LIPSCOMB UNIVERSITY | Ayers Institute for Teacher Learning & Innovation

Standards-Aligned Lesson Plan

High School Mathematics: Edmondson Park (Nashville, TN)

Developed in partnership with the Metropolitan Nashville Arts Commission.

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Planning and Presenting a Mathematics Lesson Based on CCSS

Algebra I
High School (or 8th Grade)

Section I: Planning

Overview: This section focuses on the elements to consider when planning for a CCSS lesson, such as content standards, mathematical practice standards, clear learning targets, task objectives, new learning for students, anticipated learning challenges, scaffolding, opportunities for differentiation, ways to prompt student thinking through assessing and advancing questions, instructional strategies to be used in the lesson, and materials and resources.

Lesson Topic: Interpreting Functions	**Time Frame/Lesson Length:** 2-3 days (1.5 hour blocks)

Math Content Standards	**Mathematical Practice Standards**	**Assessments** ✓ **Formative** ➢ **Summative**
CCSS.Math.Content.HSF.IF.B.4 For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. *Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior;*	1. Make sense of problems and persevere in solving them. 2. Reason abstractly and quantitatively. 3. Construct viable arguments and critique the reasoning of others. 4. Model with mathematics. 5. Attend to precision.	✓ **Formative:** Worksheet on Day 1 ✓ **Formative**: exit ticket on Day 1 ✓ **Formative**: students create a table based on artist's time spent/completion ➢ **Formative or Summative**: exit ticket on Day 2

and periodicity.* **CCSS.Math.Content.HSF.IF.B.5** Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. *For example, if the function h(n) gives the number of person-hours it takes to assemble n engines in a factory, then the positive integers would be an appropriate domain for the function.** **CCSS.Math.Content.HSF.IF.B.6** Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.*		

Planning Element	**Interpreting the function from given a given function table**
Clear Learning Targets	• Students will be able to list the domain (independent variable) and the range (dependent variable) and explain why the information is either independent or dependent. • Students will be able to show a constant rate of change between the data in the table.
Task Objectives (steps to reach mastery of clear learning targets)	• Find numerical patterns. (How does x become y? Is this same for all?) • Understand the difference between independent and dependent variables. • Recognize that constant rate of change is the same thing as slope. • Create a function table (with a linear equation rule) of time spent and completion time.
New Learning	• *This is the entry lesson for an Algebra I class beginning a lesson on functions. Functions are also studied in 8th grade math.*
Anticipated Learning Challenges	• Plotting points on a coordinate plane • Remembering (x,y)

	• Constant rate of change is the change in y over the change in x (rise over run)
Scaffolding opportunities (to address learning challenges)	• The teacher will review the concept of ratios, rates, and unit rates. • The teacher will review how to set-up and solve a proportion. • The teacher will monitor students in small groups and use questioning to guide student learning. • The teacher will demonstrate how to recognize proportional relationships.
Opportunities to Differentiate Learning (explain how you address particular student needs by differentiating process, content, or product)	• The teacher will group students strategically. • The teacher will use private think time, student to student think time, small group think time, and whole group think time to help students clarify mathematical thinking.
Questioning: Planning to Illuminate Student Thinking	***Assessing questions:*** • What patterns do you notice in the given table? • What patterns do you notice in the table that you created? • What relationship do you notice between the quantities? ***Advancing questions:*** • How might you use previous learning to help solve the task? • What is another way/model you could illustrate your thinking? • What is another tool you could you to solve the problem? • If you change the hours/cost to ___, how would that change your answer? • How can you determine if there is a directly proportional relationship?
Instructional Strategies	• Use of multiple tools • Private think time • Student to student think time • Small group think time • Student poster presentations (for gallery walk) • Whole group discussion • Reflection/Closure • Individual Assignment
Materials and Resources	**See attached materials and websites listed below in Teacher Actions and Appendices**

Section II: Presentation

Overview: This section focuses on the steps involved in presenting the lesson. The lesson presentation is divided into segments, such as "Framing the Lesson," "Exploring the Task," "Sharing, Discussing, and Analyzing Solution Paths" and "Closing the Lesson," and "Extending the Learning." For each of these lesson elements, there is an explanation of the procedure, teacher actions, and student outcomes.

