FINANCIAL AID

Is college worth the cost?

lesson guide

Going to college can be expensive. It can also set you up to get a better job and make more money. So how much more do graduates earn, and is college worth the cost?

In this lesson, students use systems of linear equations to compare how much people with different degrees will earn. Should you pursue an MBA, or take a full-time job right after high school? And is income what matters most, anyway? Students will discuss these questions and more.

Primary Objectives

- Use tuition costs and median incomes to determine net income over time for various educational paths
- Use strategies to solve systems of equations to determine when two paths will yield same net income
- Use data points on a graph to calculate tuition costs and median incomes for associate's and master's degrees
- Compare lifetime earnings for various degree types (including high school diploma)
- Discuss how and even whether income potential should affect decision of whether to attend college

Content Standards (CCSS)		Mathematical Practices (CCMP)	Materials
Grade 8 Algebra Functions	EE.5, EE.8, F.2 CED.3, REI.6, REI.11 LE.5	MP.3, MP.4, MP.5	• Student handout • LCD projector • Computer speakers

Before Beginning…

Students should be able to calculate the slope between two points on a graph, and interpret its meaning for a given real-world context. Students should also be able to solve systems of linear equations using various strategies, including algebraic and graphical.

Preview & Guiding Questions

Students watch a video snippet from the popular YouTube series, Vlog Brothers, in which the host John Green asks whether college is worth the cost. Green is from Indiana, and mentions that public in-state tuition is around $10,000/year, while out-of-state tuition is three times that. Have students discuss whether they think college is worth it, and indeed what "it" even means. It college worth the *cost*? It college worth *the time*?

The lesson explores how much different degrees cost, and the up- and downsides of each. While a higher degree is likely to yield a higher income, it can also be expensive and take a long time to earn. The purpose of the Preview activity is to get students thinking about how they'd determine whether it's worth going to college or not, including how much it costs, how much they could earn if they started work right out of college, how long it would take to pay off the various degrees, and what the overall benefit/purpose is of getting more education.

- *How much does a year of college cost? Does it always cost $10,000? Might it cost more? Less?*
- *What are some advantages of going to college? Some disadvantages?*
- *Do people who go to college usually make more? Do they always make more?*
- *How long do you estimate it would take to pay off a college degree?*
- *What do you think is the ultimate purpose of going to college?*

Act One

Students are given the median annual income for someone with a high school diploma in the United States, as well as the average tuition and median income for someone with a bachelor's degree. They use this information to calculate the total net income – total income minus educational costs – for each person in the years after high school. Someone who enters the workforce right after high school has a net income that increases every year, whereas someone who goes to college has a net income that declines for four years (in the form of tuition and expenses), but then increases *at a higher rate* after graduation. Students determine how long it would take the college graduate to "catch up" to the high school graduate – i.e. how many years until their net incomes are the same – and discuss whether going to college is a smart decision.

Act Two

In Act One, students compare the decision to enter the workforce right after high school with the decision to go to college, and in particular to pursue a bachelor's degree. Of course, there are many more educational options than just a high school diploma and bachelor's degree. In Act Two, students explore two more of these – an associate's degree and a master's degree – and determine how long someone would have to work to pay them off. Students also calculate how much each degree would yield in additional lifetime earnings, and may be surprised to find that someone with a master's degree will, on average, earn almost $1 million more over the course of his/her lifetime than someone with only a high school diploma.

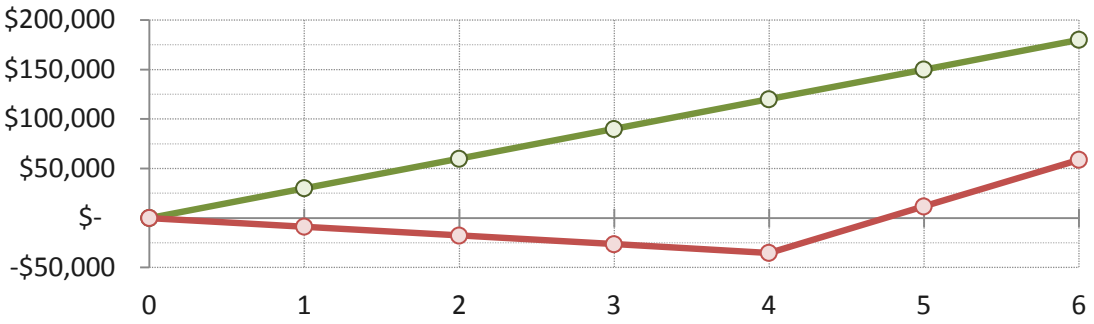
Still, money isn't everything, and students end the lesson by discussing what they value most, and the criteria they plan to use when deciding which educational path to take. After all, someone with a bachelor's degree in petroleum engineering makes way more than someone with a master's degree in social work. So does this mean that nobody should become a social worker? That would be very sad, indeed.

