Move Those Chains

ID: 11363

Time Required
15 minutes

Activity Overview

In this activity, students will explore the Chain Rule. Students are first asked to make a conjecture of the derivative of $f(x) = (2x + 1)^2$ based on the Power Rule. They are then asked to graph their derivative function and compare it to the graph of f'(x). They will then examine "true" statements about various derivatives of composite functions. They will observe patterns and use these patterns to create a rule for finding the derivative of other composite functions. They will then use their rule to create "true" examples of their own.

Topic: Chain Rule

- *Derivative of a composite function*

Teacher Preparation and Notes

- *Students can write their responses directly into the TI-Nspire document, on the worksheet, or separate sheets of paper.*
- *This activity uses the $\frac{d}{dx}f(x)$ notation to denote the derivative. This can be found in the calculator application by selecting **MENU > Calculus > Derivative**. Some students may attempt to type the letter 'd' in the numerator of a fraction and 'dx' in the denominator. This will not work. Students may press [template], the template key, to access the derivative template.*
- *Some functions will have an independent variable other than x to familiarize students with using other variables.*
- *The true statements show the derivatives in unsimplified form so that students will more easily identify the patterns.*
- ***To download the student TI-Nspire document (.tns file) and student worksheet, go to education.ti.com/exchange and enter "11363" in the keyword search box.***

Associated Materials

- *MoveThoseChains_Student.doc*
- *MoveThoseChains.tns*

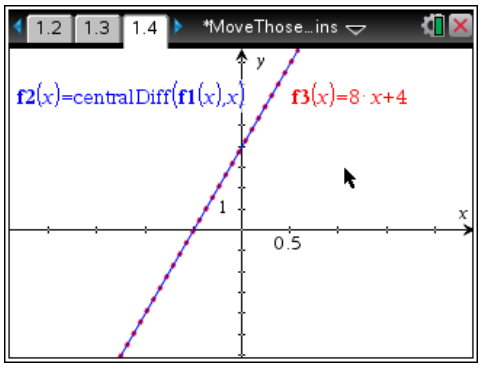
Suggested Related Activities

To download any activity listed, go to education.ti.com/exchange and enter the number in the keyword search box.

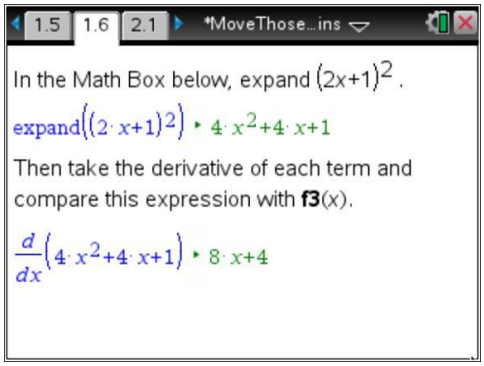
- *Derivative of Composite Functions (TI-Nspire technology) — 13418*

Problem 1 – Derivative Using the Power Rule

On page 1.2, students are asked to find the derivative of $f(x) = (2x + 1)^2$ using the Power Rule. They are to type this derivative in the Math Box provided and press enter. Students will graph their conjectures along with the derivative of $f(x) = (2x + 1)^2$, which is already stored in **f2**(x). If the two graphs coincide, the conjecture for the derivative may be correct. Remind students that they will have to confirm their conjectures algebraically.



Students are asked to use the Math Box to expand $(2x + 1)^2$, and take the derivative of this expression term by term. They are then to compare it to **f3**(x).