Day 1

Framing the Lesson (15 minutes)		
Detailed Procedure	**Teacher Actions**	**Student Outcomes**
• Students will be introduced to the Edmondson Park project and will learn about the featured artists.	• The teacher will give a detailed description of Edmonson Park by using the websites below: http://www.ayersinstitute.org/www/archive/detail/101/27940 http://www.nashville.gov/Arts-Commission/Public-Art/Find-An-Artwork/Projects-in-Progress/Edmondson-Park.aspx http://www.nashville.gov/Arts-Commission.aspx **If possible, the class could visit the park before this lesson.	• Students will gain a visual context for the park and will understand the basics of the revitalization project.
• The students will engage in a class discussion and will be introduced to Math Task 1.	• Teacher will ask students to brainstorm ideas about what types of items/labor might be in a budget for the project (cement, labor costs, benches, trash cans, etc…)	• Students will participate in a relevant class discussion regarding budget.
	• After students have had time to brainstorm, teacher will provide them with 2 function tables created from the data found in the budget (teacher-created).	• Individual student work to complete the table and the graph of the budget information

✍ **Exploring the Task (25 minutes)**		
Procedure	**Teacher Action**	**Student Outcome**
• The students will look at visuals of the park again.	• Teacher will utilize the above websites. The teacher may use a video resource of the park if one becomes available in the future.	• Students will review the resources with the stated purpose of looking for math as part of the park project.
• The students will engage in ten minutes of private think time before journaling, focusing on the prompt: *In paragraph form, how do you think math was used in the park project? Remember to think outside the box – math is everywhere!*	• The teacher will instruct students of the expectations of the prompt and will then circulate the room and monitor student progress.	• The students will write a 1-2 paragraph journal about how they think math was used in creating the park.
☺ **Sharing, Discussing, and Analyzing Solution Paths (35 minutes)**		
Detailed Procedure	**Teacher Actions**	**Student Outcomes**
• Students will engage in whole group discussion (15 minutes).	• The teacher will ask for students to share their answers on how they think math was used. (answers will vary – construction costs, supplies, etc…) • The teacher should create a list on the board. Discuss any items that might be added to the list more than once. .	• Students will observe how math can be used in a variety of ways.
• Students will work individually on given function tables/graphs (20 minutes).	• Assign the worksheet. (see Worksheet 1 in the appendix) • The teacher will circulate the room and monitor student progress.	• Students will practice the function skills, will demonstrate knowledge, and will be formatively assessed.

☐ **Closing the Lesson (15 minutes)**		
Detailed Procedure	**Teacher Actions**	**Student Outcomes**
• Students will engage in a student-to-student review (10 minutes). • Students will complete an exit ticket (5 minutes).	• Teacher will ask students to compare answers and will monitor the review. • Teacher will distribute and then collect the exit ticket (see Exit Ticket Day 1) • Teacher will explain homework.	• Students will give one another meaningful feedback. • Students will demonstrate their knowledge and be formatively assessed.
🕮 **Extending the Learning** *Day 1*		
Homework –teacher created linear equation problems (function tables, graphing linear equations)		

Day 2

🔔 **Framing the Lesson (10 minutes)**		
Detailed Procedure	**Teacher Actions**	**Student Outcomes**
• Students will be introduced to the art of Lonnie Holley, Thornton Dial, and (if teacher chooses) William Edmondson.	• Show the pieces of artwork of Lonnie Holley and Thornton Dial (see images in appendices). Teacher may also choose to show images from the following website, which includes art from William Edmondson: www.riccomaresca.com	• Students will be exposed to art created by artists associated with the Edmondson Park Project.
• Students will be introduced to Math Task 2. • Students will work collaboratively to create a poster with their plan on how	• Teacher will facilitate the task directions by asking students about how they might go about starting an art project to be installed in a public park. (Would they draw it first or start building? Would they have a plan or let it be a natural	• Students will think critically about how they would create art for public installation—and how it relates to math.

they would install a large version of one of Holley's or Dial's art pieces. (once the art pieces are actually installed in the park, the teacher may choose to use the actual images of the art pieces).	process?)	
Exploring the Task (25 minutes)		
Procedure	**Teacher Action**	**Student Outcome**
• Students will respond to the following prompt: *You have 10 minutes to list (or write in paragraph form) how you would have gone about constructing the artwork that (either Lonnie Holley or Thornton Dial) created. Include the supplies you think you might have used, referencing what you notice about sample art from the artists. (Allow students to select the artist that they choose).*	• The teacher will explain the writing prompt.	• The students think critically about the art construction process and write about this process.
• Students will engage in a whole-group discussion.	• The teacher will ask for students to share their answers on what they found interesting/important	• The students will share ideas and interesting observations, while thinking critically about their peers' ideas.
• The students will be informed of the poster project assignment: Students will work collaboratively to create a poster presentation that lists the artist name/piece of work, a function table listing domain/range (man hours, amount completed), and a graph of the information.	• The teacher will explain to students that they are to work in a group of 4 to create a poster (including a function table, rule and graph) about one of the artists' construction hours spent. (See Day 2 Task in appendix)	• The students will understand the process in order to progress toward mastery of learning targets.

