Title:	**Grade: 8**	**BIG Idea:**
Is this Cholesterol Level too High? ***Based on the GPS Frameworks Task, 8th grade, Unit 5, "Cholesterol – Good or Bad?"**	**Author:** Hope Phillips	Linear Inequality

Real-World Connection:

This lesson on cholesterol levels highlights a link between mathematics and medicine –i.e. real-world mathematics to class mathematics. Students are generally familiar with *cholesterol* via the media, relatives, and, possibly, themselves. Determining whether one's cholesterol level is too high requires one to interpret the results of a linear inequality.

How Students will Experience the Connection: highlight in yellow all that apply

Video Clip ***see *Learn More* below**	Photo	Podcast
Print Media (article, ad, etc.)	Vodcast	Other

GPS Standards:	**Objectives:**
M8A4. Students will graph and analyze graphs of linear equations and inequalities. c. Graph equations of the form y = mx + b e. Graph the solution set of a linear inequality, identifying whether the solution set is an open or a closed half-plane. f. Determine the equation of a line given a graph, numerical information that defines the line or a context involving a linear relationship. **M8P2.** Students will reason and evaluate mathematical arguments. **M8P3.** Students will communicate mathematically.	1. Understand the meaning of a ratio. 2. Write and graph a line in the form y=mx + b. 3. Graph a linear inequality on a coordinate plane. 4. Interpret data given the graph of a linear inequality.

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M8P4. Students will make connections among mathematical ideas and to other disciplines. **M8P5.** Students will represent mathematics in multiple ways.	

Materials:

Handout – Cholesterol handout; one per student
Calculators – optional

Teacher:

Video clip (See *Learn More* section below)
Digital projector

Related Task:

Begin by asking students what they know about cholesterol. Show the video clip to introduce the lesson. Discuss the task below about Javier's mom.

Javier's mom goes to the doctor regularly and has her cholesterol checked. Javier learned that there is a good kind of cholesterol (HDL) and a bad kind (LDL). People have to be most concerned about the ratio of total cholesterol to good cholesterol. The average ratio of total to good cholesterol is 4.5 to 1. A ratio above 4.5 to 1 is an increased risk for heart disease.

- *Make a graph to help Javier see the combinations of total cholesterol and good cholesterol readings that would be higher-than-average risks.*
- *Let the x values represent **good** cholesterol (**HDL**) and the y values represent the total cholesterol readings.*
- *Javier's mother HDL is 35, and her total cholesterol is 200. His father had HDL of 60 and total cholesterol of 240.*
- *Help Javier decide whether or not his parents have a higher-than-average risk concerning the ratio of total cholesterol to good cholesterol.*

Ask students to recall what a ratio is – a comparison of two quantities with

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division – and additional ways they could express this in writing. For example, 4.5:1 and $\frac{4.5}{1}$. "Friendly" ratio examples could include $\frac{10\ boys}{15\ girls}$ or $\frac{10\ boys}{25\ students}$. Tell students doctors decide if your cholesterol is acceptable (healthy) or unacceptable (unhealthy) based on this ratio of 4.5:1.

Tell students that the ratio of $\frac{total}{HDL}$ must be less than 4.5:1 to be considered *acceptable.* A reading above 4.5:1 is *unacceptable,* increasing a person's risk for heart disease/stroke.

Tell students they will be using a graph to represent this situation. Ask them why we use graphs and their advantages. Graphs give us an easy way of organizing, displaying, and interpreting data. Students will use a graph to help them determine which cholesterol ratios are *acceptable*, *unacceptable*, or *borderline*. Our graph will represent ratios of $\frac{total}{HDL}$ that are too high, or *unacceptable*.

Ask students what math symbol they would use to show values higher than 4.5:1? Remind them that higher can be interpreted as "greater than." The "greater than" symbol, >, would be used to express this. Write on the board: cholesterol ratios > 4.5:1are *unacceptable*. Ask students what type of graph allows them to show data values that are "greater than" some given value -- in this case, the ratio $\frac{total}{HDL}$ or 4.5:1. The graph of a linear inequality will allow us to represent this cholesterol data.

