

Sines and Cosines

Concepts

- Sine Function
- Cosine Function
- Trigonometric Identity

Materials

- TI-Nspire
- TI-Nspire document

Objectives

- Students will explore the relationship between the measure of an angle and its sine and cosine.
- Students will develop two trigonometric identities:

$$\frac{\sin A}{\cos A} = \tan A$$

$$\sin^2 A + \cos^2 A = 1$$

1. Download the TI-Nspire document called *Sines and Cosines* to your handheld. Use TI-Nspire computer link. (Fig 1)

2. Open the document in your handheld. Press Home, 7:MyDocuments, select the document *Sines and Cosines* using the NavPad (arrows), hit enter.(Figs 2-4)

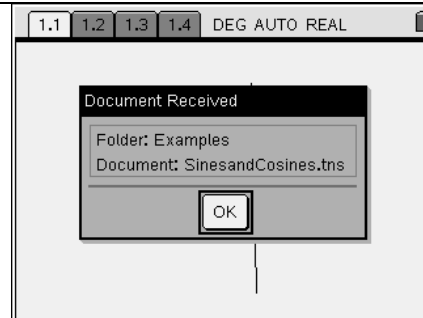


Fig 1

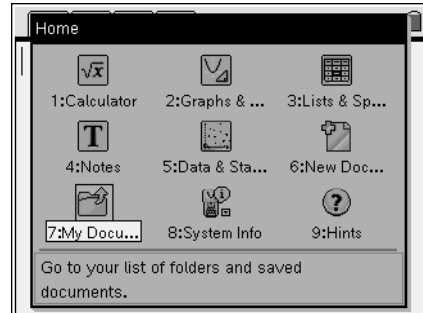


Fig2

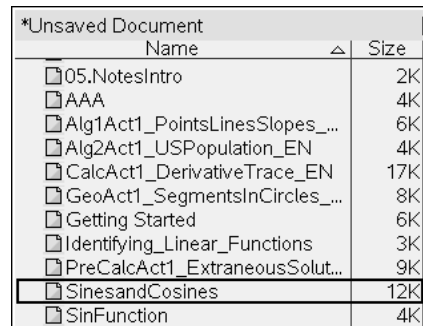


Fig3



Fig 4

- Go to page 1.3 Press Ctrl and right arrow key. (Fig 5)

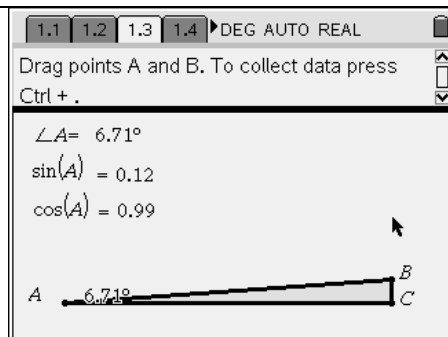


Fig 5

- Increase the measure of $\angle A$ by dragging points A and B.

- To drag a point M move the cursor to the point by using your NavPad
- When the cursor becomes a hand press ctrl click to hold the point
- Move the point to a different position using the NavPad
- Press enter to drop the point (Figs 6-7)

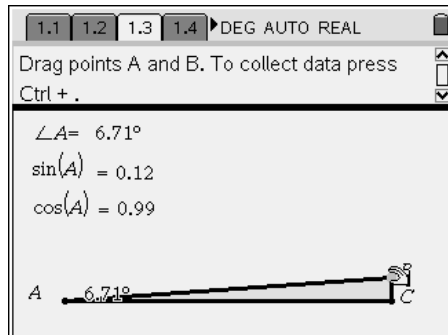


Fig6

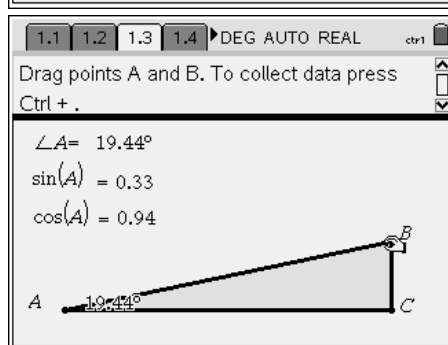


Fig7

- Each time that you modify the angle capture the angle and the values of sine and cosine. Press Ctrl + . to capture data. The data captured is on page 1.4 (Fig 8)

