# Dollars and Sense

## Stay in the Black: Saving and Spending

### LESSON 7

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# DEDICATION
From Mitch Julis of the Julis Foundation

My enthusiastic support for this project is in loving memory of my father
Maurice Ralph Julis and in honor of my mother Thelma Rabinowitz Julis.

My parents were inspirational teachers throughout their careers
in New York with a strong interest in finance and economics. I am sure they
would have embraced this book with great enthusiasm.

*Dollars and Sense*

# Dollars and Sense

## Stay in the Black: Saving and Spending

*Nothing is constant except change*
Heraclitus of Ephesus (c. 535–475 BCE)

he materials provided here use systems thinking and mathematical tools and exploratory computer simulations to challenge students and teachers to develop a realistic and personal understanding of the dynamics of the economic system in which we live. With their resulting knowledge and understanding, they should be better able to control their financial futures, minimize the chance for future pain, and maximize the chance for fostering a prosperous future.

Personal finance, at its core, involves relatively few working parts. However, managing our finances is hard, because change is ever present and none of those parts ever stay the same for long. With money flowing in and out, our funds grow or shrink at different rates, at different times, and for different reasons. Without observing, analyzing, and understanding the patterns of change in money accumulations over time and without recognizing the connections that exist between all the parts of the system, adults frequently pay a real and heavy price.

As teachers, we can help our students prepare to deal with that critical but ever-changing system of personal finance. The innovative tools of *systems thinking* and *dynamic simulations* presented in these materials offer young students (5th–7th grade) a unique opportunity to develop a better understanding of the mathematics of change; to learn constructively and collaboratively; and, over a lifetime, to successfully manage their personal finance. The activities in the seven lessons of this Module 1 utilize a series of computer simulations and their accompanying worksheets, which are designed to help young students explore how (and why) their personal finances change over time. As students explore the diverse set of financial situations, they will learn in four different ways.

- *Learn by doing (constructivism)*: asking open-ended "what if's" and using meaningful real-world examples.
- *Learn by building a conceptual foundation* that connects critically important mathematical tools (tables, graphs) and skills with a systems thinking conceptual framework that visually represents the dynamically changing financial systems (e.g., a personal savings account).
- *Learn by challenging preconceptions*, and using computer simulations to discover that there is more than one right answer or way to successfully manage one's finances.
- *Learn by sharing, comparing, collaborating, and applying lessons learned* to meaningful personal financial problems.

**The core message for success: Spend less than you earn!**

Sounds simple, but when money flows in and out in different amounts and at different times… it is not nearly so simple!  Yet our experience shows that 5th to 7th graders, working with mathematical tables, graphs, and computer simulations, can (and do!) "get it"!!

## How Is This Module Organized?

Module 1 (Personal Finance) focuses on "saving" and "spending." (Subsequent modules will deal with investment and credit.) As in each module, Module 1 is open-ended. It allows for and encourages students to create and share mathematical approaches, tables, and graphs in order to explain and discuss personal finance goals, plans, and choices with peers, teachers, or parents. These activities are supported by the worksheets provided here and by the simulations that are available on-line.

Module 1 includes seven lessons, each of which contains a computer simulation with at least one challenge. The lessons are organized into three sections, each section progressively building on the foundations of the earlier section(s).

The core systems thinking building blocks that guide student understanding of the structure of change also drive the computer models underlying the simulations.

MY ACCOUNT

Income
Flows In
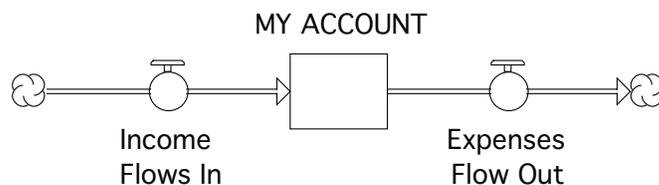
Expenses
Flow Out

- Money accumulates in MY ACCOUNT (we call that a "STOCK").

- An "inflow" into MY ACCOUNT—which can be wages, other deposits, or interest earned on the account—adds to that stock.

- An "outflow" from that stock—expenses—reduces or drains MY ACCOUNT.

### Section 1: Introduction to Personal Saving and Spending

Section 1 provides an introduction to linear (constant) saving, linear spending, and simultaneous saving and spending. We STRONGLY RECOMMEND it as a prerequisite for subsequent lessons.

- **Lesson 1: Can I Manage My Money and My Music?**

### Section 2: Extended Saving and Spending Illustrations

Section 2 moves the understanding of simultaneous inflows and outflows forward by guiding students in choosing their own personal financial goals, running a business, operating a public service, or helping a friend plan to purchase a car. We provide simulations of each of these four illustrative scenarios.