☺ **Sharing, Discussing, and Analyzing Solution Paths (55 minutes)**		
Detailed Procedure • Students will work with their group on given function tables/graphs (30 minutes).	**Teacher Actions** • The teacher will circulate the room, monitor progress, and prompt thinking.	**Student Outcomes** • Students will work collaboratively to create a poster presentation that assesses learning target goals. • Students will demonstrate mastery of lesson goals.
• Students will participate in a 25-minute gallery walk	• The teacher will instruct students about the parameters of the gallery walk: 1. students hang their final poster on the wall 2. students examine each poster leaving a post it note on each one with a reason they agree or disagree with the poster • Teacher will circulate the room and provide direction if needed. • Sample poster is located in the appendix	• Students will critique each group's work and provide meaningful feedback to one another. They will agree, disagree with one another's findings. Students will provide helpful evidence to support their opinions on the topic.
☐ **Closing the Lesson (10 minutes)**		
Detailed Procedure • Students will participate in a whole-group discussion (5 minutes).	**Teacher Actions** • Teacher will ask students about what stood out to them in the lesson and in the	**Student Outcomes** • Students will discuss the gallery walk activity.

• Students will complete an exit ticket (5 minutes).	gallery walk. • Teacher will distribute and collect an exit ticket (see appendix for Exit Ticket)	• Students will demonstrate mastery of lesson objectives through the Exit Ticket summative assessment.
🕮 **Extending the Learning** *Day 2*		
Homework – Teacher-created linear equation problems (function tables, graphing linear equations**)**		

Appendices:

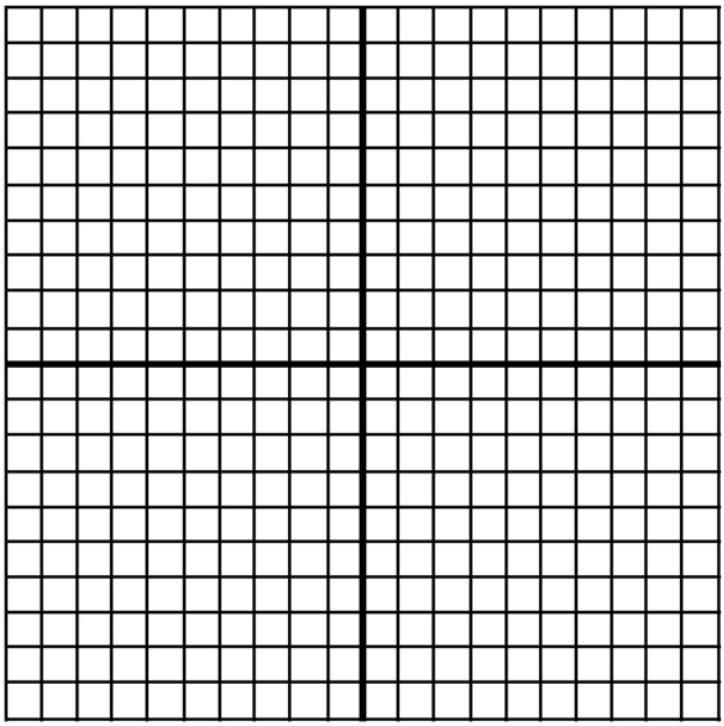
- Classwork Day 1
- Day 1 and 2 exit ticket
- Day 1 and 2 homework
- Day 2 Task
- Art of Lonnie Holley and Thornton Dial
- www.riccomaresca.com
- http://www.ayersinstitute.org/www/archive/detail/101/27940
- http://www.nashville.gov/Arts-Commission/Public-Art/Find-An-Artwork/Projects-in-Progress/Edmondson-Park.aspx
- http://www.nashville.gov/Arts-Commission.aspx
- Sample poster

CLASSWORK Day 1: Function Tables and Graphs Name: _____

When purchasing cement, the artist is charged a non-refundable $45.00 service fee. The cost of each load of cement, including the service fee, is listed in the table below.