Act One: Commence(ment?)

1 When you graduate from high school, you can enter the workforce or go to college. According to the National Center for Educational Statistics, the median income for someone with a **high school diploma** is $30,000/year, and $47,000/year for someone with a **bachelor's degree**. A bachelor's degree typically requires four years of college, and a year of college – tuition and expenses – costs $8,800 on average in the United States.

For each option, calculate and graph the net income – total income minus costs – in the years after high school.

	Net Income Since High School Graduation						
	0 years	1 year	2 years	3 years	4 years	5 years	6 years
High School Diploma	$0	$30,000	*$60,000*	*$90,000*	*$120,000*	*$150,000*	*$180,000*
Bachelor's Degree	$0	-$8,800	*-$17,600*	*-$26,400*	*-$35,200*	*$11,800*	*$58,800*



Explanation & Guiding Questions

Students should recognize that the high school graduate's net income increases at a constant rate, whereas the college student's net income is negative as she goes further into debt during the college years, before going up after graduation. On the graph, the college graduate's net income is always lower than the high school graduate's. However, students may anticipate that because the college grad's median income is higher – i.e. since the slope of her line is greater once she graduates – her net income will eventually catch up.

Note: Students may wonder what's included in "tuition and expenses." This only includes the costs of books, and does not include other college-related expenses such as room and board. Since someone who enters the workforce right out of high school would have to pay for rent and food, too, this shouldn't affect things too much. Also, the income figures are for median incomes for a given level of education. Of course, in reality how much someone earns depends not just on the level of educational advancement, but the focus. For instance, someone with a B.A. in computer science will make a lot more than someone with a B.A. in French literature.

- *With a high school diploma, how much net income will you have in the second year? With a bachelor's?*
- *Why does the red line go down before going up…and what happens in year 4?*

Deeper Understanding

- *In years 1-4, what does the [vertical] gap between the red and green points represent? (It represents the **opportunity cost** of going to college. One could say that the first year of college actually "costs" $38,800: $8,800 in actual cost, and $30,000 in foregone salary.)*
- *If we deducted living expenses from each person's net income, what would the graphs look like? (Assuming living expenses were the same for each person, the graphs would shift down by the same amount.)*

2 Imagine an 18 year-old high school senior is debating whether to take a job after graduation or to go to college. How many years would it take until each option resulted in the same net income, and how old would she be at this point? Based on this, do you think it would be a smart decision for her to attend college? Explain.

Continuing the table:

	6 years	*7 years*	*8 years*	*…*	*12 years*	*13 years*	*14 years*
H.S.	*$180,000*	*$210,000*	*$240,000*	*…*	*$360,000*	*$390,000*	*$420,000*
B.A.	*$58,800*	*$105,800*	*$152,800*	*…*	*$340,800*	*$387,800*	*$434,800*

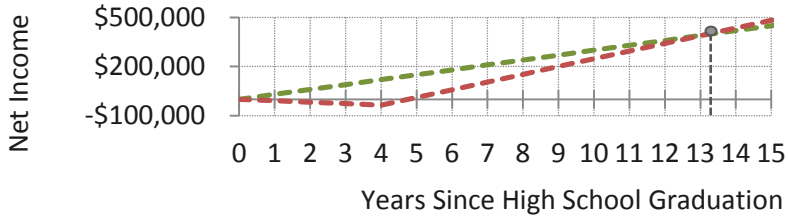
The college graduate's total net income will catch up – and then surpass – the high school graduate's net income a little more than 13 years after high school. She will be around 31 years old at this point. ("Point." Ha!!!!!)

Explanation & Guiding Questions

There are various methods that students might use to determine when the net incomes will be the same, and you might encourage them to share theirs. One method is to extend the table, as above. This is fairly straightforward. However, it's also not very accurate, since the solution is a range: somewhere *between* the 13th and 14th years.

Another method that students might attempt is to use the difference in the slopes – the difference in the annual incomes – to "close the gap." 6 years after high school, the high school graduate has $121,200 more net income than does the college grad. However, the college grad makes $17,000 more each year. Therefore, it should take $121,000 ÷ $17,000/year ≈ 7.13 *more* years to close this gap, which will happen 13.13 years after high school when each person has approximately 13.13($30,000) = $393,900 in net income.

