Growing Interest
Teacher Notes

TI-Nspire CAS   **Investigation**   **Student**   **180min**

Aim

To compare the different growth patterns for a sum of money invested under a simple interest plan and a compound interest plan.

National Curriculum Statement: Connect the compound interest formula to repeated applications of simple interest using appropriate digital technologies (ACMNA229).

Equipment

For this activity you will need:

- TI-Nspire CAS (or TI-Nspire)

Note – a 'Growing Interest' TI-Nspire file is included with this activity. You can refer to it to ensure the students are using the correct formulas in the spreadsheets and graphs.

Problem Description

Try to present the problem as something that students might reasonably relate to. You may wish to include a brief discussion about interest rates and investments. You could also show students some advertisements for bank deposits and current interest rates.

Daisy is a hard-working maths student who was the lucky winner of a scholarship lump sum payment of $2000. She was absolutely delighted but she did not need to use the money straight away. She decided to put it into an investment account so that she could withdraw it at a later time to help her with her studies. When she went to her bank, Daisy saw that there were two different investment options available:

a) Simple interest paid at 5% p.a.

b) Compound interest at 4% p.a.

> **INVESTMENT ACCOUNT**
> **5%** per annum
> (simple interest paid annually)

> **INVESTMENT ACCOUNT**
> **4%** per annum
> (compound interest paid annually)

Which investment option should Daisy choose?

An accurate answer to this question is not necessary. The idea is to encourage students to consider the options. An intuitive response is satisfactory at this stage.

Are there any other factors that could affect her decision?

Students may offer a variety of factors that are not necessarily mathematical. These could include accessibility to the bank, fees that may apply to early withdrawal from the investment plan, etc. You may use this question to stimulate discussion that explores what students might already know about banks and investment opportunities.

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Essential Understanding

It is essential for this investigation to understand that simple interest and compound interest are two different ways that interest can be calculated and paid into an investment account. This investigation will help you understand that compound interest is repeated applications of simple interest.

It may be necessary to review with students their understanding of percentages.

Simple Interest is when an interest amount is calculated on the principal and then that fixed amount is paid into the investment account at the end of each investment period.

Compound Interest is when the first interest payment is made into an account and the new account balance is then used to calculate the interest that is due for the next investment period and so on. Because the account balance grows after each interest payment, each subsequent interest payment also increases.

Technology

Calculating the interest amount for the first year

Open a new **Calculator** page. Determine how much interest would be paid for the first year by each of the two investment plans. Remember that 'percent' means 'per hundred'. A good way to do this is to input **2000** and then use the fraction template to multiply it by the percentage over **100**.
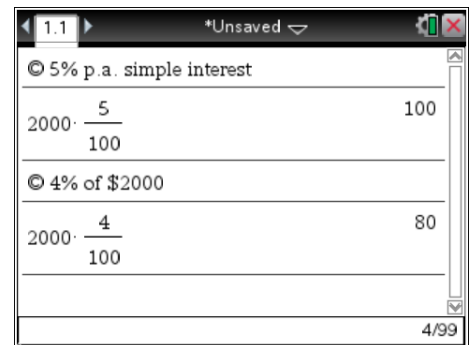

Simple Interest

First, we need build a spreadsheet that shows how the investment account balance grows under the simple interest plan.

    Step 1.   Open a new **Lists & Spreadsheet** page.

    Step 2.   Input column headings of **year**, **startbalsimp**, **intsimp**, and **endbalsimp**.

    Step 3.   In the **year** column input the data: **1**, **2**, **3**, **4**, **5**, **6**, **7**, **8**, **9**, **10**.

    Step 4.   In the **intsimp** column enter the value **100** into each of the first ten cells of that column.(Note: the 100 is the amount of simple interest that will be paid into the account each year, as determined on the calculator page in the previous section.

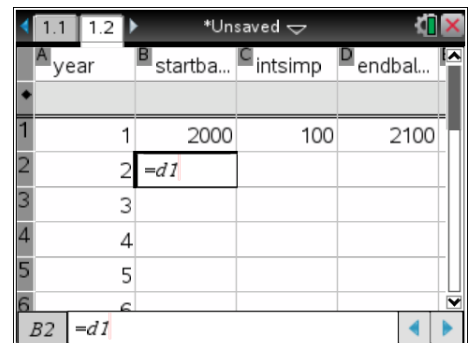**Step 5.** In cell **B1** input **2000**.

