

**Objective**

- Use the CellSheet™ App to calculate accrued interest on principal

**Activity 9****Saving for Graduation****Introduction**

As the cost of college keeps rising, more and more parents and even students are developing plans to save for college expenses. If students save a certain amount every week over the four years of high school, they will have money for expenses, books, or incidentals during college.

In this activity, you will develop a spreadsheet that will show how much money one would have after saving a set amount each week for four years. Since the money will be placed in a savings account, it will earn interest.

**Problem**

Misha, a high school freshman, has decided to open a savings account to begin saving for college. He works about ten hours a week, and figures he can save \$25.00 of his weekly earnings. The money will be deposited in a bank that pays an annual interest rate of 2.12%, compounded monthly. How much will Misha have saved at the end of his high school career (four years later)?

Interest  $I$ , is calculated on a principal  $P$ , using an interest rate  $r$  and a time  $t$  with the formula  $I = P \times r \times t$ . For your calculations, the principal is the amount in the bank at the end of the previous month, the rate is the annual interest rate, and the time is one month,  $\frac{1}{12}$  of a year.

## Exploration

1. Open a new **CellSheet**, and name it **SAVE**. Enter the information as shown here. In cells A2 to A5, enter **YR1** through **YR4**. In cell A6, enter **INTRT**. (Remember to press **[ALPHA]** **["]** before entering text.) In cells B2 to B5, enter **=25**, the weekly savings amount. In cell B6, enter **=.0212**, the *annual* interest rate paid on the savings.

SAVE	A	B	C
1			
2	YR1	25	
3	YR2	25	
4	YR3	25	
5	YR4	25	
6	INTRT	.0212	
B6: .0212			[Menu]

2. In cell A11, enter **1** to designate the beginning of the first year. Enter **2** in cell A23, **3** in cell A35, and **4** in cell A47, each marking the beginning of the year.

**Hint:** **[ALPHA]** **[↑]** jumps six rows at once so you can move around the spreadsheet more quickly.

SAVE	A	B	C
43			
44			
45			
46			
47	4		
48			
A47: 4			[Menu]

3. Starting in cell B11, you will enter the numbers **1** through **48** down column B, representing the 48 months during which money will be saved. You can use the **SEQUENCE** option to enter these numbers.

CELLSHEET MENU			
1:	File...		
2:	Edit...		
3:	Options...		
4:	Charts...		
5:	Help		
6:	Quit CellSheet		

4. In cell B11 select **Menu > Options > Sequence**.

OPTIONS			
1:	Statistics...		
2:	Fill Range...		
3:	Sequence...		
4:	Import/Export...		
5:	Sort...		
6:	Col Decimal...		

5. Enter the settings as shown:

SEQUENCE			
1st Cell:	B11		
seq(X,X,1,48,1)			
Down	Right		
Enter			

The **SEQUENCE** option places the numbers 1 through 48, by 1, in the cells B11 through B58.

SAVE	A	B	C
53		43	
54		44	
55		45	
56		46	
57		47	
58		48	
B58: 48			[Menu]

Column C will contain the amounts that are to be deposited each month, which is four times the amount in cell B2.

6. In cell C11 enter  $=4*\$B\$2$ .  
(Remember that the dollar signs denote an absolute reference.)
7. Copy this formula down through cell C22. In cell C11, press **ZOOM**  $\downarrow$  **Y=**  $\downarrow$  through cell C22, and then press **TRACE**.

SAVE	A	B	C
11	1	1	100
12		2	
13		3	
14		4	
15		5	
16		6	
C11: =4*\$B\$2			[Menu]

SAVE	A	B	C
17		7	100
18		8	100
19		9	100
20		10	100
21		11	100
22		12	100
C22: =4*\$B\$2			[Menu]

8. Repeat steps 6 and 7 in cell C23 (year 2), cell C35 (year 3) and cell C46 (year 4).

In cell C23, enter  $=4*\$B\$3$  and copy it down through cell C34.

In cell C35, enter  $=4*\$B\$4$  and copy it down through cell C46.

In cell C47, enter  $=4*\$B\$5$  and copy it down through cell C58.

SAVE	A	B	C
53		43	100
54		44	100
55		45	100
56		46	100
57		47	100
58		48	100
C58: =4*\$B\$5			[Menu]

The graphing handheld will work much faster if recalculation is turned off until you complete the spreadsheet. Select **Menu > File > Format**. Turn the automatic recalculation off by selecting **AutoCalc: N**.

