# 'Value'able Theorems

ID: 11203

Time required
*20-25 minutes*

## Activity Overview

*This activity is a student-centered exploration of the Intermediate Value Theorem and the Extreme Value Theorem from a graphical perspective. It is stated that f(x) is a continuous function on a finite closed interval [a, b]. The teacher can use the slider to change the value of k and demonstrate that there is a value c on the interval [a, b] such that f(c) = k.*

## Topic: Calculus Theorems

- *Intermediate Value Theorem*
- *Extreme Value Theorem*

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## Teacher Preparation and Notes

- *This activity is designed for use as a student discovery or exploration activity.*
- *Students are introduced to the Intermediate Value Theorem. Students can use the slider to change the value of k and observe that for every value of k in between **f1**(a) and **f1**(b) there is a value c on [a, b] such that **f1**(c) = k.*
- *Students are also introduced to the Extreme Value Theorem. For each figure, the teacher should ask whether or not the given function fulfills the hypothesis of the Extreme Value Theorem.*
- *Notes for using the TI-Nspire™ Navigator™ System are included throughout the activity. The use of the Navigator System is not necessary for completion of this activity.*
- ***To download the student TI-Nspire document (.tns file) and student worksheet, go to education.ti.com/exchange and enter "11203" in the keyword search box.***

## Associated Materials

- *ValueableTheorems_Student.doc*
- *ValueableTheorems.tns*

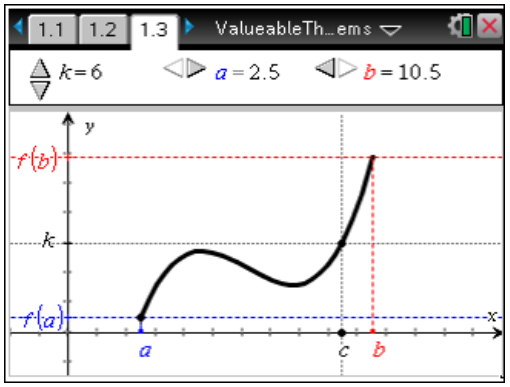
## Suggested Related Activities

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

- *Absolute Extrema (TI-89 Titanium) — 3264*
- *Finding Extreme Values (TI-89 Titanium) — 3244*
- *Extrema (TI-89 Titanium) — 9413*
- *Functions and Their Extrema (TI-89 Titanium) — 6436*

### Problem 1 – Intermediate Value Theorem

Have students explore the Intermediate Value Theorem by using the slider to change the value of *k*. Students will see that for every value of *k* in between *f1*(*a*) and *f1*(*b*) inclusive there is a value *c* on [*a*, *b*] such that *f1*(*c*) = *k*.




**TI-Nspire Navigator Opportunity: *Quick Poll***

**See Note 1 at the end of this lesson.**

**TI-Nspire Navigator Opportunity: *Screen Capture***

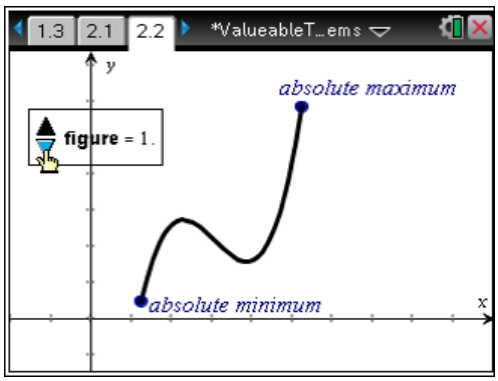
**See Note 2 at the end of this lesson.**

***Student Worksheet Solutions***

1. *Sample answer*: If the function was not continuous, like a step function, the function would not have to take on all values between **f1**(*a*) and **f1**(*b*).
2. *Sample answer*: 3.1≤ *k* ≤ 5.4 (or more precisely 3.16457 ≤ *k* ≤ 5.45766). This does not contradict the Intermediate Value Theorem because the theorem states that there is at least one value, *c*.

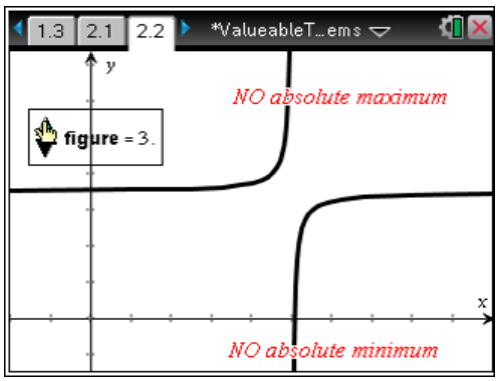
### Problem 2 – Extreme Value Theorem

Introduce the Extreme Value Theorem by showing three figures which include one example and two non-examples of the theorem. Ask the students which of the figures fulfill the hypothesis of the Extreme Value Theorem and which do not.



***Student Worksheet Solutions***

3. *Sample answer*: Figure 1 fulfills the hypothesis of the theorem while Figures 2 and 3 do not.




**TI-Nspire Navigator Opportunity: *Collect From Class***

**See Note 3 at the end of this lesson.**

## TI-Nspire Navigator Opportunities

**Note 1**
**Problem 1, *Quick Poll***
Use the question on page 1.5 as a Quick Poll by pressing the Start Poll button.

Yes/No question: "Can there be a *k* between *f(a)* and *f(b)* that gives more than one number *c* in the interval of [*a,b*]?"
Correct answer is yes.

**Note 2**
**Problem 1, *Screen Capture***
Use the class screen capture for formative assessment. Ask the students to change the value of *k* so that there is more than one value of number *c* that corresponds to *k.* Refresh after a short time to make sure that 100% of the class can find this situation.

**Note 3**
**Problem 2, *Collect From Class***
After the question on page 2.3 has been answered, you can Collect from Class, Save to Portfolio, and Open in Workspace to discuss the results.