Step 6. In cell **D1** input **=b1+c1**.
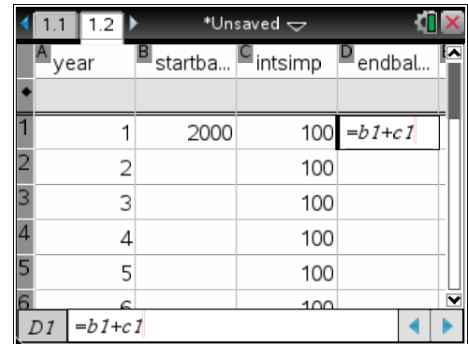
Step 7. Press **enter** and the formula will convert to **2100**, which is the balance at the end of the first year.
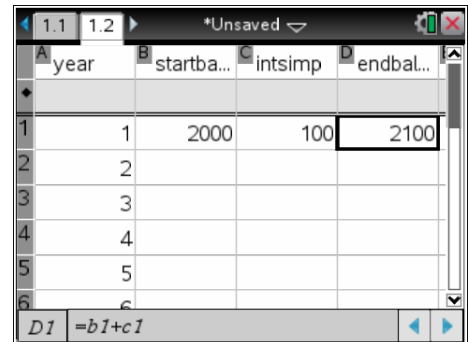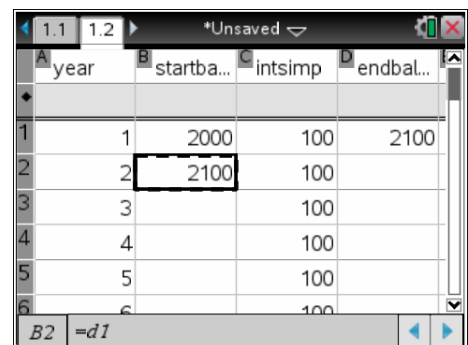
Step 8. Move to cell **B2** and input **=d1**.
(Note that the spreadsheet will insert the value **2100** into cells **D1** and **B2**.)

Step 9. We now want to do a relative copy of the formulas in cells **D1** and **B2** to the other cells of those columns. There are several ways in which this can be done. If you are unsure how to do this, then you may wish to perform the following steps:

    a. Use the arrow keys to highlight cell **B2**.

    b. Press and hold the **mouse** key until a broken dashed line indicates that the cell has been selected.

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c. Use the **down arrow** key to 'stretch' the selected area downwards until you get to row 10.

d. Press **enter**. (Note: No values will be displayed yet as the **startbal** for each year needs the figures of the **endbal** from the previous year, which are yet to be calculated).

e. Move the cursor to cell **D1**.

Step 10. Perform the following steps to set up the **endbal** formula in column **D**:

a. Use the arrow keys to highlight cell **D1**.
b. Press and hold the **mouse** until a dashed line indicates that the cell has been selected.
c. Use the **down arrow** to 'stretch' the selected area downwards until you get to row 10.
d. Press **enter**. (Note that all the values for both columns **B** and **D** will now be displayed.

Question: By referring to the spreadsheet, what amount will Daisy's $2000 investment have grown to after 10 years?

Daisy's investment will have grown to $3000 in 10 years.

Step 11. Open a **Data & Statistics** page. Set **year** as the independent variable (horizontal axis) and **endbalsimp** as the dependent variable (vertical axis).

Question: How would you describe the shape of the scatterplot?

The shape of the scatterplot is linear.
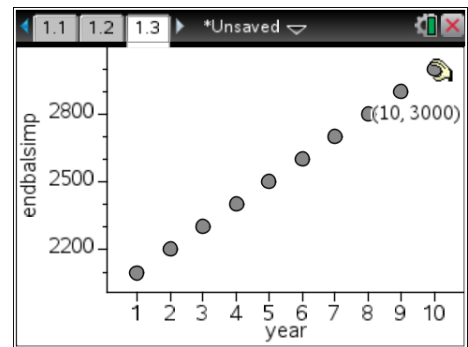
Compound Interest

Now let's build a spreadsheet that shows how the investment account balance will grow under the compound interest plan.
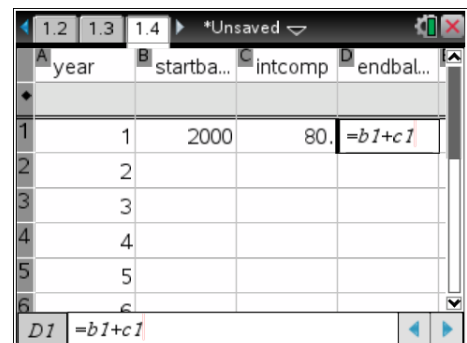
Step 1. Open a new **Lists & Spreadsheet** page.