- **Lesson 2: Can I Reach a Personal Saving and Spending Goal?**
- **Lesson 3: Can I Make Money with a Lemonade Stand?**
- **Lesson 4: Can I Successfully Run the Local Food Bank?**
- **Lesson 5: Can I Help a Responsible Teen Buy a Car?**

### Section 3: Growing Savings through Interest and Compounding

In Section 3, the lessons move into compounding growth (rather than linear growth) to explore the role of interest on savings. We provide an introduction to compound interest and then a more ambitious illustration of long-term planning that brings together earning, spending, and saving with compounded interest.

- **Lesson 6: How Does Interest Grow My Savings?**
- **Lesson 7: Can Compounding Interest Make Me a Millionaire?**

Each individual lesson offers the following:

1. An open-ended and meaningful question or problem for the students to explore or solve.

2. Support for that learning through a set of System Dynamics conceptual and simulation tools to help students structure, improve, and communicate their understanding of these issues and processes.

3. Encouragement to expand that understanding by identifying and exploring "better questions" and other contexts in which those dynamics also apply.

4. The challenge and the tools with which to address problems of students' own creation.

5. Opportunities to share and communicate what they have learned with peers, teachers, and parents.

## Frequently Asked Questions

**Will this be fun as well as educational?**

*Students love this approach. It is fun to play hands-on games and learn through experience. Students can work in teams, share ideas, talk with and listen to each other, not just respond to the teacher. Often something surprising happens and discovering the reason is eye-opening.*

*When students are active, cooperating, and solving their own problems, their level of engage-*

*ment is high and the learning sticks with them. In addition, students who have struggled with more typical academic tasks often have a new opportunity to "show what they know" using new learning tools.*

**Will this be complicated for me to teach?**

*Teachers are provided with concise supporting materials that include an overview and context for the student activities. Each lesson begins with a brief summary so that teachers can see what is covered. Background information is succinct and procedures are laid out step by step. Student worksheets are at the end of each lesson, ready to photocopy.*

**Can my students actually do these lessons?**

*Although the activities in this book have been written with a focus on 5th–7th grade capabilities, they may be used with a wide range of student ages. Lesson 1 was designed to serve as a foundation for later lessons (2–6); those later lessons can be pursued in whatever way best suits the needs and interests of the teacher. Lesson 7 assumes the knowledge and understanding developed in Lesson 6.*

**What benefits do the students get from these lessons?**

- *Students acquire new learning tools and work independently and together to apply them. Each individual lesson fosters constructivist learning.*
- *Teamwork gives rise to better thinking through dialogue, motivation to tackle tougher problems together, mutual respect, and fun.*
- *All the lessons are structured to build cooperative learning.*
- *Finally, each lesson is designed to provide practical opportunities for students to experience by doing, by making different choices, and by comparing and evaluating relative outcomes.*

**How do these activities interact with recognized 5th–7th grade content and standards?**
**(See also "Meeting Standards" table below.)**

*The challenges presented in these activities take on big ideas that are central to the 5th–7th grade curriculum and that are transferable to other topics.*

*1. Module 1 lessons align with the National Council of Teachers of Mathematics (NCTM) Content AND Process Standards.*

- *Content standards include skills for Number and Operations, Algebra, and Data Analysis and Probability.*
- *Process Standards apply to all areas (Problem Solving, Reasoning and Proof, Communication, Connections, and Representation).*

*2. The lessons also address several of the Economics Standards advocated by the Council on Economic Education (CEE), including concepts involving opportunity costs; incentives; supply; demand; and price, interest, and earnings.*

*3. Finally, the lessons support the National Science Teachers Association (NSTA) standards related to the following:*

- *Systems, order, and organization;*
- *Evidence, modes, and explanation; and*
- *Change, constancy, and measurement.*

## Curriculum Connections

The tool-sets and mind-sets developed here have application far beyond *just* an understanding of personal finance. As students use graphs to understand how money accumulations (STOCKS) change over time, they also find that similar patterns of behavior arise in other places in the real world. And their practical application of the systems thinking tools taught here to represent change can be applied to a wide variety of "systems," ranging from populations (of people, animals, plants, etc.) to resources and even to emotions about people and events. All of these systems in the real world are subject to factors that increase and decrease the overall STOCK in variable ways.

## Meeting Standards

The simulations and worksheets that are part of each lesson are designed to use personal finance challenges to address age-appropriate CONTENT and PROCESS standards in Mathematics, as well as emerging national standards in Economics, the NSTA standards identified above, and the transferable tool- and mind-sets of System Dynamics that support wide-ranging critical thinking and collaborative skills. The following table provides a more detailed breakdown of how Module 1 relates to these standards.

| Dollars and Sense | |
| --- | --- |
| • Hands-on Activities | • Accommodation to different ability levels |
| • Teamwork | • Sophisticated content |
| • Reflection | • High-level critical thinking |
| • Dialogue among students | • Agreement with goals of national standards |
| • Constructivism and inquiry | • Simple preparation and easy directions |

**NOTES**

1  The Waters Foundation uses these questions in its teacher training workshops—a good way to maintain focus on the central purpose of system dynamics in education. Students delve beyond surface events to question their causes and broader implications.

