listen carefully. This chart says that auto mechanics make \$13 an hour. Display auto mechanic graph and linear (not in correct position) graph. Point to the graph that matches the auto mechanics wages.	Student indicates auto mechanic graph.

SELF DETERMINATION COMPONENT: Select jobs that earn most and least. Choose preferred job.

CLASS DISCUSSION/WRAP-UP: We have been learning about wages. Display job wages chart. **Some jobs make more than others.** Point to \$/hr column. **This column tells us how much each job makes per hour. Which job makes the most money?** Pause and wait for students to respond. **Which job makes the least money?** Pause and wait for students to respond. 🕒 If students need practice with selecting most and least use TIME DELAY script to practice this skill.

It is also important that we like what we do. Display large pictures of jobs. **Here are some pictures of people working at these jobs. Which job do you think you might like to try to work at?**



This is the end of the lesson. Have the student analyze the local weather patterns. They can either take data by reading a thermometer and tracking rainfall, or lookup the information online. They can then graph the data in scatterplots and line graphs to identify outliers or patterns in the data. Then have students complete descriptive statistics on the data. There is a generalization worksheet with this level. You can use this for additional guided practice or to send home as homework.

INDEPENDENT PRACTICE: Data Analysis Skills Test	Teacher Says/Does	
	Give student the <i>Data Analysis Skills Test: HS grade aligned component</i> . Read directions for each problem and have student select response. Record whether response is correct or incorrect.	Only provide praise for completing assessment (if student needs encouragement). Do not provide specific praise for correct answers while student is testing.

Troubleshooting and Data-Based Decision Making for Data Analysis Skills Test:

If student is unable to complete any items on the data analysis test independently and correctly, go back and teach one problem step-by-step.

MASSI CULMINATING ACTIVITY: Visit places where people work in jobs discussed in the lesson plan, have students interview employees, and have employees discuss what they like and do not like about their jobs about and demonstrate their work. When you return have students discuss which jobs they might like to do and why.