Step 2. Set the column headings as **year**, **startbalcomp**, **intcomp**, and **endbalcomp**.

Step 3. In the **year** column, the previous data **1**, **2**, **3**, **4**, **5**, **6**, **7**, **8**, **9**, **10** will be displayed. If not, input these values again.

Step 4. In cell **B1** input **2000**.
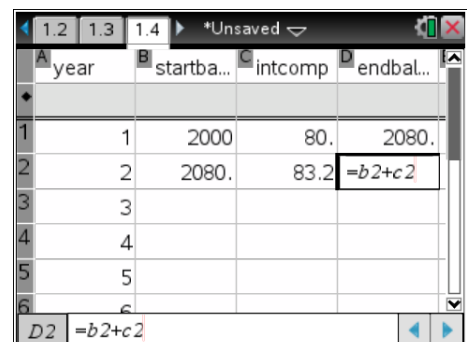
Step 5. In cell **C1** input **=b1×0.04**.

Step 6. In cell **D1** enter **=b1+c1**.

Step 7. In cell **B2** input **=d1**.

Step 8. In cell **C2** input **=b2×0.04**.

Step 9. In cell **D2** input **=b2+c2**.

Step 10. Perform the following steps to relatively copy the row two formulas:

a. Use the arrow keys to move to cell **B2**. Press and hold the **mouse** key and then press the **right arrow** to move across to column **D**.

b. Press and hold the **mouse** key until a broken dashed line indicates that the three cells have been selected.
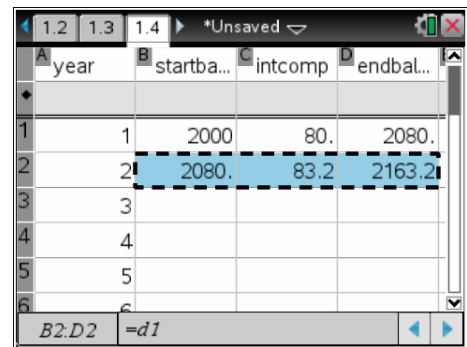
c. Use the **down arrow** to 'stretch' the selected area downwards until you get to row 10.

d. Press **enter**. (Note that all the values for columns **B**, **C** and **D** will now be displayed.

There is also a 'Fill Down' option available in the menu.
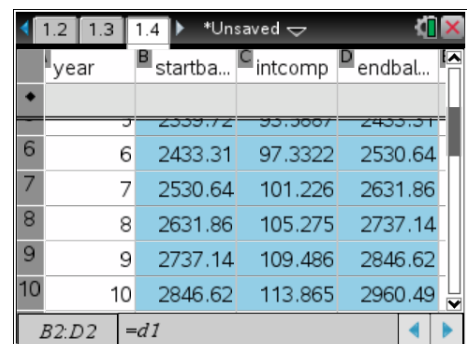
Question: By referring to the spreadsheet, what amount will Daisy's $2000 investment have grown to after 10 years?

Daisy's investment will have grown to $2960.49 in 10 years.

Question: Over a *ten year* period, which investment option has been better?

Option 1 using simple interest is the best investment over a ten year period.

Step 11. Open a **Data & Statistics** page. Set **year** as the independent variable (horizontal axis) and **endbalcomp** as the dependent variable (vertical axis).

Question: How would you describe the shape of the scatterplot?