2  Gayle Richardson framed these questions as a way to help students understand and graph change. For more information, see "Getting Started with Behavior Over Time Graphs: Four Curriculum Examples," 1998, available from the Creative Learning Exchange at www.clexchange.org.

| Lesson | Math Standards (NCTM) | Economics Standards (CEE) | System Dynamics Objectives (CLE) |
|---|---|---|---|
| **Lesson 1: Can I Manage My Money and My Music?** Saving for a GOAL (an mp3 player and tunes), and spending "wisely" to make that savings last.<br><br>**Lesson 2: Can I Reach a Personal Saving and Spending Goal?** Pursuing saving and spending PLANS to reach a personal goal.<br><br>**Lesson 3: Can I Make Money with a Lemonade Stand?** Running a business, with income, expenditures, and profit.<br><br>**Lesson 4: Can I Successfully Run the Local Food Bank?** A non-profit maximizing the "good" it does (rather than profits!) while needing to be sustainable.<br><br>**Lesson 5: Can I Help a Responsible Teen Buy a Car?** Role of "trade-offs" (short-term vs. long-term gratification, sacrificing free time for work) to pursue a "big" financial goal.<br><br>**Lesson 6: How Does Interest Grow My Savings?** Introducing the "miracle" of compound interest and its power for generating long-term savings.<br><br>**Lesson 7: Can Compounding Interest Make Me a Millionaire?** Putting all of the pieces together—saving, spending, and earning interest—to see if an "average" person can become a millionaire! | **CONTENT STANDARDS**<br>**Number and Operations**<br>• Understand meanings of operations and how they relate to one another.<br><br>**Algebra** (includes some Grade 6–8 standards)<br>• Understand patterns, relations, and functions.<br>• Use mathematical models to represent and understand quantitative relationships.<br>• Analyze change in various contexts.<br><br>**Data Analysis and Probability**<br>• Formulate questions that can be addressed with data; collect, organize, and display relevant data to answer questions.<br>• Develop and evaluate inferences and predictions that are based on data.<br><br>**PROCESS STANDARDS**<br>**Problem Solving**: Build new mathematical knowledge; apply/adapt a variety of strategies to solve problems; reflect on process.<br><br>**Reasoning and Proof**: Make/ investigate mathematical conjectures; develop/evaluate mathematical arguments; use various types of reasoning and methods of proof.<br><br>**Communication**: Organize and consolidate thinking; communicate coherently and clearly to peers, teachers, and others; analyze and evaluate thinking/strategies of others.<br><br>**Connections**: Recognize and use connections among mathematical ideas; recognize and apply mathematics in contexts outside of mathematics.<br><br>**Representation**: Create/use representations to organize, record, and communicate mathematical ideas and to model and interpret physical, social, and mathematical phenomena. | **Standard 1**: Students will identify what they gain and what they give up when they make choices.<br><br>**Standard 2**: Students will make effective decisions as consumers, producers, savers, investors, and citizens.<br><br>**Standard 3**: Students will evaluate methods of allocating goods and services, by comparing the benefits and costs of each method.<br><br>**Standard 4**: Students will identify incentives that affect people's behavior and explain how incentives affect their own behavior.<br><br>**Standard 8**: Students will predict how prices change when the number of buyers or sellers in a market changes.<br><br>**Standard 12**: Students will explain situations in which they pay or receive interest.<br><br>**Standard 13**: Students will predict future earnings. | 1. Systems are dynamic, meaning that they are characterized by change over time (familiarity with Behavior-over-Time Graphs).<br><br>2. Dynamics in systems are a result of the interaction of stocks and flows (ability to create a simple one-stock stock/flow diagram).<br><br>3. Altering inflows and outflows can create many patterns of change in stocks (understanding different graph patterns and the underlying data and dynamics to which they are linked).<br><br>4. Inflows and/or outflows are controlled in many ways to achieve a desired size of stock (ability to manipulate a simple one-stock model to achieve desired outcomes).<br><br>5. Reinforcing feedback loops (e.g., compound interest) are powerful and often non-intuitive in their effects (familiarity with the concept of reinforcing feedback and how it influences stocks and flows). |

# Can Compounding Interest Make Me a Millionaire?

N O T E — The material developed in Lesson 1 and Lesson 6 is strongly recommended to familiarize students with the basic concepts that are used and further expanded in this lesson.

