Move Those Chains

ID: 11364

Time Required
15 minutes

Activity Overview

In this activity, students will explore the Chain Rule. Students are first asked to make a conjecture about 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 derivatives 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 will type **d(f(x),x)** in the entry line of the TI-89. When they press ENTER, the TI-89 will return the expression in 'pretty print', and it will appear as* $\frac{d}{dx}(f(x))$.
- *Note: 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 worksheet, go to education.ti.com/exchange and enter "11364" in the keyword search box.***

Associated Materials

- *MoveThoseChains_Student.doc*

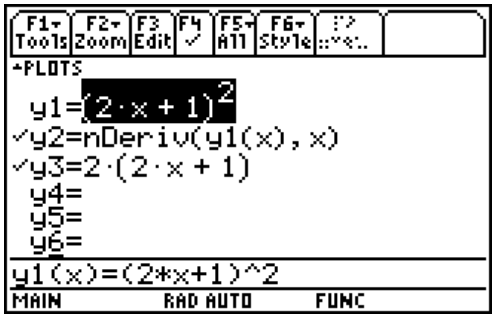
Suggested Related Activities

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

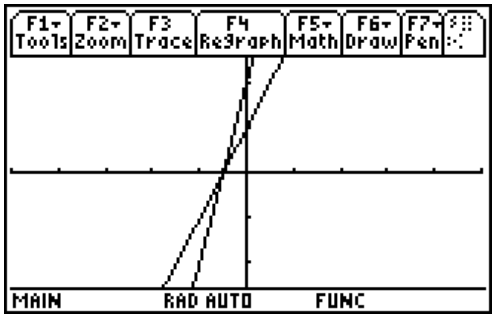
- *Computing Derivatives (TI-89 Titanium) — 2968*

Problem 1 – Derivative Using the Power Rule

Students are asked to make a conjecture about the derivative of $f(x) = (2x + 1)^2$ using the Power Rule. From the home screen, students are to go to the Y= Editor by pressing ◆ + [Y=]. Students should enter the function in **y1**, **nDeriv(y1(x),x)** in **y2**, and their conjecture for the derivative of $f(x) = (2x + 1)^2$ in **y3**. (To access the **nDeriv** command, go to the Math menu ([2nd] + [MATH]) and select **B:Calculus > A:nDeriv(**.



Students should graph only functions **y2** and **y3**. (To deselect a function, highlight the function and press [F4].) Note: The graphs may take a minute to appear. If the graphs of **y2** and **y3** coincide, a student's conjecture for the derivative may be correct. Remind students that they will have to confirm their conjectures algebraically. If a student's conjecture is incorrect, the graphs of **y2** and **y3** will not coincide.



Students are asked to expand $(2x + 1)^2$, and take the derivative of this expression term by term. They are then to compare this result to **y3**(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.

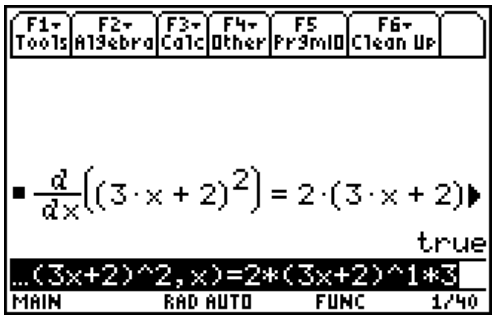
3.
$$\begin{aligned}\frac{d}{dx}\left((2x+1)^2\right) &= \frac{d}{dx}\left((2x+1)(2x+1)\right)\\ &= \frac{d}{dx}\left(4x^2+4x+1\right)\\ &= \frac{d}{dx}\left(4x^2\right)+\frac{d}{dx}(4x)+\frac{d}{dx}(1)\\ &= 8x+4\end{aligned}$$

Problem 2 – The Chain Rule

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

Students are asked to use the pattern observed to make "true" statements for the derivatives of composite functions. If the handheld does not return the word 'true,' students can try again by editing their solutions, and pressing ENTER again.

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

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

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

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

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