Cubic Tons of Cement		Cost Per Cubic Ton
0		$45.00
1		$345.00
2		$645.00
3		$945.00
5		$1545.00

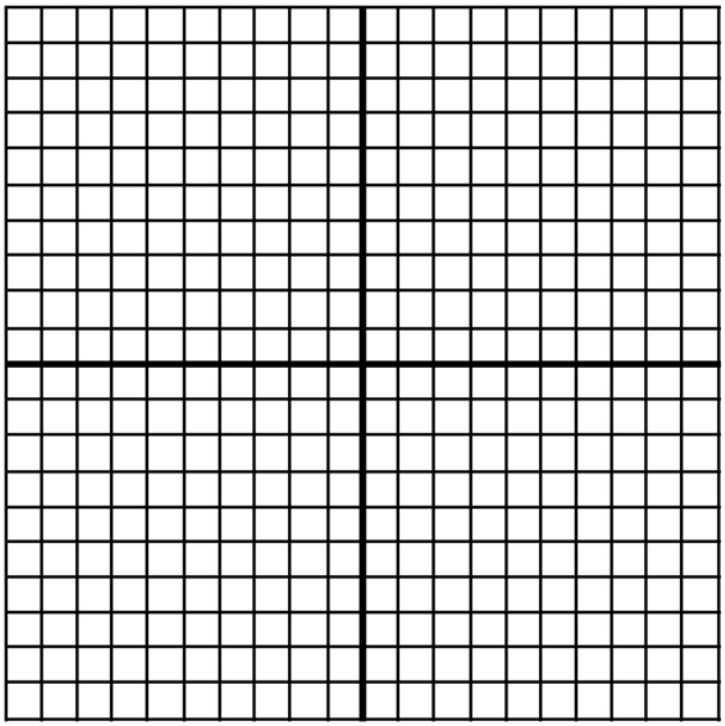
1. What is the function rule above?
2. List the domain and range:
3. Graph the equation you found below:



4. Why does the line not cross the origin? What could you attest to this amount?

Pounds of Screws	f(x) =	Cost ($)
10		$24.00
15		$36.00
20		$48.00
25		$60.00

4. What is the function rule shown above?
5. List the domain and range:
6. Is the relationship directly proportional? Explain.
7. Graph the relationship:



Day 1 Homework:
Using the domain values of 0, 1, 3, 5, 7, create **function tables** for:

1. $F(x) = 4x - 3$
2. $F(x) = 3x + 7$
3. $F(x) = -1.75x - 1$

Day 2 Homework:
Using the domain values of 0, 1, 3, 5, 7, create **graphs** of the following rules from last night:

4. $F(x) = 4x - 3$
5. $F(x) = 3x + 7$
6. $F(x) = -1.75x - 1$

Day 2 Task:

Like all artists, Lonnie Holley and Thornton Dial spent many hours on their artwork. Please see the tables below about the artists' ability to create pieces of art.

Lonnie Holley

Total Number Hours Working in Studio	Number of Pieces Completed
2	0
14	1.5
28	3

Thornton Dial

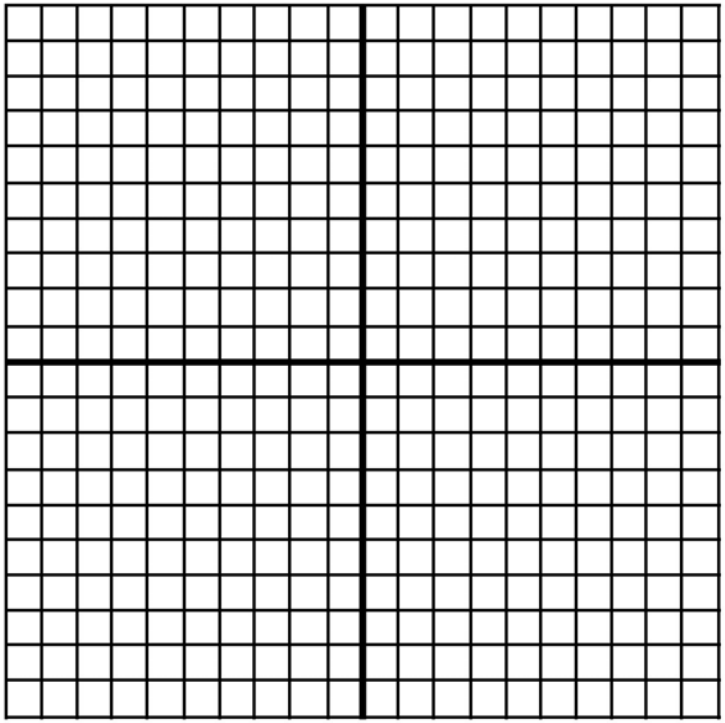
Total Number Hours Working in Studio	Number of Pieces Completed
3	1
15	5
27	9

You are tasked with the following:

A. Select an artist and create a function rule for the information listed in the table.
B. Graph the information and label the graph in slope intercept form.
C. Compare the 2 artists man hours. Can you make any mathematical conclusions about their man hours? (Be sure to use your math vocabulary – linear, nonlinear, proportional, inversely proportional, constant rate of change)