## Instructions for Teachers

### Student Challenge:

This culminating lesson brings together all of the concepts developed in earlier lessons (saving, spending, and compounding interest) to offer students a real-world challenge to save $1 million. Using a computer simulation, students are challenged to see if (and how) an average person, starting an everyday job at age 21, can manage this ambitious personal financial GOAL within a period of 44 years (their working lives!) or less.

### At the Lesson's End:

- Students will have completed a structured exploration of the connections between long-term saving, spending, and compounding interest in generating a net savings of $1 million.

- Students will have used tables, graphs, and systems thinking concepts to select and evaluate different saving and spending strategies, together with different interest rates; to identify their preferred PLANS based on personal values; and to share their results with classmates (and parents!).

(See the following Instructions and the Worksheet for more details)

## Overview

Lesson 7 contains a single exercise, utilizing a computer simulation, to allow students to explore the implications of long-term efforts, reflected in saving, spending, and interest rates, to accumulate $1 million. Prior to using the simulation students are encouraged to work on paper to develop budgets (Income and Expenses) based on real-world salaries and costs.

The decisions the students make, together with various interest rates, are then entered into the simulation using the Control Panel. The Control Panel, reproduced below, shows 3 PLANS using a Fireman's salary of $2600/month, an Annual Interest Rate of 4%, and 3 different monthly Expenses: $2250, $2000, and $1750. NOTE: the success in PLAN #3 (Expenses of $1750) comes with considerable sacrifice in minimizing monthly Expenses!

**M A T E R I A L S**

- Computer Simulation (available on-line at http://clexchange.org/curriculum/dollarsandsense/lesson7.asp).

- Worksheet to record plans and results.

## Can Compound Interest Make Me A Millionaire?

NAME:

MY AGE: 62    YEARS OF SAVING: 41

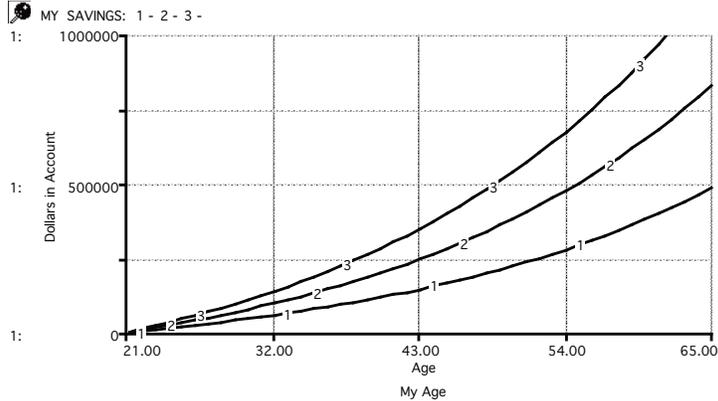TOTAL EARNED INCOME ($): 600031 / 1279200
MY SAVINGS ($): 1018231
TOTAL EXPENSES ($): 861000

Monthly Deposit ($) (earnings - expenses): 850
Last Monthly Interest Payment: 3394

Enter the amounts ($$) below that represent expected monthly income and budgeted expenses (You can use the worksheets provided to help). Define an Annual Interest Rate on Savings. Then Run.

| U | PLAN To Be Millionaire | |
|---|---|---|
| | Monthly Income | 2600 |
| | Monthly Expenses | 1750 |
| | Annual Interest Rate % | 4 |
| | | |

MY SAVINGS: 1 - 2 - 3 -

Dollars in Account — 1000000, 500000, 0

Age: 21.00, 32.00, 43.00, 54.00, 65.00
My Age

Explore different PLANS before selecting a favorite. Be prepared to explain WHY.

Clear Graph & Table    Run    Print    Exit    Back    Main Intro

For another "look" at the same simulation, click here for a table.    Table

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Students will observe that in these illustrations, the STOCK of MY SAVINGS grows at an ever-increasing rate. To understand what is behind that pattern of growth, it is critical to recognize three factors—all operating simultaneously—that contribute to the flow of money in and out of one's account.

1. Money flows into MY SAVINGS through two sources: Earnings Income <u>and</u> Interest Income. Money flows out in the form of Expenses. *The fact that MY SAVINGS consistently grows means that the two sources of Income always exceed Expenses. This reinforces a core principle for managing personal finance:* SPEND LESS THAN YOU EARN.

2. The Flow of Earnings Income  into MY SAVINGS is constant in this illustration; hence, Earnings Income causes MY SAVINGS to grow steadily or linearly. That means the non-linear pattern of growth in MY SAVINGS reflects a changing amount of Interest Income.

3. The amount of Interest Income (in blue, in the Stock and Flow Map), which the bank pays each year, is governed by two factors. Two "connectors," the skinny arrows, carry this information from other parts of the model to the Interest Income Flow. The two pieces of information needed for the bank to calculate its annual interest payment are:

a. The amount of money in MY SAVINGS; and

b. The interest rate paid by the bank.