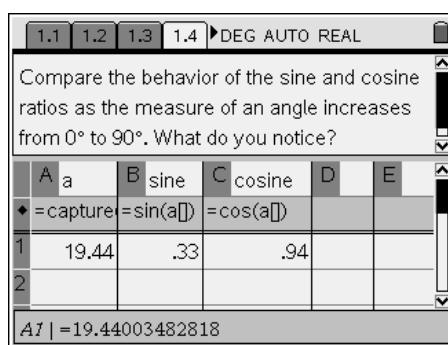


Fig 8

- Repeat step 4. Capture at least 10 different angles. Answer the question on page 1.4

- Compare the behavior of the sine and cosine ratios as the measure of an angle increases from 0 to 90. What do you notice? Which function increases and which decreases?(Fig 9)

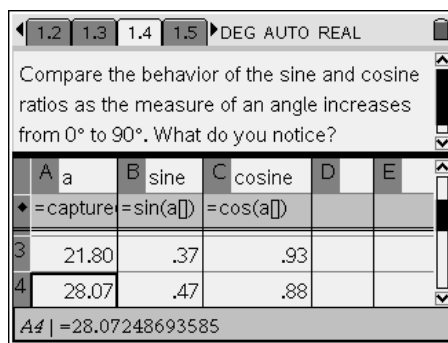


Fig 9

7. Go to page 1.5. On this page you will see the graphs of the points plotted in your spread sheet. Here you can visualize the graphs of sine and cosine from the points you captured in your right triangle.
(Fig 10)

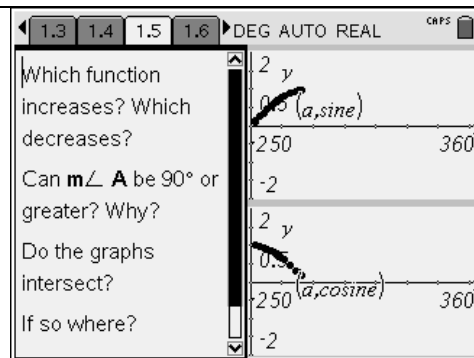


Fig 10

8. Observe the graphs and answer the questions:
- Which function increases?
 - Which decreases?
 - Can $\angle A$ be 90° or greater? Why?
 - Do the graphs intersect? Where do you think is the point of intersection?
9. Go to the next page and take a look at the two graphs.
- Press ctrl right arrow key to move to the next page
10. Answer the question in your handheld.
- Do the graphs of sine and cosine verify the conclusions you made on the last page? (Fig 11)

Extensions:

11. Use the trace tool. Find maximums, minimums, zeros and intersection points.

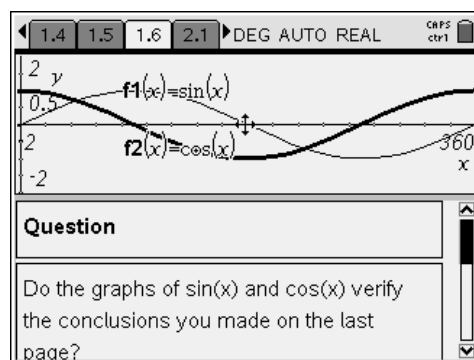


Fig 11

Activity 2: Developing Trigonometric Identities

- Go to problem 2. Page 2.1
 - Press ctrl and use your NavPad (Fig 12)
- Go to page 2.1 Increase the measure of $\angle A$ by dragging points A and B.
 - To drag a point move the cursor to the point by using your NavPad
 - When the cursor becomes a hand press ctrl click to hold the point
 - Move the point to a different position using the NavPad
 - Press enter to drop the point (Figs 13-14)
- Each time that you modify the angle capture the angle and the values of sine and cosine. Press Ctrl + . to capture data. The data captured is on page 2.3 (Fig 15)
- Repeat step 3. Capture at least 10 different angles. Observe columns B,C,D, and E. Answer the questions:
 - Which values repeat? What are those values? (Fig 15)

