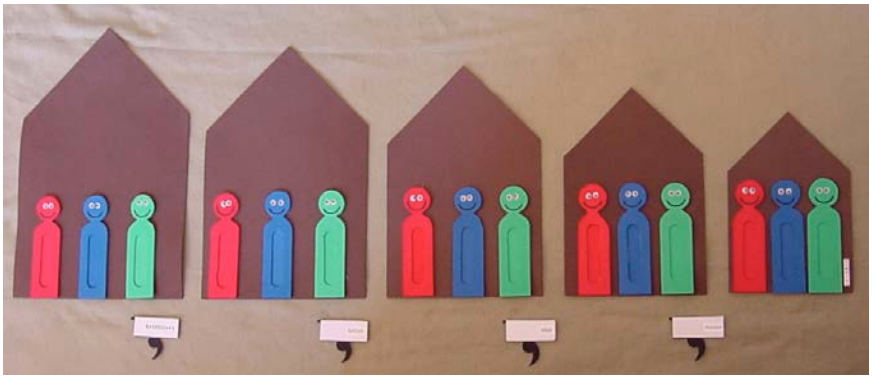
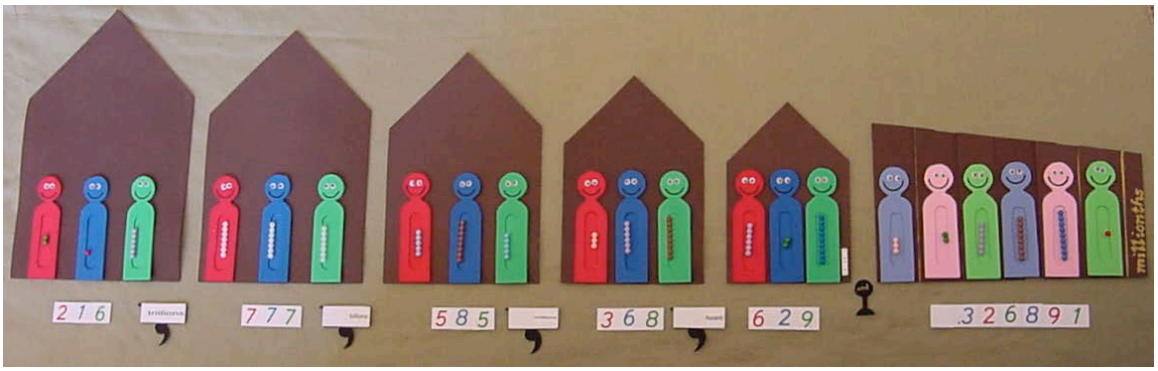
Streets in Infinity

with many thanks to those who came
before who contributed to this lesson

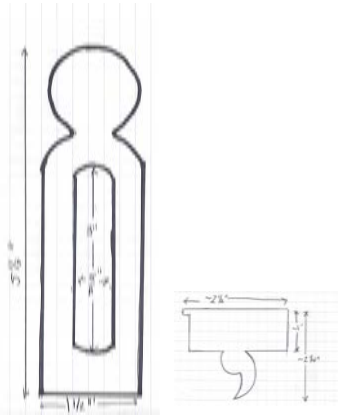




Streets in Infinity

Materials

- Set of 15 craft foam "people" (see alternative at end of lesson):
  5 green
  5 blue
  5 red
  Refer to the cover photo and to approximate dimensions on drawings to the right. Each "person" has 2 layers- one is solid and one has an oval cut from its "belly" that is sufficiently large to fit a 9-bar. Using white glue, glue the "person" with a "belly hole" on top of the solid "person".