Yet another method is to use the graph to find the intersection. Since the visible domain of the graph on the student handout is restricted to 6 years, this will be difficult. However, students might create one on scratch paper.



It's probably less likely that your students will attempt a purely algebraic solution. The red function is piecewise, and the equation of the second piece isn't what students might expect. While some may think it's $y = 47{,}000x$, it's not; if we extended the line, its y-intercept would clearly be negative. In fact, the correct equation is $y = 47{,}000x - 223{,}200$. So what does this unfamiliar y-intercept mean? It's the total *effective* cost of going to college: the $32,000 that the person paid, plus the $188,000 that the person *didn't otherwise earn* by going to college, aka the **opportunity cost** of four years of college. (Actually, since the person is only able to earn $47,000 *because* she goes to college, the equation is a bit misleading.)

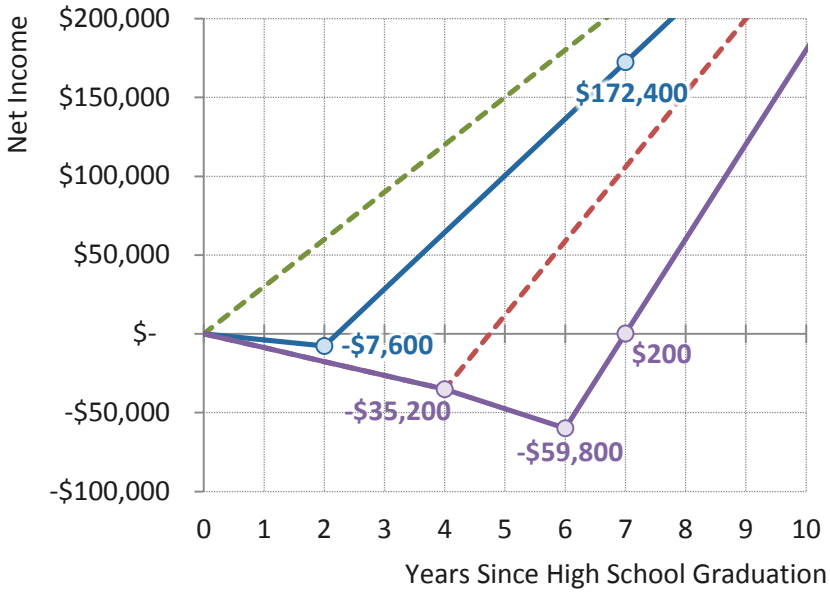
- *If you continue the table from before, when does the college grad's net income surpass the H.S. grad's?*
- *If you graph each person's net income, what does it mean when the lines cross/intersect one another?*
- *Is it possible to come up with a single equation for the H.S. graduate's net income? For the college grad's?*

Deeper Understanding

- *What is the equation of the second part of the graph, and how can you find it? (One way to find it is to use slope-intercept form. We know the slope of the line is 47,000, and that it includes the point (6, 58,800). Using this, we can write the equation $y - 58{,}800 = 47{,}000(x - 6)$, which simplifies to $y = 47{,}000x - 223{,}200$.)*
- *What is the y-intercept of this line, and what does it represent in the context of going to college?*

Act Two: Commence(ment?)

3 Students who opt for college have another decision to make: which degree to pursue. In addition to a **bachelor's degree**, the graph below shows the net incomes for two additional degrees: an **associate's degree** and a **master's degree**. For each, determine the annual tuition and expenses, as well as the median annual income.



Tuition, Associate's Degree
*2 years costs $7,600, so 1 year must cost **$3,800**.*

Income, Associate's Degree
*In five years, net income increases from -$7,600 to $172,400, for a gain of $180,000. This suggests a median annual income of **$36,000**.*

Tuition, Master's Degree
*Undergrad: **$8,800/year***
*Graduate School: **$12,300/year***

Income, Master's Degree
$60,000/year

Explanation & Guiding Questions

In Act One, students are given the slope and asked to draw the lines. Now they're given points and asked to find the slopes of the lines between them. They should also be able to interpret these slopes in context; a negative slope represents the cost per year of college, while a positive slope represents the income per year of work.