The Interest Income is then added to MY SAVINGS. The next interest payment will be larger, since it will then be based on this larger amount in MY SAVINGS.

## Optional Pre-Lesson Discussion

Although Lesson 7 contains a single, simulation-based, exercise, prior to letting the students work with the simulation, we strongly recommend that students stop and think: How Much is $1 Million?

There are two ways to approach this question.

Compounding interest creates a Reinforcing Feedback Loop. Interest Income added to MY SAVINGS increases the amount of money in that STOCK, thus increasing the amount of interest received next year, resulting in still more money in MY SAVINGS . . . and so on.

**If left alone for a long time, reinforcing feedback produces explosive growth.**

### 1. What Could You *Buy* with $1 Million?

Consider a few simple illustrations (or choose your own).

| Item | Cost For One: | # You Could Buy with $1 Million: |
|---|---|---|
| House | $250,000 | 4 |
| Car | $25,000 | 40 |
| Family Trip to Disneyworld | $2500 | 400 |
| Nintendo Wii | $250 | 4000 |
| OTHER? | | |

### 2. How Long Would It Take an Average Working Person to Save $1 Million?
(Assuming they only earned money but never spent any!)

| Job and Hourly Pay | Total Hours to Earn $1 Million | Weeks to Earn $1 Million | Years to Earn $1 Million |
|---|---|---|---|
| Fast Food Counter Help ($8 an hour) | 125,000 | 3125 | 62.5 |
| Taxi Driver ($10 an hour) | 100,000 | 2500 | 50 |
| Postal Clerk ($25 an hour) | 40,000 | 1000 | 20 |
| OTHER? | | | |

Note: If you would like students to learn about what different jobs pay, have them check the Bureau of Labor Statistics (*http://www.bls.gov/oes/2008/may/oes_nat.htm#b00-0000*).

# Bringing The Lesson Home
**(for the Pre-Simulation Exercise)**

**What would be the greatest benefit of having $1 million?**

*Here's a chance to have students examine/communicate what they value most.*

**How many fast food workers, taxi drivers, or postal clerks do you think are millionaires? Why do you think this?**

*The numbers shown don't factor in their normal living expenses —housing, transportation, food, etc. They need to pay for these out of their earnings. Therefore, it will take them even longer (much longer!) to save $1 million.*

## Lesson Structure

### 1. Planning—Developing a Budget on Paper

This simulation requires the students to identify their likely Income and Expenses. The worksheet provides guided instruction.

**A. Developing a Budget: Income**

Select a job from the options listed below. (The salaries are shown AFTER taxes have been taken out—students should be encouraged to ask a parent about that!)

|  | PAY AFTER TAXES | |
| --- | --- | --- |
| JOB | ANNUAL | MONTHLY |
|  |  | (rounded to nearest $10) |
| Teacher | $35,000 | $2,920 |
| Local TV Reporter | $32,000 | $2,670 |
| Fireman | $31,000 | $2,580 |
| Cook | $28,000 | $2,330 |
| Model (NOT *super*model) | $26,000 | $2,170 |
| Insurance Agent | $37,000 | $3,090 |
| Nurse | $48,000 | $4,000 |
| OTHER: _____ | $_____ | $_____ |

## B. Developing a Budget: Expenses

Students are provided a range of options for their lifestyle and expenses. They are asked to describe them in the following way.

1. Circle the amount they choose to spend in each budget category.

2. Write that amount in the 3rd column.

3. Add the 6 amounts to arrive at their total monthly expenses.

| Budget Category | Range of Monthly Expenses | | | Your Choice |
|---|---|---|---|---|
| HOUSING (with water, heat, and electricity) | $750 rent small apartment | $1000 rent comfy condo | $1500 buy a house | |
| TRANSPORTATION | $50 bus pass or old basic car | $250 own 3 yr old car | $450 drive new car | |
| ELECTRONICS (phone, computer, tv) | 0 own none | $125 basic services | $250 all services | |
| FOOD | $200 basics | $350 good | $500 fancy | |
| ENTERTAINMENT | $100 basic | $200 moderate | $300 extensive | |
| OTHER EXPENSES | $150 | $300 | $500 | |
| TOTAL EXPENSES = | **Add all your expenses together OR pick one of the following summary values for total monthly expenses:** **Careful: $1250** **Modest: $2225** **Moderate: $3500** | | | |

To make sure students appreciate the choices they are making, they are asked to respond to this question: "Following a budget can be difficult. What sacrifice (or sacrifices), if any, will be the most challenging for you and why?" This offers a reality check for both students and teachers to reflect carefully on what it means to create and follow a budget (and, presumably, make trade-offs in the short-term to achieve longer-term benefits).