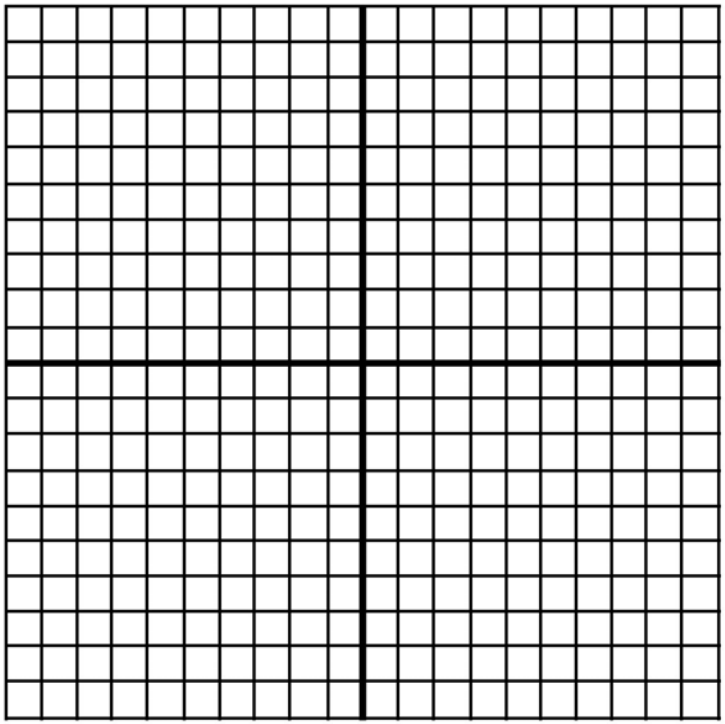
Exit Ticket Day 1

Graph: f(x) = 3x + 4



Exit Ticket Day 2

Graph: f(x) = 1.5x



Art of Lonnie Holley and Thornton Dial

Olympic Rings (LH)

Monument_to_the_Minds_of_the_Little_Negro_Steelworkers.jpg n (TD)

Gabriel's Horn (LH)

Keeping You out of Harm's Way (LH)

High and Wide (Carrying the Rats to the Man) - (TD)

Art of Alabama (TD)

The Man Hours of Lonnie Holley

hrs	# complete
2	0
14	1.5
28	3

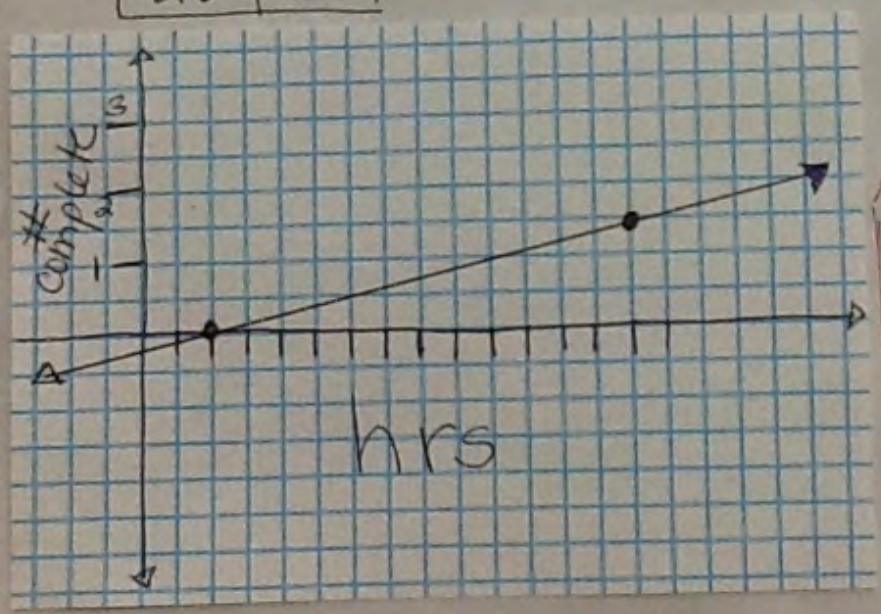
+12, +1.5, +12, +1.5

$f(x) = \frac{1.5}{12}x + 12$

rule graph

We don't agree with your equation. Δy is +1.5 Δx is 12 but 12 isn't the y-intercept.

$y = mx + b$ (b: y-int)



your graph is correct but it has a slope int form to $y = \frac{3}{12}x - 0.5$ $(\rightarrow f(x) = \frac{1}{4}x - 0.5$

- The 2 graphs/tables that show Holley + Dial man hours are both (linear.)

True but are they directly proportional?