- Set of 4 mailboxes with black posts shaped like commas and one small rectangular mail slot
  - Each mailbox is labeled with one family name (Thousands, Millions, Billions, Trillions)
  - The mail slot is labeled "Simples"
    (Note: family names can be hand-written with fine-tipped paint pens or with Dymo-Labels)
- Set of 5 houses – cut from craft foam or drawn on butcher paper
  - Note that the five houses differ in size (See cover photograph). Specific dimensions of the houses are not critical, so long as the smallest house can fit three people.
- Box of bead bars
- Set of Hierarchical Numerals (from Bank Game)
- Rug(s)

Preparation

- Gather the above-listed materials.

Target Students

This lesson is appropriate for children who have had success with the Wooden Hierarchical Materials, naming numbers up to 1,000,000. (generally age 6 and up).

Direct Aim

- Extending the child's concept of numeration to hundreds of trillions and beyond

Indirect Aims

- Reinforcing the concept of family names
- Reinforcing the idea that each family has up to three members
- Giving the child greater confidence with very large numbers

Presentation

1. Invite the children to a lesson. "This lesson is called *Streets in Infinity*. What do you know about **infinity**?" (Children will have various answers. A simple explanation is that infinity is a number that is bigger than the biggest number they can think of. If someone started counting the day s/he was born and kept counting ever second that s/he was alive, s/he would never get to infinity because infinity is still a bigger number.)

2. "For the purpose of this lesson, Infinity is also a place. It is an imaginary place. Imaginary people live there. I live in a **real** place. The place where I live is called <city>, <state>, <country>." <Ask a few children where they live.>
3. "There are streets in my real place. Are there streets where you live?"
4. "All along the streets where I live are houses. Are there houses along the streets where you live?"
5. "In Infinity, there are streets, too. In Infinity, there are houses along the streets. But there is something unusual about the houses along the streets in Infinity." <Lay out the houses such that the smallest house is to the children's far-right and the size of each subsequent house increases to the left, as shown in the photograph on the cover of this lesson.> "What do you notice that is unusual about the houses in Infinity?" (Children should note that the houses become progressively larger from right-to-left or that they get progressively smaller from left-to-right).
6. "What do you think that we might find in these houses? People! Each house has one family living in it, and each family has exactly 3 people in it. Is that the way it is where you live? Does each house have just one family in it, and does each family have exactly 3 people in it?" … "No, it isn't that way where I live either. It is kind of funny, isn't it? But that is the way that it is in Infinity."
7. "Would you like to know something else that is unusual about Infinity? Not only is it true that each family has exactly 3 members, but it is also ALWAYS true that one of the members is green, " <lay a green person in the smallest house on the far right side of the house as seen by the children>, "one of the members is blue, " <lay a blue person in the center of the smallest house>, "and one of the members is red!" <lay a red person in the smallest house on the far left side of the house as seen by the children>
8. "It is that way in every house on every street in Infinity!" <Verbally guide the children to direct the laying out of all of the remaining green, blue, and red "people".>
9. "Now we have filled every house. Is this ALL of the people who could possibly live on this street? No! We could always add another house on the left end of the street." Optional: Tie this back to the concept of the number infinity by asking how many more houses could be added to the street and realizing that there is no limit to the number of houses that can be added.
10. "Next we are going to look inside the smallest house, at the family living in the first house on the Street in Infinity. But before we do that, I want to ask you a question about the people in your family. Do they all have names? The people in my family have names too!" <Show a family picture. The picture can show a real or fictitious family. The lesson will be simpler if the family picture shows a collection of people with a common last name. Give the name of each person naming first, middle and last name of each person.> "What do all of those names have in common? Each person has a different first and middle name, but they all have the same last name. That is called the family name."
11. "Sometimes people who are all part of a family don't have the same last name. But in Infinity, where every house is bigger than the house to its right and smaller than the house to its left, where each house has one family and each family has 3 members, everyone who shares a house has the same family name."
12. "Can you guess any family names – families that are likely to live in Infinity?" (If children do not volunteer family names, offer "Thousands … Millions …" and see if they pick up on the pattern. If children say "units" or "simples", they are indicating a very solid knowledge base. If they offer "hundreds", they are indicating a real need for this lesson.)
13. "Now one more question: where does your family get mail?"