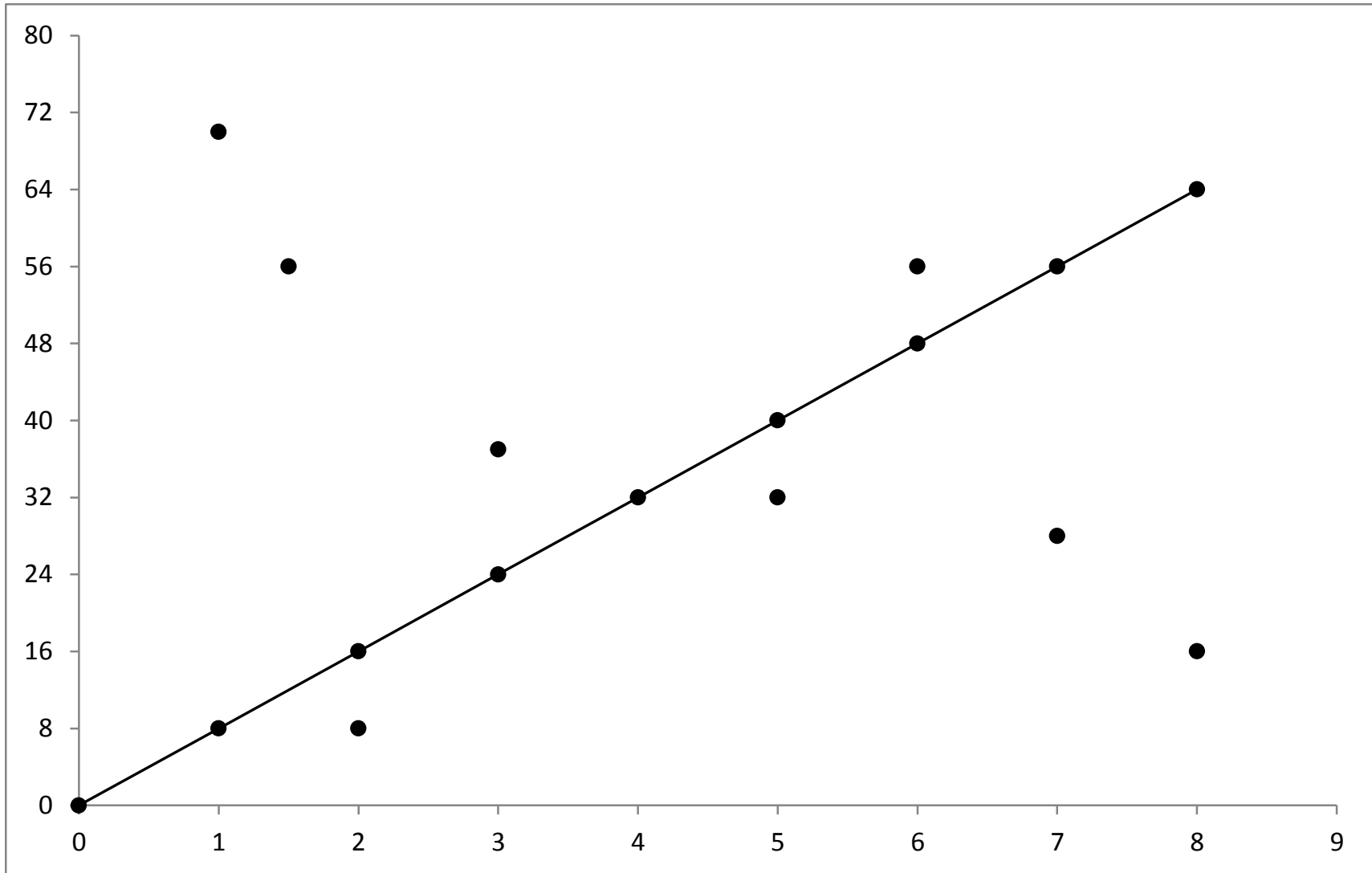
BUILD TOWARDS FULL GRADE LEVEL COMPETENCE

Here are ideas to build competence towards the full grade level competence using this same activity. See the unit plan and talk with the general education teacher for more ideas.

Component	Activity	What Student Does	Generalization/ Fluency
Given a contextual situation, describe whether the situation in question has a linear pattern of change or an exponential pattern of change.	Using data from a real-world situation, students will look at the data graphed on a graphing calculator and decide if the data are linear or exponential in nature.	