After you have set up the spreadsheet, use this same option to turn the recalculation back on.

9. In Column D, you will be able to see how much money you will have at the end of each month. At the end of the first month, the amount in the bank is only what was deposited. You earned no interest since the money was not in the bank long enough. Enter **=C11** in cell D11.

SAVE	B	C	D
11	1	100	100
12	2	100	
13	3	100	
14	4	100	
15	5	100	
16	6	100	

D11: =C11 [Menu]

10. Each subsequent month, you will earn interest on the previous amount in the bank. Enter **=D11+D11\*\$B\$6\*1/12+C12** in cell D12. This calculation adds the previous balance (D11) and the interest earned on the previous balance (**D11\*\$B\$6\*1/12**) to the deposit made for that month (C12).

SAVE	B	C	D
11	1	100	100
12	2	100	200.18
13	3	100	
14	4	100	
15	5	100	
16	6	100	

D12: =D11+D11\*\$B\$6\*1/12+C12 [Menu]

After entering a very involved formula like this one, check to see if the result makes sense before copying it. You've made two \$100 deposits and expect some, but very little, interest. Therefore, the total of \$200.18 makes sense.

11. Copy the formula in cell D12 down through cell D58.

SAVE	B	C	D
53	43	100	4463.5
54	44	100	4571.3
55	45	100	4679.4
56	46	100	4787.7
57	47	100	4896.1
58	48	100	5004.8

D58: =D57+D57\*\$B\$6\*1/12+C58 [Menu]

Again, check to see if the amounts make sense before moving on.

12. To make the spreadsheet easier to read, enter the following in each cell as indicated:

- in cell C2: **=D22**
- in cell C3: **=D34**
- in cell C4: **=D46**
- in cell C5: **=D58**

SAVE	A	B	C
1			
2	YR1	25	1211.7
3	YR2	25	2449.4
4	YR3	25	3713.6
5	YR4	25	5004.8
6	INTRT	.0212	

A1: [Menu]

These formulas put the yearly totals at the top of the spreadsheet making them easy to see.

# Student Worksheet

Name \_\_\_\_\_

Date \_\_\_\_\_

## Reviewing the Concepts

- Interest on the last month's \_\_\_\_\_ is calculated and added to the total each month. Interest works for you when you \_\_\_\_\_ money.

## Solving the Problem

- If Misha puts \$25.00 a week in the bank, how much will he have saved after one year? \_\_\_\_\_ After 2 years? \_\_\_\_\_ 3 years? \_\_\_\_\_ 4 years? \_\_\_\_\_

## Analyzing the Data

- How do the amounts he accrues each year compare? Will he have earned the same amount in interest in year 1 as in year 2? In which year will he have earned the most interest? How can you explain the results knowing that he saves the same amount each week?
- How much more money would Misha earn over four years if the bank paid him 2.75% interest? (He's still saving \$25.00 a week for four years.)
- During his junior year, Misha gets a different job and is able to save more money. He decides to save \$40.00 a week for the next two years. How much money will he have saved by the end of four years?
- Look at these three savings plans and calculate the yearly totals for each plan. (Interest is compounded monthly.) In which plan would you have saved the most money after four years?

	Plan 1		Plan 2		Plan 3	
	Weekly Savings	Yearly Totals	Weekly Savings	Yearly Totals	Weekly Savings	Yearly Totals
Year 1	\$25		\$43.75		\$25	
Year 2	\$35		\$43.75		\$35	
Year 3	\$50		\$43.75		\$50	
Year 4	\$65		\$43.75		\$65	
Annual Interest Rate	2.12%		2.12%		2.75%	

7. Looking at the data you collected, explain why the totals for the second and third plans are greater than the totals in the first plan even though the total amount deposited is the same.

8. Calculate the amount of interest earned in each of the three scenarios in Question 6.

	Plan 1		Plan 2		Plan 3	
	Weekly Savings	Yearly Totals	Weekly Savings	Yearly Totals	Weekly Savings	Yearly Totals
Year 1	\$25		\$43.75		\$25	
Year 2	\$35		\$43.75		\$35	
Year 3	\$50		\$43.75		\$50	
Year 4	\$65		\$43.75		\$65	
Total Interest Earned						

9. Let us say you have followed Plan 2. At the end of four years, you have accumulated a tidy sum! Now you want to begin to withdraw money monthly over the next four years. Since your average monthly deposit was \$43.75, will you be able to withdraw less than, the same, or more than that amount if you want the money you have saved to last you four years? Explain.
10. How easy is it to save \$65.00 a week? Imagine that you have a job that pays \$8.75 an hour. Your weekly expenses are about \$30.00. How many hours per week will you have to work in order to net (after taxes—use 28% for your deductions) \$65 per week? Show your calculations.