For the associate's degree graph, students will calculate two slopes: the cost of a year of tuition, and the median annual income. For the master's degree graph, they'll calculate three: the cost per year of undergraduate tuition, the cost per year of graduate tuition, and the median annual income. On the master's degree graph, though, the first two segments don't *look* all that different – it's hard to *see* a $3,500 difference in slope when the vertical increments are $50,000 – and some students might mistakenly think that a master's degree costs $59,000 ÷ 6 years ≈ $9,833.33/year, rather than four years of undergrad at $8,800/year, and two years of grad school at $12,300/year. To address this, you might ask, "If each year costs $9,833, then would four years cost $35,200?" Ultimately, the goal is for students to look at the master's degree graph as having three parts: years 0-4, years 4-6, and onward.

- *How many years does it take to get an associate's degree, and how much does it cost in total?*
- *Based on this, how much is a year of community college?*
- *Between Years 2-5, how much does someone with an associate's degree make? How much is this per year?*
- *In total, how many years would someone have to go to college to earn a master's degree?*
- *How many years is the master's degree part of a student's education, and how much does it cost?*

Deeper Understanding

- *Do you think everyone with the same level of education will have the same net income graph? (No. It doesn't just depend on how long they study, but also what they study and what job they have.)*
- *What are the linear equations for each income segment? (Diploma: $y = 30{,}000x$ for $x \geq 2$. Associate's: $36{,}000x - 79{,}600$ for $x \geq 2$. Bachelor's: $y = 47{,}000x - 223{,}200$ for $x \geq 4$. Master's: $60{,}000x - 419{,}800$ for $x \geq 6$.)*

4 Imagine three high school seniors are debating which degree to pursue. For each choice, determine how old they would be when each educational path yielded the same net income. Then, if workers retire at 65 years old, what would be the expected lifetime net income for each option?

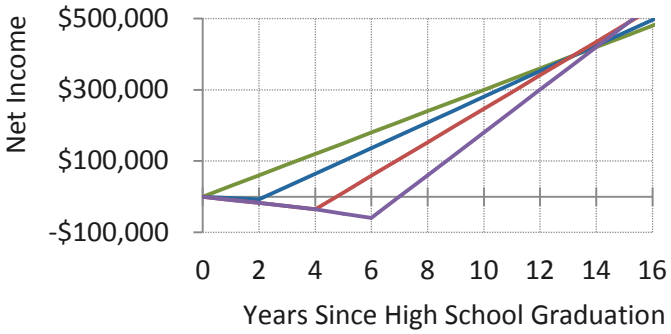
	Associate's vs. Diploma	Bachelor's vs. Associate's	Master's vs. Bachelor's
Age for Same Net Income	*13.27 years after H.S.* *(So around 31 years old)*	*13.05 years after H.S.* *(i.e. around 31 years old)*	*15.12 years after H.S.* *(i.e. around 33 years old)*

	Diploma	Associate's	Bachelor's	Master's
Lifetime Net Income	*Starts work at 18* *Works for 47 years* ***Total: $1,410,000***	*Starts work at 20* *Works for 45 years* ***Total: $1,620,000***	*Starts work at 22* *Works for 43 years* ***Total: $2,021,000***	*Starts work at 24* *Works for 41 years* ***Total: $2,460,000***

Explanation & Guiding Questions

There's a lot going on here. It's not a hard question per se, it just takes a lot of thought. Consider having students work in groups to figure it out. Fundamentally, the first part of this question is the same as #2, where students have to find the intersection between pairs of linear systems. And like before, there are multiple ways to approach it. Creating a table would work, but it would be cumbersome, as it would involve four degrees (or really, a diploma and three degrees). If students come up with linear equations for each income segment, then they can find the intersections either algebraically or graphically.

Income, Associate's	=	Income, Diploma
$36{,}000x - 79{,}600$	=	$30{,}000x$
x	≈	13.27
Income, Bachelor's	=	Income, Associate's
$47{,}000x - 223{,}200$	=	$36{,}000x - 79{,}600$
x	≈	13.05
Income, Master's	=	Income, Bachelor's
$60{,}000x - 419{,}800$	=	$47{,}000x - 223{,}200$
x	≈	15.12



However, perhaps the most intuitive way – and the way that many students may employ – is to use the "close the gap" method. It's not foolproof, though, and there's one place in particular where students might have trouble; once they determine the differences in annual incomes, they still must remember to only begin closing the gap once each version of the person has started earning money.

