



BLUEBIRD MATH CIRCLE

Alliance of Indigenous Math Circles

MEASURING DISTANCES

Issue 18

Share your problems, solutions, models, stories, and art:
<https://aimathcircles.org/Bluebird>

Indigenous people were scientists before there was that word.

—Debbie Stein, Kumeyaay language and STEAM program coordinator for Viejas Tribal Education Center

Join LIVE Bluebird Math Circle to work on these activities together with friends and family.

NEWSFLASH

Monday December 13, 5-6 PM MDT online.

Sign up at <https://aimathcircles.org/Bluebird>

MATH PUZZLE

If a hen and a half lays an egg and a half in a day and a half, how long will it take 10 hens to lay 10 eggs?

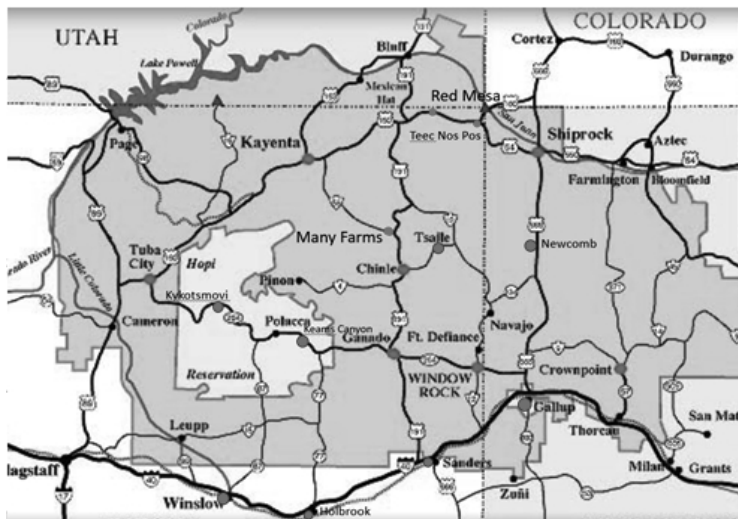
Measuring Distance

One way to measure distance is ‘as the crow flies’. But we will fly with our Bluebird instead.

To the right is a chart of Bluebird distances between communities. Distances are given to the nearest mile. Here are some questions about it:

- 1) Why is the upper half blank? Is some information missing?
- 2) What is the distance (given by the table) between Tsaille and Kykotsmovi?
- 3) What is the distance between Gallup and Red Mesa?
- 4) Suppose you were at Kayenta, and you wanted to read off the distances to each of the other towns on the chart. How could you do this easily? Which town is closest to Kayenta? Which is furthest?

| (nearest mile) | Chinle | Farmington | Gallup | Ganado | Holbrook | Kayenta | Keams Canyon | Kykotsmovi | Many Farms | Newcomb | Red Mesa | Sanders | Shiprock | Teec Nos Pos | Tsaille | Tuba City | Window Rock | Winslow |
|----------------|--------|------------|--------|--------|----------|---------|--------------|------------|------------|---------|----------|---------|----------|--------------|---------|-----------|-------------|---------|
| Chinle | | | | | | | | | | | | | | | | | | |
| Farmington | 84 | | | | | | | | | | | | | | | | | |
| Gallup | 53 | 50 | | | | | | | | | | | | | | | | |
| Ganado | 31 | 100 | 46 | | | | | | | | | | | | | | | |
| Holbrook | 93 | 167 | 91 | 66 | | | | | | | | | | | | | | |
| Kayenta | 55 | 111 | 115 | 78 | 126 | | | | | | | | | | | | | |
| Keams Canyon | 42 | 127 | 83 | 39 | 62 | 64 | | | | | | | | | | | | |
| Kykotsmovi | 62 | 146 | 108 | 61 | 72 | 62 | 25 | | | | | | | | | | | |
| Many Farms | 13 | 80 | 73 | 45 | 106 | 43 | 49 | 66 | | | | | | | | | | |
| Newcomb | 48 | 40 | 51 | 59 | 126 | 90 | 90 | 110 | 52 | | | | | | | | | |
| Red Mesa | 57 | 74 | 105 | 87 | 148 | 47 | 91 | 101 | 41 | 61 | | | | | | | | |
| Sanders | 66 | 121 | 39 | 36 | 52 | 115 | 65 | 86 | 80 | 81 | 121 | | | | | | | |
| Shiprock | 65 | 25 | 50 | 87 | 154 | 86 | 108 | 124 | 60 | 34 | 41 | 113 | | | | | | |
| Teec Nos Pos | 58 | 51 | 98 | 86 | 151 | 65 | 96 | 111 | 50 | 49 | 17 | 118 | 25 | | | | | |
| Tsaille | 21 | 86 | 59 | 44 | 111 | 64 | 64 | 83 | 23 | 46 | 48 | 75 | 80 | 43 | | | | |
| Tuba City | 90 | 169 | 143 | 97 | 102 | 68 | 61 | 36 | 90 | 137 | 130 | 122 | 146 | 129 | 109 | | | |
| Window Rock | 44 | 86 | 20 | 26 | 83 | 99 | 55 | 89 | 56 | 46 | 92 | 36 | 80 | 85 | 45 | 124 | | |
| Winslow | 100 | 181 | 115 | 80 | 31 | 120 | 60 | 59 | 108 | 141 | 152 | 77 | 166 | 158 | 121 | 82 | 103 | |



We want to look at the situation geometrically. Below to the left is a map showing the towns in the chart.

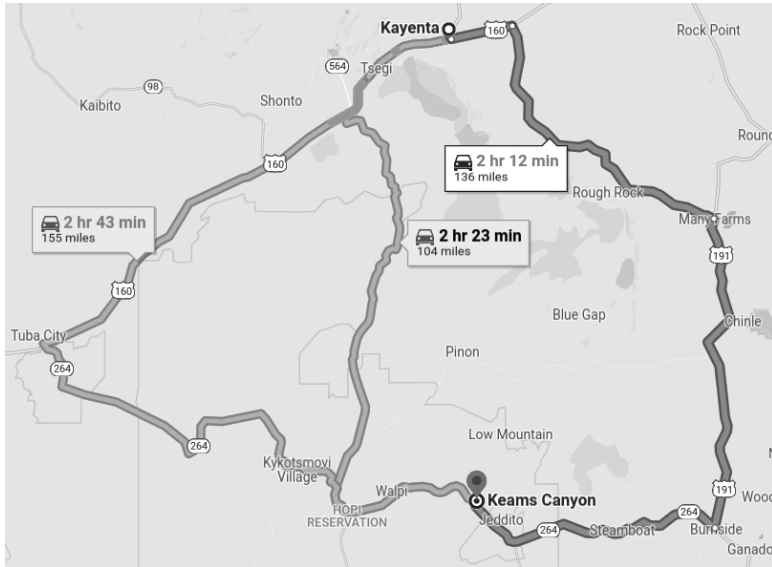
- 5) Suppose we had to decide whether to travel to a certain store which has a branch in Tuba City and another in Gallup. Which towns are closer to the store in Tuba City? Which are closer to Gallup?
- 6) What is the ‘border’ between points closer to Tuba City and points closer to Gallup?
- 7) Which points are the same distance (‘equidistant’) from Tuba City and Gallup? There may not be a town at such a point, but is there a town that is almost equidistant?
- 8) Suppose we are thinking about the distance from each town to Tuba City. Which towns are closer to Tuba City than Chinle is to Tuba City? What is the shape that separates these towns from those that are further than Chinle is from Tuba City?

Other ways to measure distances

Most of us cannot travel as the bluebird does. We cannot fly directly—unless we are piloting a helicopter. So let’s talk about automobile distances. These are distances along roads between towns. To make things a bit simpler, we will only consider roads on the map above.

- 9) Why does it make sense that the numbers in the first column are larger than those in the second column? Both are given to the nearest mile.
- 10) Using a calculator, or otherwise, find the ratios between the air distance and road distance from Kayenta to each town. Notice that we are ‘stretching’ the distances, in going by road rather than by air. But we are not stretching each in the same ratio.
- 11) What stays the same between the two columns?

| Kayenta to | by road | by air |
|---------------|---------|--------|
| Chinle | 70 | 55 |
| Tsaile | 95 | 64 |
| Ganado | 104 | 78 |
| Keam's Canyon | 99 | 64 |
| Tuba City | 75 | 68 |
| Shiprock | 101 | 86 |
| Kykotsmovi | 87 | 62 |
| Window Rock | 131 | 99 |



We can also measure distance in another, very unusual way: in minutes. The map on the left shows yet another strange thing about ‘time as distance’. One of the grey routes is the shortest road distance. But the blue route is the shortest time distance. How does that happen?

Ask Bluebird

QUESTION—What is the largest number you can name? From Donna Fernandez.

BLUEBIRD SAYS—All languages have names for numbers. But for very large numbers, the names for numbers are often borrowed from older languages. The largest number with an English word root is ‘thousand’. The numbers after that (millions, billions, trillions...) are borrowed from Latin or Greek.

If you are curious about languages, you can find out what the largest number name is in other languages, before the names are borrowed.



FUN FACT OF THE FORTNIGHT

In traditional Chinese literature, there are different words for distance uphill, distance downhill, and distance along a flat surface. Why might this be useful? In this system, is the distance from point A to point B always the same as the distance from point B to point A?

Share your ideas with other Bluebird Math Circle participants at <https://aimathcircles.org/Bluebird>