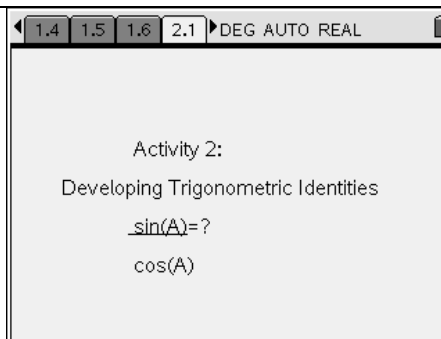


Fig 12

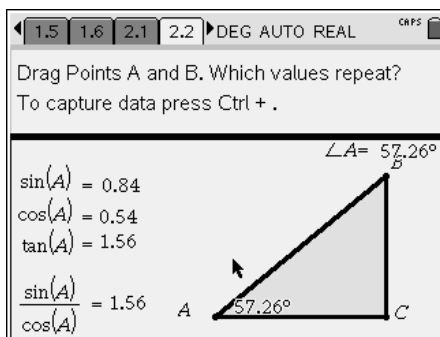


Fig 13

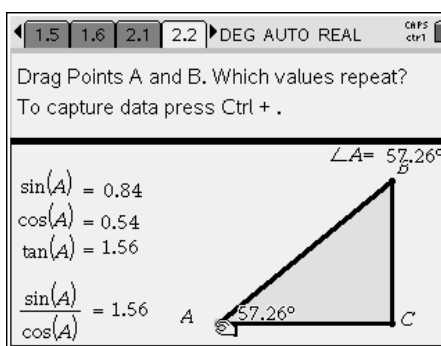


Fig 14

	A a	B b	C c	D	E
	=captu	=sin(a[])	=cos(a[])	=b[]/c[]	=tan(a[])
1	38.66	.62	.78	.80	.80
2	45	.71	.71	1.00	1.00
3	53.13	.80	.60	1.33	1.33

A1 = 38.65980825409

Fig 15

5. Go to page 2.4 and answer the question:
 - Based on your observations write a conjecture that involves the values that you found repeating in the spreadsheet (Fig 16)

Fig 16

6. Go to page 2.5 and write a trigonometric identity involving the sine, cosine and tangent ratios. (Fig 17)

Fig 17

7. Go to page 2.6 and check the identity for different angle values. Two different ways to do it are shown in figs 18 and 19.

$\frac{\sin(20)}{\cos(20)}$.36
$\tan(20)$.36

Fig 18

$\frac{\sin(20)}{\cos(20)} = \tan(20)$	true
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Fig 19

Activity 3: Developing Trigonometric Identities

1. Go to problem 3. Page 3.1
 - a. Press ctrl and use your NavPad (Fig 20)

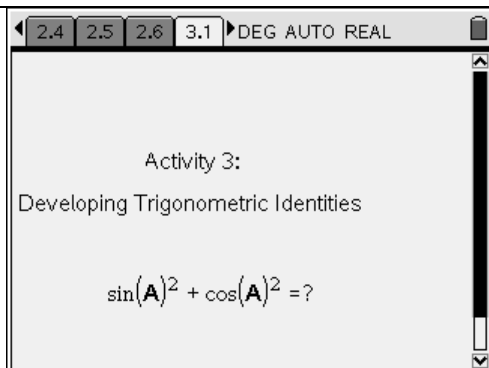


Fig 20

2. Go to page 2.1 Increase the measure of $\angle A$ by dragging points A and B.
 - To drag a point move the cursor to the point by using your NavPad
 - When the cursor becomes a hand press ctrl click to hold the point
 - Move the point to a different position using the NavPad
 - Press enter to drop the point (Figs 21-22)