Student Solutions

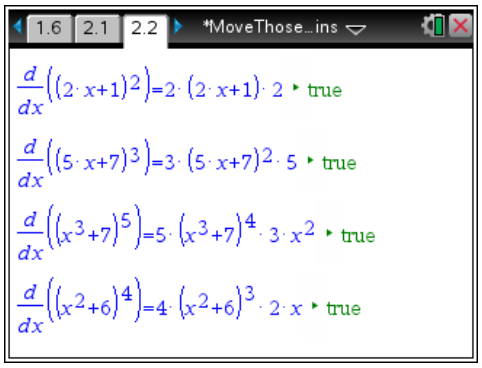
1. Sample answer: $2(2x + 1)$

2. Sample answer: No, my answer was not correct. I can try expanding the function before taking the derivative.

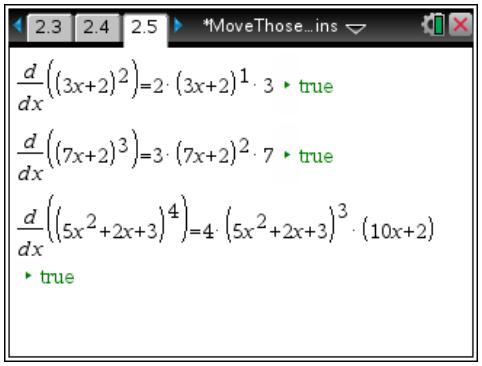
3.
$$\begin{aligned}\frac{d}{dx}\left((2x+1)^2\right) &= \frac{d}{dx}\left((2x+1)(2x+1)\right)\\ &= \frac{d}{dx}\left(4x^2+4x+1\right)\\ &= \frac{d}{dx}\left(4x^2\right)+\frac{d}{dx}(4x)+\frac{d}{dx}(1)\\ &= 8x+4\end{aligned}$$

Problem 2 – The Chain Rule

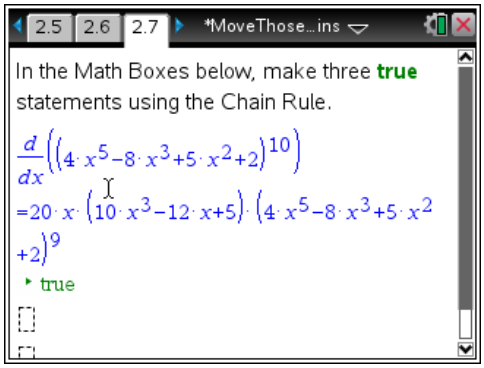
Students are asked to examine "true" statements of the derivatives of composite functions while looking for patterns. They are asked to discuss the patterns they observed with another student.



Students are asked to use the pattern observed to make "true" derivatives of composite function statements. If the handheld does not return the word 'true,' students can try again by pressing del and then changing their responses.



The Chain Rule is presented to students, and they are asked to write three additional true statements.



Student Solutions

4. Sample answer: The Power Rule is applied to the "outer" function, and then is multiplied by the derivative of the "inner" function.

5. $\frac{d}{dx}\left((3x+2)^2\right)=2\cdot(3x+2)^1\cdot 3$

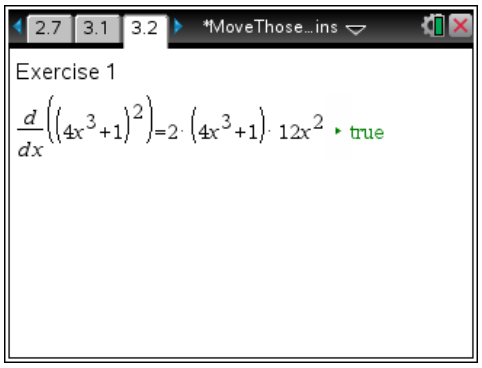
6. $\frac{d}{dx}\left((7x+2)^3\right)=3\cdot(7x+2)^2\cdot 7$

7. $\frac{d}{dx}\left((5x^2+2x+3)^4\right)=4\cdot(5x^2+2x+3)^3\cdot(10x+2)$

8. Answers may vary.

Problem 3 – Homework Problems

Students are given five additional exercises that can be used as homework problems or as extra practice during class.



Student Solutions

1. $\frac{d}{dx}\left(\left(4x^3+1\right)^2\right)=2\cdot\left(4x^3+1\right)^1\cdot\left(12x^2\right)$

2. $\frac{d}{dx}\left(\left(-5x+10\right)^7\right)=7\cdot\left(-5x+10\right)^6\cdot\left(-5\right)$

3. $\frac{d}{dt}\left(\left(2t^5-4t^3+2t-1\right)^2\right)=2\cdot\left(2t^5-4t^3+2t-1\right)^1\cdot\left(10t^4-12t^2+2\right)$

4. $\frac{d}{dx}\left(\left(x^2+5\right)^{-2}\right)=-2\cdot\left(x^2+5\right)^{-3}\cdot 2x$

5. $\frac{d}{dz}\left(\left(z^3-3z^2+4\right)^{-3}\right)=-3\cdot\left(z^3-3z^2+4\right)^{-4}\left(3z^2-6z\right)$