14. "In Infinity, each family gets its mail from a mailbox that is right in front of the house." <Lay out the mailboxes in hierarchical order, as shown in the cover photograph.> "Notice that the family names are on the mailboxes. Do you notice anything unusual these mail boxes – or about the posts that they sit on? Yes, the posts are shaped like commas! Isn't that funny!"
15. "You may have noticed that the first house doesn't have a mailbox. That is the family of Simples. They are a little sensitive – they don't like their family name very much. So out of respect for their feelings, we don't often use their family name. So instead of a mailbox, this family gets their mail delivered through a mail slot." <Place the mail slot on the far right-hand side of the right-most house>
16. <Place a 9-bar in the belly of the units person in the Simples house, a 2-bar in the belly of the tens person, and a 6-bar in the belly of the hundreds person.>
    "Now lets look at who is living inside the first house.
    - the **first** name of each person in the house by looking at the bead bars in their bellies
    - the **middle** name is told by the color – it is like a name tag.
    - the **last** name is the family name – the one on the mailbox

    Here in the first house, we have 6 Hundred Simple, 2 Ten Simple (which we call Twenty Simple for short – like a nickname) and 9 Unit Simple. If we were going to name everyone in this family we would say the first names all together and then the family name: 629 Simples.
    OOPS! I am sorry – I forgot that they don't like their last name. So we would say 629 <whisper the word, *Simples*.> "
17. <Get the appropriate hierarchical numerals to represent the quantities 600, 20, and 9. Stack them appropriately to make the numeral 629 and repeat the numeral 629 *Simples.*>
18. "One day the *Simples* family got some exciting news! A new family was moving in next-door! We already know the last name of the new family, don't we? Yes, Thousands! See the name on the mailbox? <Place an 8-bar in the belly of the units person in the Thousands house, a 6-bar in the belly of the tens person, and a 3-bar in the belly of the hundreds person.>
19. Get the appropriate hierarchical numerals to represent the quantities 300, 60, and 8. Stack them to make the numeral 368 and name the people in the Thousands house: *368 Thousands.*
20. "Now let's say the names of everyone who lives on this street in Infinity." <Point to each bead bar as it is named, and then to the family name on the mailbox.> "Three hundred sixty eight Thousand, six hundred twenty nine *Simples.*"
21. <Build the number house-by-house, reading the names of all of the people living on this street in Infinity each time, until all of the houses through trillions are filled. NOTE – choose the numerals judiciously to avoid having to re-use a given hierarchical number ticket within a single number. That is, do not choose to have 800 Million and 800 Thousand. The number 216,777,585,268,629 works well, but there are many others, of course.>
22. Repeat this with other numbers during the lesson. You may wish to do this only with bead bars (not adding the hierarchical numerals) for the sake of speed. Or you may "deal" out hierarchical numerals and assign families to all of the participants in the lesson and have each child add the bead bar that represents his / her hierarchical numeral, after which the children all read the resulting number together. To build fluidity, be sure to emphasize reading the 3-digit numeral within a given house as the first step, and reading the family name on the mailbox as the second step, and then go to the next family.

Suggested Follow-Ups / Extensions

1. Children can draw tickets with numbers that they then build and name. Alternatively, with a partner, one can build a number while the partner writes and reads the number (using hierarchical colors). Partners trade roles and play again.
2. Children can research family names beyond trillions, making the largest number that they can.
3. Individually, in pairs or trios, children can draw their own Streets in Infinity on butcher paper, writing and reading the number that they have drawn. (These make wonderful hallway decorations!)
4. Children can write large numbers in hierarchical colors on adding machine tape and take it to another classroom to read to other children (especially younger children).