Student will look at the data path and decide if the data are linear (straight line) or exponential (curved line).	Students may look at a variety of different graphs, such as from a newspaper, magazine, or website and describe the data as linear or exponential in nature.

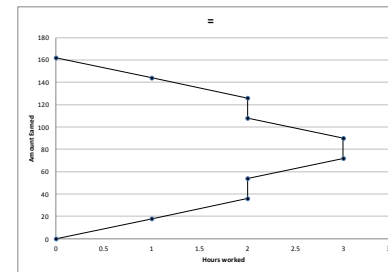
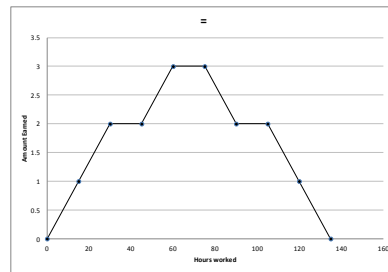
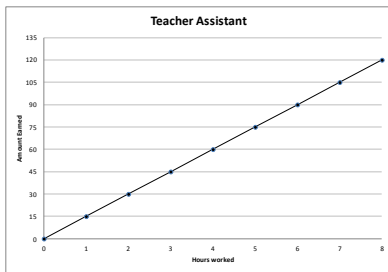
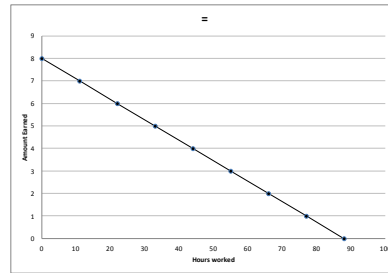
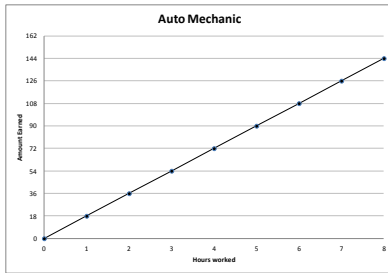
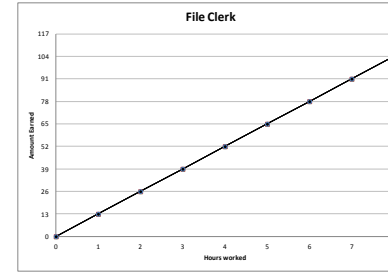
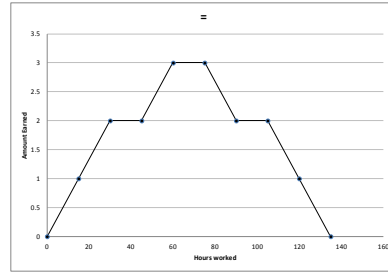
Worksheet 1 Generalization: Concepts and Symbols

Have students cross out all the points that are NOT part of the data set.

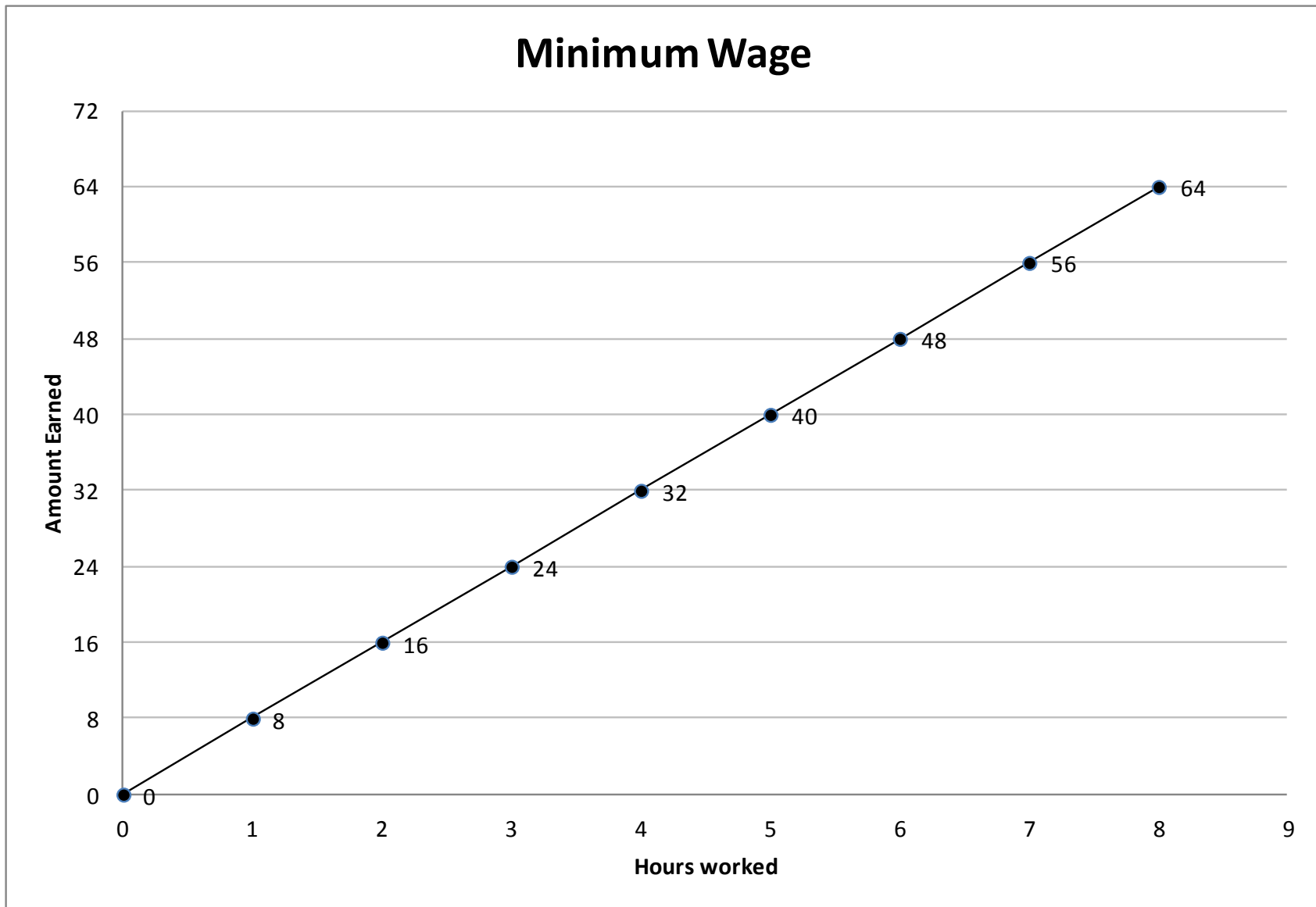


Worksheet 2 Generalization: HS Grade Aligned Component

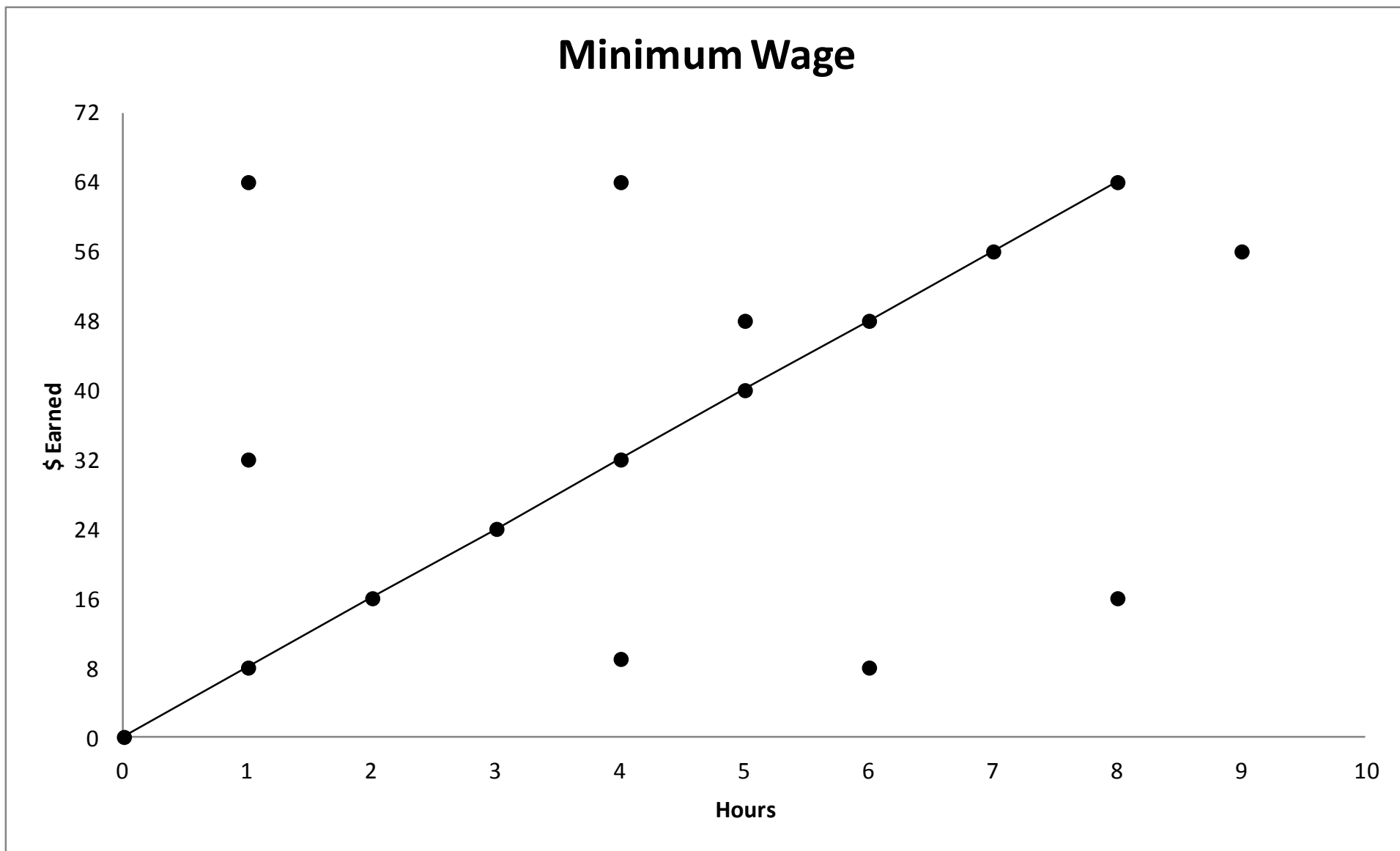
Have students circle all the graphs that show a proportional relationship.