On a coordinate plane, we will let the "x" values represent *HDL levels*. The "y" values will represent *Total Cholesterol*. To graph on a coordinate plane, we either need data points or an equation. Since we do not yet have data points, we need an equation. Ask students what information we have that would lead to the generation of an equation.

We have the information that cholesterol levels must be in a ratio of $\frac{total}{HDL} > 4.5:1$. Ask students what forms linear equations can take? Slope-intercept of y=mx +b and standard form Ax + By = C. Remind students, again, that the "x" values will represent *HDL levels* and the "y" values will represent *Total Cholesterol.* So, we can re-write our ratio as

$\frac{y}{x} > 4.5$. Ask students which form of a linear equation would be "friendlier" to adapt our inequality to for ease of graphing? We have an "x" value, a "y" value and a constant of 4.5 that represent the slope, "m." Selecting the slope-intercept form is the most expedient way to write an equation. To graph from an inequality, we must change the "greater than" sign to an equal sign.

y = 4.5x + 0

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Total Cholesterol = 4.5(HDL Cholesterol) + 0

Remind students that, practically speaking, one cannot have a HDL level of "0" so there is no y-intercept. Mathematically speaking, if HDL were "0," then Total Cholesterol would be "0," as well. Since there isn't a y-intercept, we need only write **y = 4.5x**

Ask students how they will show that the graph is, in fact, an inequality, and not just a linear function. There will be either a solid or dashed boundary line. Since our slope is 4.5, it might be easier to determine ordered pairs in order to create the graph. Create the following t-chart:

HDL Cholesterol (x)	**y = 4.5x**	**TOTAL CHOLESTEROL (y)**
0	y = 4.5(0)	0
10	y = 4.5(10)	45
20	y = 4.5(20)	90
40	y = 4.5(40)	180
60	y = 4.5(60)	270

Remind students that the original problem stated, "Make a graph to help Javier see the combinations of total cholesterol and good cholesterol readings that would be higher-than-average risks*."* Ask students what kind of boundary line they should draw – solid or dashed. Since our inequality is $\frac{y}{x} > 4.5$, we will use a dashed line.

Have students plot their data points and draw the dashed boundary line on their coordinate plane handouts. Ask students which half-plane they are interested in for this problem. Ask them to re-read the problem where it is stated, "Make a graph to help Javier see the combinations of total cholesterol and good cholesterol readings that would be higher-than-average risks*."* We are interested in data points that lie *above* the boundary line.

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Now students have all of the factors in place to answer Javier's questions. Pose them to students --

- *Javier's mother HDL is **35**, and her total cholesterol is **200**. His father had HDL of **60** and total cholesterol of **240**. Help Javier decide whether or not his parents have a higher-than-average risk concerning the ratio of total cholesterol to good cholesterol.*

Make sure students can articulate what the boundary line does on the coordinate plane. It separates cholesterol levels into the categories unacceptable (above boundary line) and acceptable (below boundary line).

Potting the data point (35, 200), we find it falls *above* the boundary line. Students should interpret this as meaning that Javier's mother's cholesterol level is too high, or *unacceptable* according to our ratio of 4:5 to 1. Plotting the data point (60, 240), we find it falls *below* the boundary line. Students should interpret this as meaning that Javier's father's cholesterol level falls below the 4.5 to 1 ratio and is, therefore, *acceptable*.

Tell students that mathematicians have a standard way of showing the part of the coordinate plane that has a special meaning. In this case, cholesterol levels that are too high. The shading of the upper portion of this graph, above the boundary line, indicates the area in which we have interest. As stated in the original problem, our focus is cholesterol levels whose ratios are *above 4.5 to 1*.