## C. Selecting an Interest Rate for Savings

Banks over the years have paid interest rates on insured savings that range from VERY low (less than 1% per year) to relatively high (approaching 10% during inflationary times). We provide students with the opportunity to choose a rate from within that range and encourage them to experiment to see what effect different rates will have on their savings outcome.

## 2. Using the Computer Simulation—Asking "What Ifs"

The simulation provides an opportunity for students to test and revise(!) their PLANS over a 44-year (age 21 to 65) period. Will their PLANS generate the desired outcome ($1,000,000)? Students should devise and test several PLANS to explore different options. Those PLANS are recorded in a Table (illustrated below); the entries correspond to the information provided on the Control Panel shown earlier in this lesson.

| | Choices | | | Results | |
|---|---|---|---|---|---|
| PLAN # | Monthly Earned Income ($ per month) | Monthly Expenses ($ per month) | Interest Rate on Savings (%) | Time to earn $1,000,000 (years) | OR Total $$ in MY SAVINGS (at age 65) |
| 1 | 2600 | 2250 | 4 | - | $484,734 |
| 2 | 2600 | 2000 | 4 | - | $830,973 |
| 3 | 2600 | 1750 | 4 | 41 years | - |

## 3. Using Graphs and Tables

Students use Graphs and Tables to describe and communicate the patterns of change that they observe over time in their accounts. (Tables and Graphs can be printed from the simulation or created by the students themselves.) Each has distinctive strengths.

- The Behavior-over-Time Graph in the simulation allows students to compare the 3 different PLANS identified earlier; the colors match the PLANS. Note that, of the three PLANS tested, only PLAN 3 (with perhaps painfully reduced expenses) is successful. (See illustration of the Control Panel earlier in these Instructions.)

- The Table records savings in MY SAVINGS changing as a result of additions of yearly income and new interest, as well as subtractions of regular yearly Expenses. Notice how, in the case of the successful PLAN 3, as the account reaches $1 million (age = 62), the last year's "Interest Income" is almost FOUR TIMES GREATER (about $38,770 versus $10,200) than the added net earnings (Earned Income minus Expenses). This example illustrates the explosive power of compounding interest!

| Years | MY SAVINGS | Expenses | Earned Income | Interest Income |
|---|---|---|---|---|
| 51 | $572,066.37 | $21,000.00 | $31,200.00 | $22,882.65 |
| 52 | $605,149.02 | $21,000.00 | $31,200.00 | $24,205.96 |
| 53 | $639,554.98 | $21,000.00 | $31,200.00 | $25,582.20 |
| 54 | $675,337.18 | $21,000.00 | $31,200.00 | $27,013.49 |
| 55 | $712,550.67 | $21,000.00 | $31,200.00 | $28,502.03 |
| 56 | $751,252.69 | $21,000.00 | $31,200.00 | $30,050.11 |
| 57 | $791,502.80 | $21,000.00 | $31,200.00 | $31,660.11 |
| 58 | $833,362.91 | $21,000.00 | $31,200.00 | $33,334.52 |
| 59 | $876,897.43 | $21,000.00 | $31,200.00 | $35,075.90 |
| 60 | $922,173.33 | $21,000.00 | $31,200.00 | $36,886.93 |
| 61 | $969,260.26 | $21,000.00 | $31,200.00 | $38,770.41 |
| Final | $1,018,230.67 | | | |

## 4. Putting the Pieces Together

A. After completing the exercise, students are asked to ANALYZE and DESCRIBE what happened and why. As part of their analysis, students should be able to recognize the following.

1. After some time had passed, the interest being earned was more than the income being earned (after expenses) and deposited each year. As the account got closer to $1,000,000, almost all the money moving into MY SAVINGS was from that interest! There really is an impressive "something for nothing" feeling to such compounding interest **IF** it is left to do its thing long enough!

2. The annual interest being earned by the time $1,000,000 is accumulated is (typically) MORE than the student's income. This concept opens up an area of discussion focused on the value of saving for retirement. If I build up a large enough nest egg, can I stop working and meet my Expenses on the interest from MY SAVINGS?

B. Use a Graph and a Table to compare different options; to select from a number of successful options one's optimal PLAN; and to explain why the optimal PLAN was selected.

C. Work and communicate with others to compare ob-servations and to recognize how the pieces of the puzzle work together. In the process of communicating with each other, students discover there are a number of ways to meet the PLAN GOAL of saving $1 million. Some are better than others, for different individuals; but there is no single right answer.

# Where and When Will Students Need Guidance?

1. Fully understanding the mathematics behind the com-plex processes of saving, spending, **and** compounding interest can be beyond the grasp of many students. As such, this simulation is designed to help students think about real-world personal finance issues, including "average" salaries and monthly expenses, as they combine with compounding interest to generate unfamiliar (and impressive!) patterns of long-term savings.