## Teacher Notes



## Activity 9

### Saving for Graduation

#### Preparation

According to U.S. government statistics, personal savings rate in 2003 was only 3.3%. Many students may not realize the benefits of having a savings account or familiar with the concepts of periodic compounding of interest.

Getting them to consider making periodic payments into an interest-bearing account is important. Even with a very low interest rate, they should see that it is good to have interest working for you.

#### Elicit Questions

You might want to start with a discussion about college planning. Ask how many have started saving for college. Do their parents have a college fund for them? How much do they think college costs? Bring up incidental costs that students will also incur. Have students generate a list of incidentals. You could also talk about the feasibility of working while in college (generally more difficult than working while in high school). Lead students to the idea of saving for college during high school.

#### Management

Students may work in groups on this activity. Each group may want to use their own monthly amounts. Students should explain their work to the other members of the group when they have finished.

#### Objective

- Use the CellSheet™ App to calculate accrued interest on principal

#### Materials

- TI-84 Plus/TI-83 Plus

#### Time

- 60 minutes

## Answers to Exploration Questions

### Reviewing the Concepts

- Principal; save

### Solving the Problem

- After one year: \$1,211.70; after two years: \$2,449.40; after three years: \$3,713.60; after four years: \$5,004.80.

### Analyzing the Data

- He will have earned more interest in year 2 than in year 1 (\$11.70 in year 1 and \$37.70 in year 2). He will earn the most interest in year 4 because the principal is the greatest. The principal amount on which interest is calculated monthly constantly increases, so the amount of interest paid increases.
- \$63.00 (total saved after four years at 2.75% = \$5,067.80)
- \$6,474.40
- You would save the most with Plan 3

	Plan 1		Plan 2		Plan 3	
	Weekly Savings	Yearly Totals	Weekly Savings	Yearly Totals	Weekly Savings	Yearly Totals
Year 1	\$25	\$1,211.70	\$43.75	\$2,120.50	\$25	\$1,215.20
Year 2	\$35	\$2,934.10	\$43.75	\$4,286.40	\$35	\$2,950.40
Year 3	\$50	\$5,420.40	\$43.75	\$6,498.70	\$50	\$5,463.10
Year 4	\$65	\$8,686.90	\$43.75	\$8,758.40	\$65	\$8,774.80
Annual Interest Rate	2.12%		2.12%		2.75%	

- Even though the total deposited is the same for each scenario, Plan 2 earns more interest than Plan 1 because more money is deposited early in the first and second year. That money accumulates more interest which results in a larger sum. In the last scenario, the interest rate is greater and thus more interest is earned over the four years.



8.	Plan 1		Plan 2		Plan 3	
	Weekly Savings	Yearly Totals	Weekly Savings	Yearly Totals	Weekly Savings	Yearly Totals
Year 1	\$25	\$1,211.70	\$43.75	\$2,120.50	\$25	\$1,215.20
Year 2	\$35	\$2,934.10	\$43.75	\$4,286.40	\$35	\$2,950.40
Year 3	\$50	\$5,420.40	\$43.75	\$6,498.70	\$50	\$5,463.10
Year 4	\$65	\$8,686.90	\$43.75	\$8,758.40	\$65	\$8,774.80
Total Interest Earned		\$286.90		\$358.40		\$374.80

9. You will be able to withdraw more than that amount each month for four years. Interest will continue to accrue on the balance even as you make withdrawals. Even with an interest rate as low as 2.12%, you would be able to withdraw in the neighborhood of \$50 per week for all four years.

10. You have to net \$65 plus \$30 = \$95.00.

$$\text{Net} = \text{gross} - \text{deductions} \rightarrow \$95.00 = \text{Gross} - 0.28(\text{gross}) \rightarrow \$95 = 0.72(\text{gross})$$

$$\rightarrow \text{Gross} = \$95/0.72 \approx \$132.00$$

$$\$132.00 = \$8.75 \text{ per hour (\# hours worked)}$$

$$\rightarrow \# \text{ hours worked} = \$132.00/\$8.75 \approx 15 \text{ hours}$$