The shape of the scatterplot is almost linear but it has a slight upward curve.
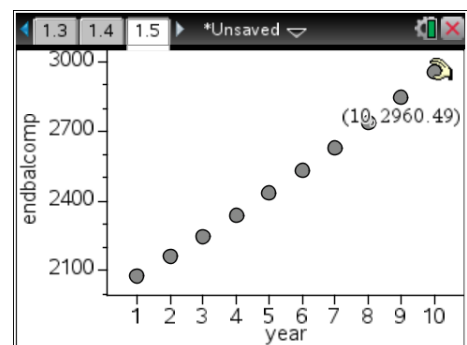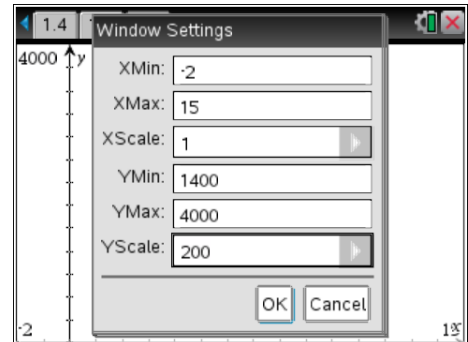
Examining the investment over the longer term

Will your answer to the question in the last section always be the case? Let us now consider what happens over a longer time period.
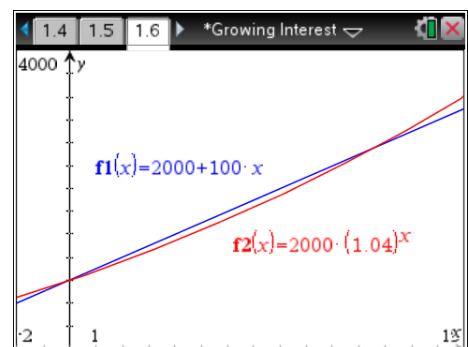
Step 1.   Open a **Graphs** page.

Step 2.   Press **menu > Window/Zoom > Window Settings**. Set a domain of **−2 ≤ x ≤ 15** and a range of **1400 ≤ y ≤ 4000**.

Step 3.   Input **f1(x)=2000+100x** to show the growth of the account balance under the simple interest plan.

Step 4.   Input **f2(x)=2000(1.04)^x** to show the growth of the account balance under the compound interest plan.

Step 5.   Notice that both the **f1(x)** and **f2(x)** investment graphs start at the same point on the y-axis ($2000). Initially, the simple interest line grows at a faster rate but eventually the compound interest curve crosses the line and grows at a faster rate.

Step 6.   Press **menu > Analyse Graph** > **Intersection** and click on either side of the point to determine the coordinates of the point of intersection.
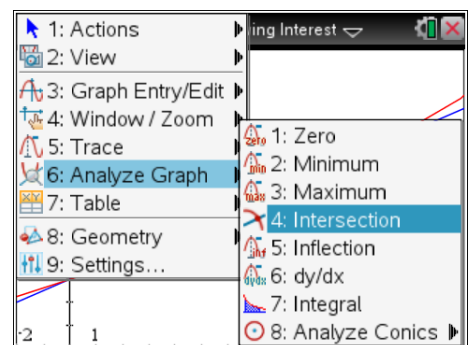
Question: What do the *x* and *y*-values of these coordinates mean?

The x-value represents the number of years. The y-value represents the amount that the investment has grown to.

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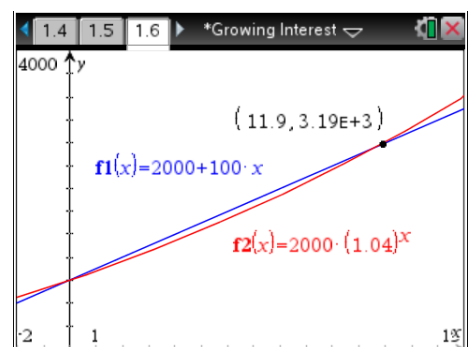
Conclusion

Look again at the original questions posed in the Problem Description.

Question   Which investment option should Daisy choose?

If Daisy is going to invest her money for less than 11.9 years, she should choose the first option using simple interest.

If Daisy is going to invest her money for more than 11.9 years, she should choose the second option using compound interest.

Question   Are there any other factors that could affect her decision?

Interest rates vary over the years. If interest rates are high, Daisy should try for a fixed term rate. If interest rates are low, she should not select a fixed term rate in case interest rates rise.

To further extend this investigation, you may wish to:

    a. Fill down your spreadsheet formulas to compute values for a longer time period.

    b. Experiment by amending the formulas to show different interest rates.

The Finance Solver

Another feature of TI-Nspire CAS that is useful for quickly seeing the effect of changing different compound interest variables (such as the interest rate) is the **Finance Solver**. To access it, open a **Calculator** page and press **menu > Finance > Finance Solver**.

If appropriate, show students that they can use the Finance Solver for compound interest calculations.

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