# Trapezoid and Midpoint Approximations

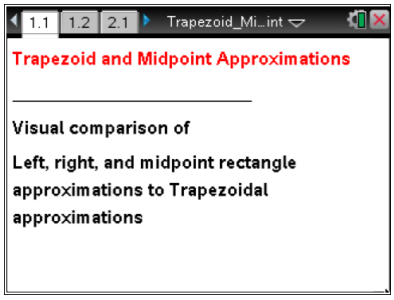
**Student Activity**

**Name** _____

**Class** _____

**Open the TI-Nspire document *Trapezoid_Midpoint.tns.***

You don't have the tools, using the geometry you know, to find the exact area under some curves. In this activity, you will investigate several methods to determine if there is a "best" way to estimate the area under a curve using known geometric figures.




**Move to page 1.2.**

1. Use the up arrow to view the estimates of the shaded area under the curve.
   a. How is the left endpoint rectangle constructed?

   b. How is the right endpoint rectangle constructed?

   c. How is the trapezoid constructed?

2. Which of these three estimates in question 1 overestimates the actual area? Which of these underestimates? Which do you think is the closest estimate?

3. Will your answers to question 2 be true for any function? Explain your reasoning.

**Move to page 2.1**.

4. Use the up arrow to view the estimates of the shaded area under the curve. Is your prediction from question 3 still true? If so, explain why. If not, how would you adjust your prediction?

5. When will the trapezoid be an overestimate? When will it be an underestimate? When will it be the best estimate? Explain your reasoning.

**Move to pages 3.1 and 4.1.**

6. Use the up arrow on each page to view the estimates of the area. Was your prediction from question 5 correct? If it is correct, explain why. If it is incorrect, explain how you would adjust your prediction to reflect your observations.

**Move to page 5.1.**

7. Use the up arrow to view the midpoint rectangle estimate of the area under the curve. (Don't go past the midpoint rectangle yet.)
   a. How is the midpoint rectangle constructed?

   b. Why is it hard to tell whether the midpoint rectangle area is an overestimate or underestimate?

8. Use the up arrow to pivot.
   a. What are you pivoting when you click the arrow?

   b. As the segment pivots, how does the shaded area compare to the shaded area of the original midpoint rectangle? How do you know?

   c. Once the segment is done pivoting, a dashed line appears. What does it represent?

   d. Is the midpoint rectangle area an overestimate or an underestimate? Explain.

**Move to pages 6.1, 7.1, and 8.1.**

9. Like the function graph on page 5.1, these functions are all positive, but they vary as to whether they are increasing or decreasing, or concave up or concave down. Use these to identify which of the rectangle (L, R, or M) and trapezoidal (T) approximations are underestimates and which are overestimates of the definite integral:
   a. Function is positive, increasing, and concave up.

   b. Function is positive, decreasing, and concave up.

   c. Function is positive, increasing, and concave down.

   d. Function is positive, decreasing, and concave down.

10. How do the answers in question 9 change if *positive* is replaced by *negative*? Explain.