2. Students should be comfortable with the "Basics," in understanding why compounding growth is not linear: because the amount of growth is influenced by the size of the STOCK. Thus, as the STOCK grows, it leads to greater growth, a still larger STOCK and still greater growth, and so on.

3. Computer games can focus all too often on "Winning." The purpose in using this simulation is to be able to compare PLANS and their implications, and to recognize the range of options on income (salaries), expenditures, and rates of interest. This simulation is designed to encourage students to explore those options and to evaluate important trade-offs. Each student needs to explicitly consider the following questions.

   - *How do I set expenditures to match my desired "quality of life"?*
   - *What trade-offs am I willing to make in the short term (e.g., living a more frugal lifestyle than I may want) to enjoy the longer-term advantages of having a million dollars?*
   - *How can I maximize the return on my savings?*

# Bringing the Lesson Home

**What is the important student-learning from this simulation?**
- *Understanding and appreciating the importance of math in designing a financial plan to operate over an extended period of time; being successful exploring different strategies or plans; and understanding the utility of Graphs and Tables.*
- *Learning to compare, discuss, and even (respectfully and constructively) to disagree on their choices. Learning from one another is very powerful.*

# Extending the Learning

This simulation offers opportunities for students to think about personal financial planning as a multi-faceted endeavor involving career (income) and lifestyle (expenses) choices and trade-offs. Ideally, this savings challenge will inspire questions about other large expense items (e.g., buy a home or save for college), both how to obtain them and what one needs to sacrifice in the short term to receive long-term benefits.

Name_____

# Can Compounding Interest Make Me a Millionaire?
## Using the Simulation

Albert Einstein is said to have called compound interest *"the most powerful force in the universe."* Is it powerful enough to make an average young adult (like you will soon be!) into a millionaire? This exercise gives you the chance to make a PLAN and use a computer simulation to explore ways that an average young adult might budget and save to BECOME A MILLIONAIRE!!

To use the simulation, you will need to record your expected monthly income, monthly expenses, and interest rate on savings. Steps 1–3 help guide you in making those 3 choices. Steps 4–5 help you evaluate your PLANS.

### 1. Developing a Budget: INCOME

Select your job from the options listed below. (The salaries are shown AFTER taxes have been taken out—ask a parent about that!)

| Job | Annual | Monthly Pay After Taxes (rounded to nearest $10) |
|---|---|---|
| Teacher | $35,000 | $2,920 |
| Local TV Reporter | $32,000 | $2,670 |
| Fireman | $31,000 | $2,580 |
| Cook | $28,000 | $2,330 |
| Model (NOT *super*model) | $26,000 | $2,170 |
| Insurance Agent | $37,000 | $3,090 |
| Nurse | $48,000 | $4,000 |
| OTHER: _____ | $_____ | $_____ |

### 2. Developing a Budget: EXPENSES

On the Table below, do the following.

   A.  Circle the amount you choose to spend in each budget category.

   B.  Write that amount in the 3rd (YOUR CHOICE) column.

   C.  Add the 6 amounts to arrive at your TOTAL (monthly) EXPENSES.

Name_____

| Budget Category | Range of Monthly Expenses | | | Your Choice |
|---|---|---|---|---|
| HOUSING (with water, heat, and electricity) | $750 rent small apartment | $1000 rent comfy condo | $1500 buy a house | |
| TRANSPORTATION | $50 bus pass or old basic car | $250 own 3 yr old car | $450 drive new car | |
| ELECTRONICS (phone, computer, tv) | 0 own none | $125 basic services | $250 all services | |
| FOOD | $200 basics | $350 good | $500 fancy | |
| ENTERTAINMENT | $100 basic | $200 moderate | $300 extensive | |
| OTHER EXPENSES | $150 | $300 | $500 | |
| TOTAL EXPENSES = | **Add all your expenses together** <br> **OR pick one of the following summary values for total monthly expenses:** <br> **Careful:** **Modest:** **Moderate:** <br> **$1250** **$2225** **$3500** | | | |

Following a budget can be difficult. What sacrifice (or sacrifices), if any, will be the most challenging for you and why?

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**3. Selecting an INTEREST RATE on Savings**

In addition to calculating income and expenses, you will need to **SELECT AN INTEREST RATE** that your savings will earn**.** NOTE: While there are many options for investing those savings in the "real world," many involve taking risks. Over the past 20 years, *safe* bank savings accounts and Certificates of Deposit (another kind of safe savings) **have paid on average 5% per year.** (See: *http://www.bankrate.com/brm/publ/passbkchart.asp.*)

Name_____

**4. Recording your Choices**

**Record your choices** (Income, Expenses, Interest Rate) in the first three open columns of the Table below. Then, open the simulation, enter your information, and RUN the model. The model begins at age 21 and gives you up to 44 years (to age 65) to get your million dollars. **Record your results in the final two open columns of PLAN 1 in the worksheet**.