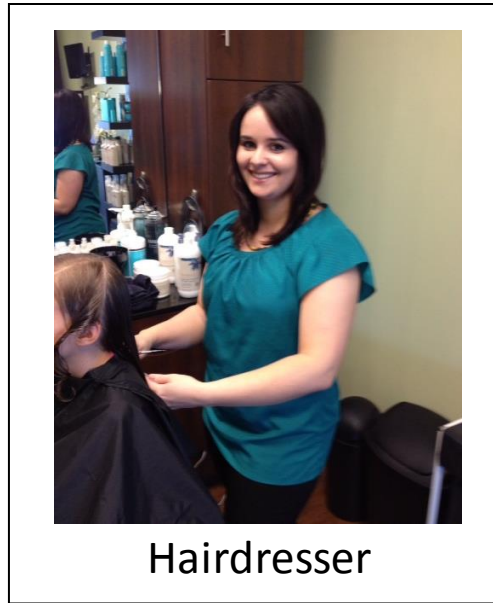
Materials:



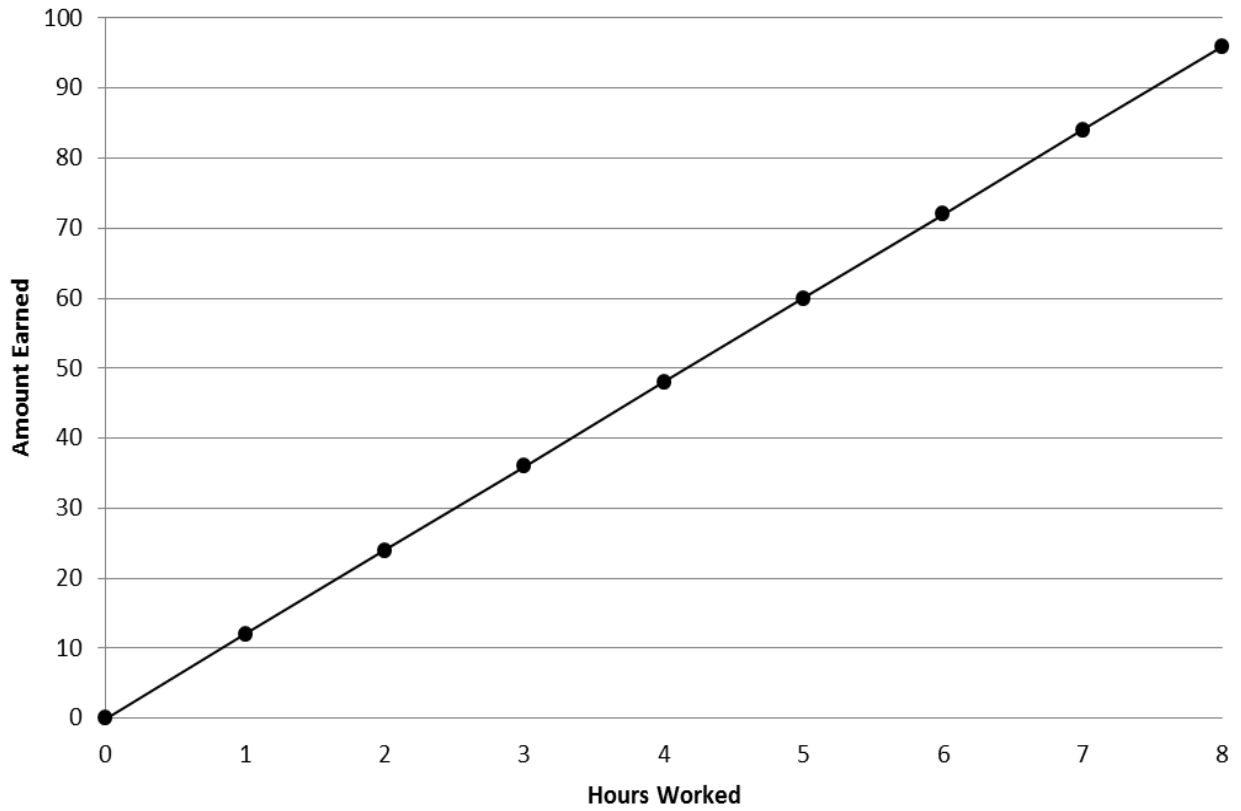
Minimum Wage



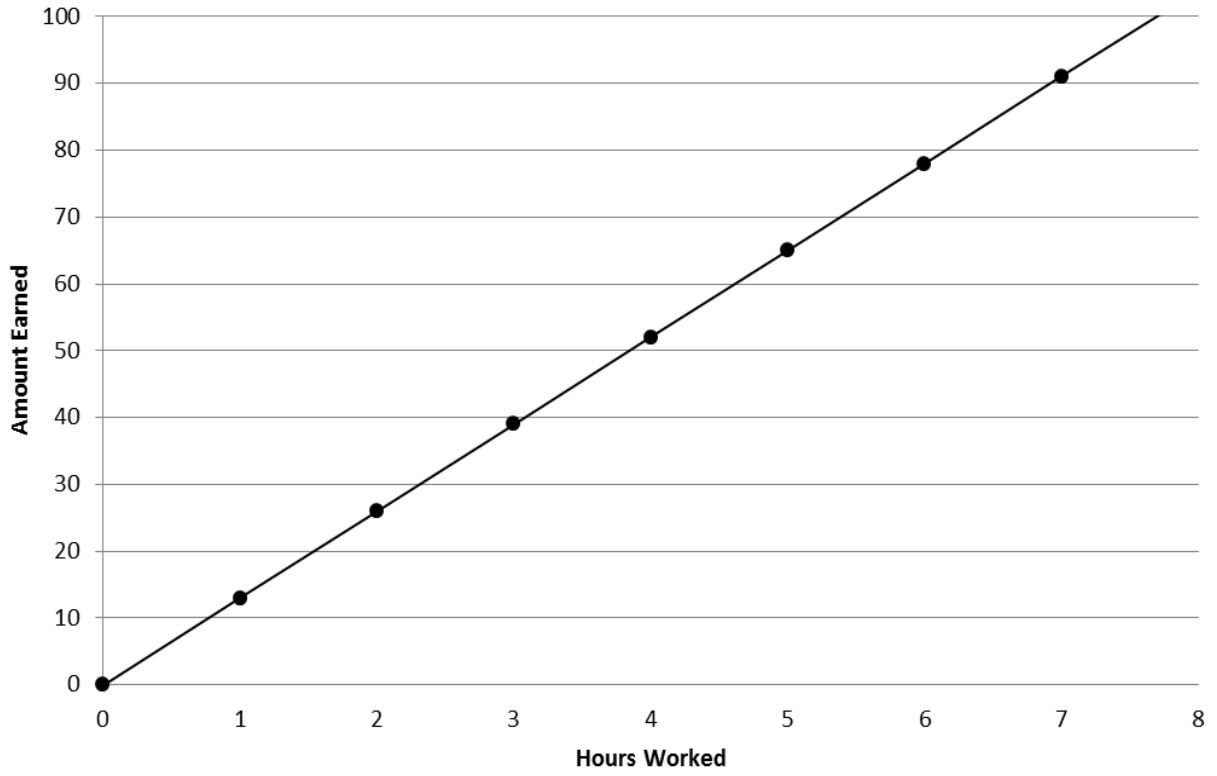
Job	Dollars per Hour
 Hairdresser	\$12
 File Clerk	\$13
 Cook	\$11
 Teacher Assistant	\$15
 Auto Mechanic	\$18