For instance, if students tried to find the solution to *bachelor's vs. associate's* beginning in year 2, it wouldn't work; the bachelor's person hasn't started earning yet. Instead, students need to reason something like, "In year 4, the associate's person has $64,400 in net income to the bachelor person's -$35,200, so there's an income gap of $99,600. Earning $11,000 more each year, it will take the bachelor's person 9.05 years *after she's graduated college* to close the gap." Once they have this intersection year, they must translate it to an age, e.g. "**9.05 years after college**…means **13.05 years after high school**…which means the person would be 18 + 13.05 ≈ **31 years old** when each educational track – associate's and bachelor's degree – yielded the same net income.

Calculating the lifetime incomes for each degree type is a bit more straightforward: determine the number of years that the person would work in each scenario, and multiply this by the median income. Of course, the figures that students come up with won't be perfectly realistic. After all, people's annual income is likely to go up as they gain experience and expertise over time, which is to say, the income isn't strictly a function of the degree.

- *What are we trying to find? (The point where the income lines intersect.)*
- *How many ways can you come up with to find the solution?*
- *If you use an algebraic or graphical method, what does the solution represent? (Years since high school)*
- *If you use the "close the gap" method, what does the solution represent? (Years since process started)*
- *How can you translate from this number to years since high school, and translate this into age?*
- *In each case, how long will each person be in the workforce, and how much would they earn over that time?*
- *Do you think someone's income will be the same every year they're in the workforce?*

Deeper Understanding

- *For many people, a year of college can cost more than $8,800. They might have to pay out-of-state tuition at a public university, or they might attend a private university where tuition and expenses can exceed $50,000/year. How would this affect the graphs? (It would make the graphs decline at a faster rate, so that the person starts work in more debt than on the current graphs.)*
- *Beyond higher tuition costs, why else might college cost more than $8,800/year? (Interest on student loans.)*
- *What do you think the net income graph would look like for someone who didn't graduate from high school? (According to the National Center for Education Statistics, the median income for someone with less than a high school diploma is around $23,000. The graph of this person's income would be less steep than that of the high school graduate. That's the downside. The upside is that the graph would start higher. After all, the x-axis is measured in years since high school graduation. Because this person would ostensibly have already starting working, his net income would be positive at $x = 0$, i.e. when the rest of his peers graduate.)*
- *Financially speaking, might it make sense to drop out of high school? (Regardless of what educational path they take, high school graduating peers will likely catch up very quickly in terms of their net income.)*
- *What do you think the net income graph would look like for a doctor? (Medical school can be very expensive, and lasts a long time. With internships, residency, etc., it can take more than ten years to finish. Once you're done, though, you can make a killing…pardon the pun. What this suggests is that a doctor's net income graph would start out by going down at the regular undergraduate rate, then go down by an even greater rate for the years of med school, begin to rise at whatever the intern/resident rate is…and then skyrocket once the person becomes a fully paid doctor.)*

5 In reality, how much you earn depends not just on what degree you have, but also what you studied. The average starting salary for someone with a bachelor's degree in petroleum engineering is $98,000, and $33,100 for someone with a bachelor's degree in social work. When deciding what to study (and for how long), how important do you think average income is, and do you think it's the most important factor? Explain.

Answers will vary.

Explanation & Guiding Questions

For the entire lesson, students have been evaluating the value of an educational pursuit – associate's degree, bachelor's, master's – strictly in terms of income. The more money you can make, the better the degree. But is this the most important criteria for deciding what to study, indeed what to do with your life?

For some students – and lots of parents, too! – a starting salary of $103,000 could be all they need to study petroleum engineering. At the same time, there may be others whose desire to help their communities is so strong that they'd become social workers – or teachers, firefighters, etc. – regardless of the salary.

To conclude the lesson, students discuss what they value, and consider what they'll take into account when deciding which degree to pursue (or whether to pursue one at all). To facilitate this, students watch another video clip from John Green, in which the popular YouTube commentator and best-selling author explains *his* reasons for going to college. It's quite poetic.

- *How important is it to you to make a lot of money?*
- *How important is it to you to enjoy or feel fulfilled by your job?*
- *Which would you prefer: a job that paid a lot that you hated, or one that paid very little that you loved?*
- *Can you think of any jobs that you'd find fulfilling and that pay well? Do they require a certain degree?*
- *If you could have any job in the world, what would it be?*

Deeper Understanding

- *Do you think there's a difference between how much a job is paid, and how much it's worth?*
- *The Nobel Prize-winning economist Daniel Kahneman found that, after an annual income of $60,000, any additional income does not improve happiness. Do you think this would have an effect on what you study?*