   **Try different options**. Record your choices and results below for PLAN 2 and later PLANS. Keep trying until you are satisfied with your results, filling in new PLANS, as needed.

| | Choices | | | Results | |
|---|---|---|---|---|---|
| Plan # | Monthly Earned Income ($ per month) | Monthly Expenses ($ per month) | Interest Rate on Savings (%) | Time to earn $1,000,000 (years) | <u>OR</u> Total $$ in MY SAVINGS (at age 65) |
| 1 | | | | | |
| 2 | | | | | |
| 3 | | | | | |
| 4 | | | | | |
| 5 | | | | | |

**5. Comparing and Contrasting PLANS to become a MILLIONAIRE**

A. Prepare a Graph or a Table (or print from the simulation) that shows your favorite PLAN. Use it to explain why you chose this PLAN over other successful options.

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B. Recognizing there are many ways to be successful, did you choose the "fastest way?" If not, why not? If so, can you identify why the fastest way might be harder to achieve than other PLANS?

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# About Us

### The Creative Learning Exchange

The Creative Learning Exchange (CLE) is a non-profit organization in Acton, Massachusetts dedicated to promoting learner-centered learning and system dynamics in K-12 education. The CLE disseminates classroom curricular materials developed by teachers, publishes a quarterly newsletter, hosts a biennial conference for educators and interested citizens, maintains a listserve, and provides system dynamics training materials and programs for educators. Information is available at *www.clexchange.org*.

### System Dynamics

System dynamics is a field of study and a perspective for understanding change. Using computer simulation and other tools, system dynamics looks at how the feedback structure of systems causes the change we observe all around us. System dynamics was developed fifty years ago by Professor Jay W. Forrester at MIT and is used to address problems in areas ranging from ecology, to business management, economics, and psychology. Under Forrester's guidance, system dynamics is helping teachers make K-12 education more learner-centered, engaging, challenging and relevant to our rapidly changing world.

### CLE Curriculum Series

This series of books, *Dollars and Sense, The Shape of Change* and *The Shape of Change: Stocks and Flows,* introduces students and their teachers to some of the basic ideas of system dynamics and systems thinking as a way to observe and understand change.

**MORE COPIES AVAILABLE:**

*Dollars and Sense*
*The Shape of Change* and
*The Shape of Change: Stocks and Flows*

can be purchased from the
Creative Learning Exchange at:

*www.clexchange.org*
978-635-9797
*milleras@clexchange.org*

These and other lessons can be downloaded
for free from the CLE website in PDF format.

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**Lesson Title(s):**
*Dollars and Sense*, Lesson 6: How Does Interest Grow My Savings?
*Dollars and Sense*, Lesson 7: Can Compounding Interest Make Me a Millionaire?

**Overview:**
The simulations in *Dollars and Sense* introduce 5th – 7th grade students to the terminology and basic structures of saving and spending using stocks and flows as well as graphs. Students become aware of the tradeoffs whereby present decisions to save or spend money can affect future financial goals.

**Related Characteristic(s) of Complex Systems:**
Conflicts arise between short-term and long-term goals.

**Ideas and Examples for Connecting to the Characteristic:**
Lesson 6 of the *Dollars and Sense* series introduces students to the concept of exponential growth through examples and exercises using compounding interest, the spread of rumors and the spread of infection. Using the simulation, students explore how money in a savings account grows over time under various interest rates.

In Lesson 7, they test various scenarios for saving and spending that will enable them to reach the long-term goal of saving one million dollars. Living below one's means in the short term is often viewed as a difficult sacrifice. This lesson illustrates the benefits of starting to save early in life to realize the full benefits of compounding interest over a long timeframe.

To prompt discussion with students:

1. Ask students about their own savings habits. Do they receive an allowance from their parents or money as gifts? What do they do with their money – save a portion or spend everything?
2. If the concept of saving a large sum such as one million dollars is difficult, use smaller amounts (such as weekly allowance sums) and shorter timeframes to illustrate how long it will take them to achieve more modest savings goals. Be sure to specify how much additional savings comes from earning interest.
3. Help students brainstorm a list of "big purchases" they may make in their lifetimes or their parents have made for the family (college education, car, house, etc.). Ask what they think the impact of such big purchases may be on one's ability to save one million dollars. Iterate that the key to saving large sums of money is to spend less than you earn and allow interest to accumulate over a long period of time!

**Resource(s)**
*Dollars and Sense* by Jeff Potash

A fun quiz about saving and spending habits of millionaires:
http://themint.org/kids/the-truth-about-millionaires.html