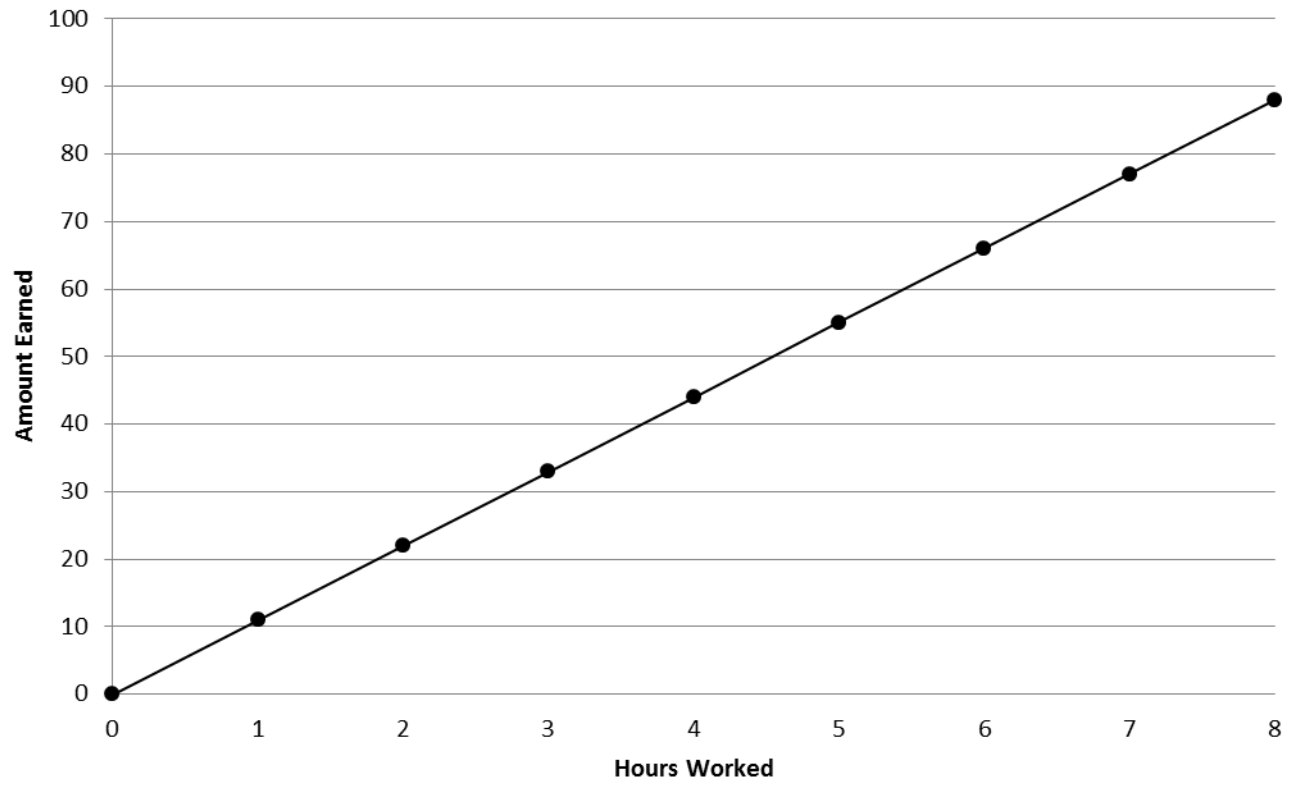
Hair Dresser



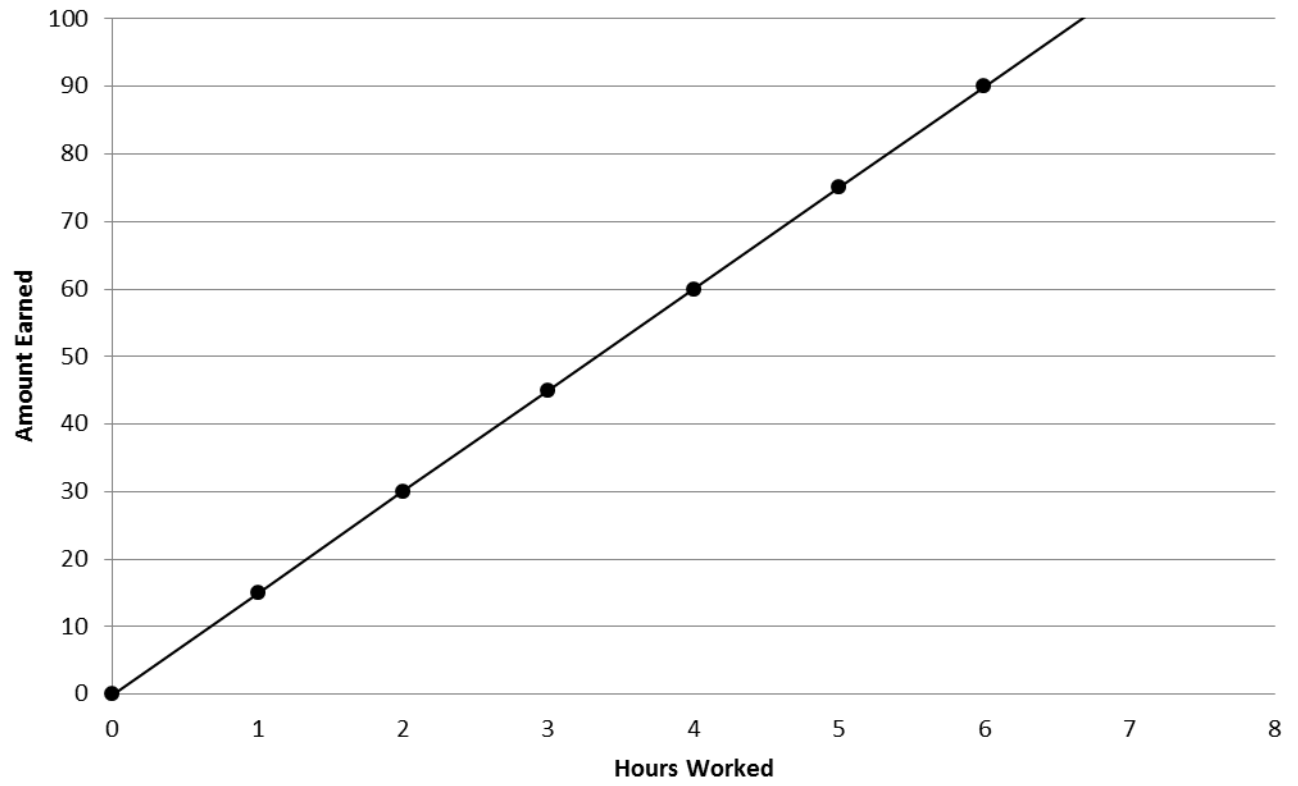
File Clerk



Cook



Teacher Assistant



Auto Mechanic