Since the upper portion of the graph is shaded, we need a way to communicate what this half-plane represents. Tell students that by titling the graph, they can communicate this information to a reader. One

Learn More:

http://www.healthination.com/Conditions/Videos/Cholesterol
click on "What is Cholesterol?"
running time - 2:18

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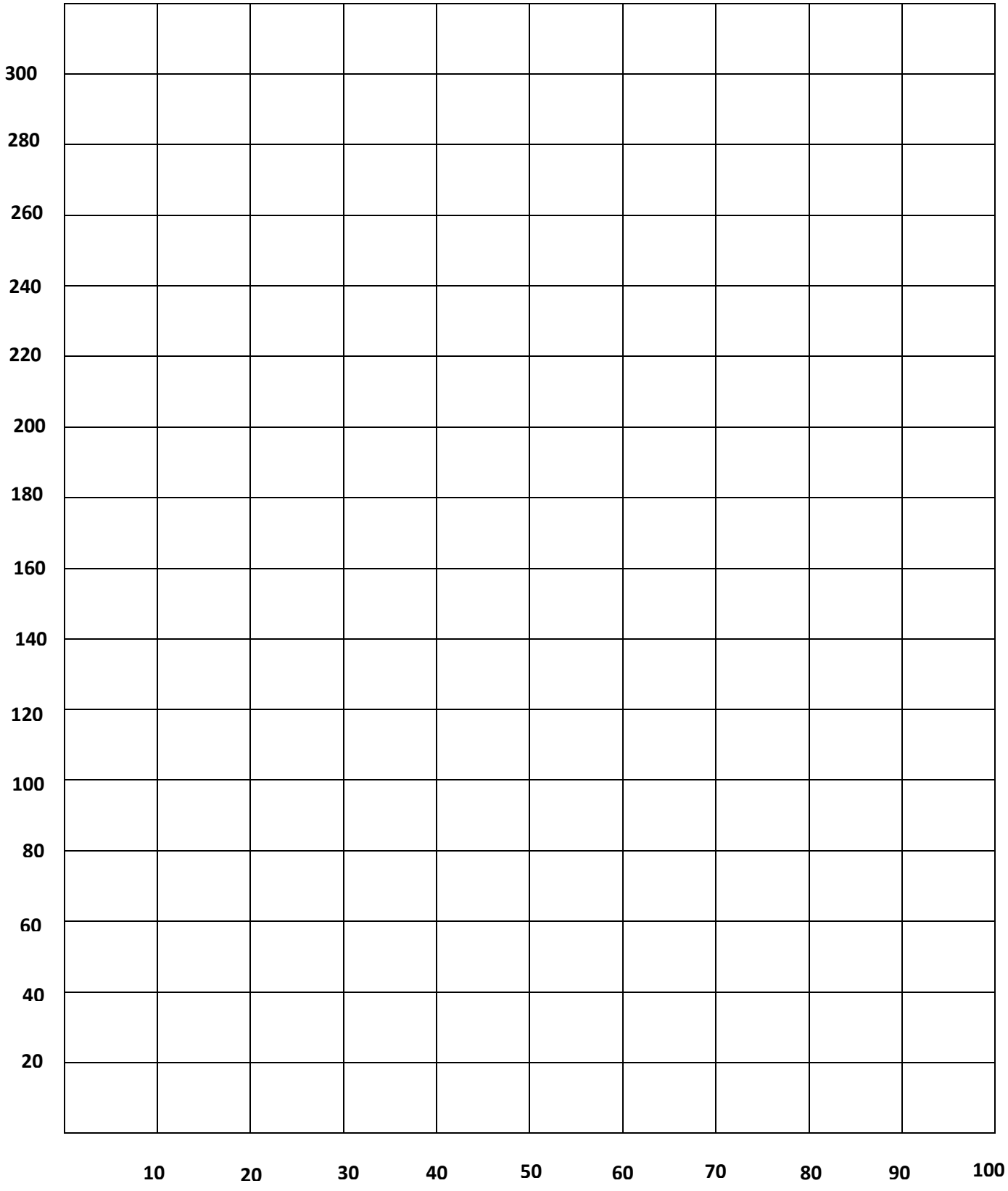
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HDL Cholesterol (mg/dL)

TITLE: