An Introduction to Base Counting

There are many different counting systems that exist, most just used by mathematicians for different purposes. We traditionally use a counting system known as Base 10. This means that when we get to the number 10, we start a new place value. It also means we have 10 numbers we use to create all other numbers: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9. Most mathematicians and scientists believe this is the system we use because we have 10 fingers on our hands.

But…

What if there was a different species that had human intelligence but only 4 total fingers? They might end up counting...in Base 4!

So they would have 4 numbers in their counting system: 0, 1, 2, 3. Every time they got to 4, it would start a new place value spot.

So, they would count 0, 1, 2, 3, 10, 11, 12, 13, 20, 21, 22, 23, 30, 31, 32, 33, 100. So… our "4" would be 10 in Base 10, "8" would be 20, and "12" would be 30. When you got to "16", it would be written 100.

In Base 10, 100 is ten 10s. In Base 4, 100 is four 10s (which is really four 4s in our counting).

Want to hear it explained in a different way? Watch this YouTube video: **https://bit.ly/3eIVPMw**

The Mizrat of Planet Loggu

The 4 fingered Mizrat aliens from planet Loggu use a Base 4 counting system. In Base 4, you add a number to the "tens" place when you get to 4. So, their counting would go: 0, 1, 2, 3, 10, 11, 12, 13, 20, 21, 22, 23, 30, etc. So their number 12 would really be our number "6".

Translate the Mizrat numbers below into our Base 10 numbers:

1. 32 = _____   2. 121 = _____   3. 213 = _____

In Base 4, 210 would be our number 36, so 220 would be our 40, and 100 would be represented as our 16. Translate these numbers using this information:

4. 121 = _____   3. 222 = _____   4. 321 = _____

<u>Mizrat Addition</u>

The Mizrat are running out of Loggula Trees because they are beginning to overpopulate their tiny planet, Loggu. Last year there were 132 Mizrat (remember, that's in Base 4, so in Base 10 we would call it 30). This year, even more Mizrat were born. They added 121 Mizrat. How many are there now?

In Base 4

      132 + 121 = _____ (The answer is <u>not</u> 193)

In Base 10

      30 + _____ = _____

Next year, it is predicted that there will be 213 more Mizrat and the planet will be too full to sustain the population. How many Mizrat will be on planet Loggu then **<u>in Base 4</u>**? (By the way, no Mizrat have died yet. Show your work below or on another sheet.)

Solve the following Mizrat addition problems. Remember, they are all written in Base 4.

32 + 11 = _____

130 + 33 = _____

213 + 21 = _____

1032 + 30 + 11 = _____

1321 + 1222 + 131 = _____

Write your own Mizrat Base 4 addition problem below. Then solve it.

Mizrat Subtraction

The Mizrat have decided to leave their planet before they overpopulate it. They have found a planet in a nearby galaxy that has plenty of trees, water, and other resources that they need. However, the Mizrat are not going to send their entire population, just a small colony of creatures. There are 133 Mizrat right now on Loggu. They are planning on sending 21 Mizrat to the planet to investigate. How many Mizrat are going and how many are staying?

In Base 4

$133 - 21 =$ _____ (the answer is <u>not 112</u>)

In Base 10

_____ - _____ = _____

On the way to the planet, called by its current residents "urth", the Mizrat have 13 more babies and experience the loss of 10 Mizrat. How many Mizrat land on the new planet?

In Base 4

_____ $+ 13 - 10 =$ _____

In Base 10

_____ + _____ - _____ = _____

Solve the following Mizrat subtraction problems. Remember, they are all written in Base 4.

22 - 10 = _____

100 - 33 = _____

232 - 21 = _____

1111 - 130 = _____

1321 - 1223 = _____

Write your own Mizrat Base 4 subtraction problem below. Then solve it.

The Final Mizrat Adventure

The Mizrat have arrived on planet Urth and have found that the Huemins that are already living there do not want them to be there. The Huemins are claiming that the Mizrat are invading Urth and they are threatening to use their Wepins on the Mizrat. The Mizrat have decided to leave Urth and find a different planet. Nearby, they find the planet Joopitter. When they land, they find THAT planet also has creatures living on it. They are green little aliens with antennas and 6 fingers total on their hands. The Mizrat discover they count in Base 6. Using what you know about Base 4, write the Base 10 numbers 1-20 in Base 6 below.