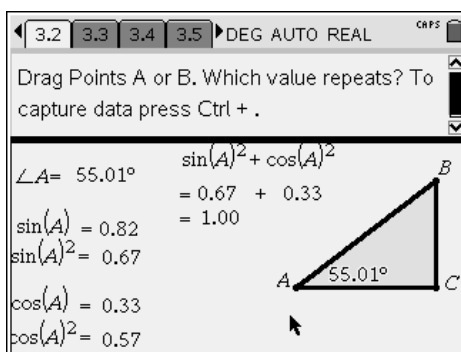


Fig 21

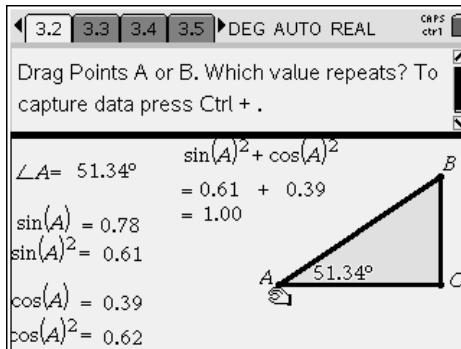


Fig 22

3. Each time that you modify the angle capture the angle and the values of sine and cosine. Press Ctrl + . to capture data. The data captured is on page 3.3 (Fig 23)

Which value repeats?

	A	a	B	C	D	E	F
• =captu							
1	37.57		.37	.63	1.00		
2	42.27		.45	.55	1.00		
3	45.00		.50	.50	1.00		
4	46.04		.55	.45	1.00		
A1	=37.56859202883						

Fig 23

4. Repeat step 3. Capture at least 10 different angles. Observe columns B,C, and D. Answer the question:
 - Which value repeats? (Fig 23)

5. Go to page 3.4 and answer the question (Fig 24)

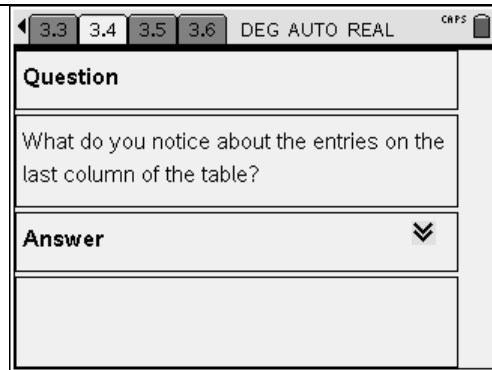


Fig 24

6. Go to page 3.5 and write a trigonometric identity involving the sine, cosine and the number you found repeating on your table. (Fig 25)

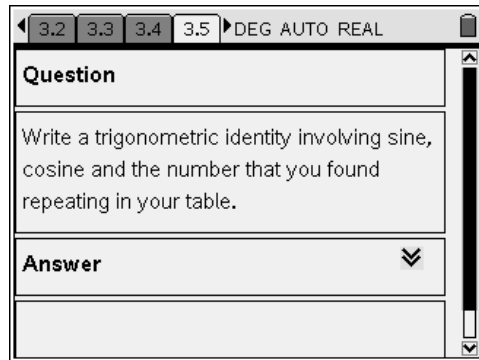


Fig 25

7. Go to page 3.6 and check the identity for different angle values. Two different ways to do it are shown in fig 26

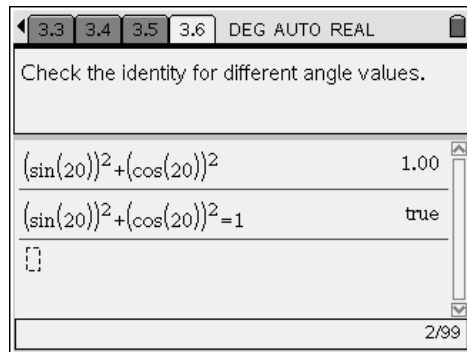


Fig 26