Points of Interest

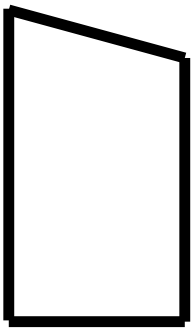
1. The story itself.
2. Personification of numbers.
3. Finding the patterns in numbers.
3. Building and reading really, really large numbers.
4. If foam people are used, the beauty of the materials.
5. If markers and butcher paper are used, children love to decorate the houses with chimneys, landscaping, etc.

NOTE: This lesson can be given effectively by drawing the houses, mailboxes, and people on a white board in hierarchical colors. The height of the people in the houses should depict the numerical value. Drawing 294, there would be a very short red person with the number 2 at the bottom, a very tall blue person with the number 9 at the bottom, and a green person of moderate height with the number 4 at the bottom.

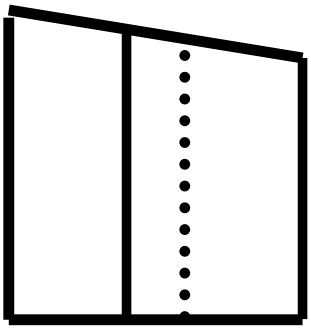
More Streets in Infinity

Materials

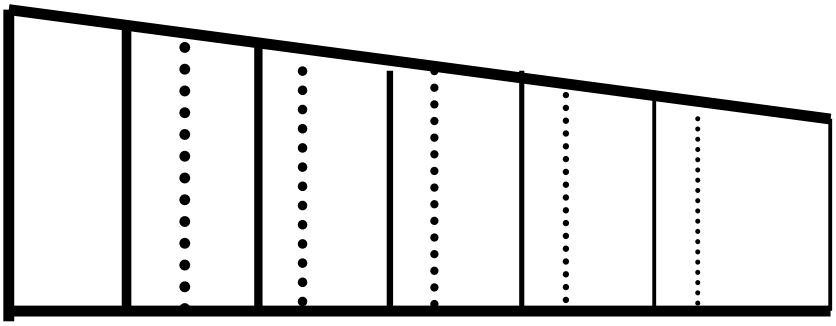
- All materials necessary for the initial Streets in Infinity lesson
- Decimal Hierarchical Numerals (from Decimal Division Board)
- One reversible sign on card stock
  - Front side has a red octagon with the word STOP in the center
  - Back side has a black circle with the word AND in the center
- Set of 6 "apartments" cut from craft foam (see sketches, below)
  - Note that each apartment is progressively shorter than the last, but retains the same width.
  - When the apartments are laid out so that they overlap one another by about 1/3, the roof line makes one contiguous line (see photograph on the cover of the lesson. The place value of each apartment (tenths, hundredths, etc.) is written on the right side of each apartment such that it is covered when by the overlap (refer to cover photograph)



One Apartment



Two Apartments (overlapped edge shown dashed)



Six apartments

Preparation

- Gather the above-listed materials.

Target Students

This lesson is appropriate for children who

- have mastery of numeral nomenclature with whole numbers
- have sufficient mastery of whole number and fraction operations to be ready to move into decimal operations
- have, through introductory decimal lessons
    - knowledge of the names of decimal place values
    - an understanding that .1 is 1/10, .01 is 1/100, etc.

Direct Aim

- Extending the child's concept of numeration and numeration nomenclature to millionths and beyond

Indirect Aims

- Reinforcing whole number hierarchy

Presentation

1. Invite the children to a lesson. Review the *Streets in Infinity* lesson concepts, drawing the following concepts from the children to check for retention. Lay out materials to support the summary of the story.
    a. Houses get bigger as one builds to the left
    b. Each house has one family
    c. Each family has 3 members: red hundreds, blue tens, and green units
    d. Each house has a mailbox that shows the family name, except *Simples*. They don't like their family name much so they have a mail slot.
    e. Build and name a number or two.
2. "What comes after the *Simples* family? Sometimes nothing. Sometimes that is the end of the road – a dead end. But some streets have a cross-street. Do two streets ever meet one another in your neighborhood? Mine too. We call that an intersection. What do we often see when 2 streets intersect that helps know drivers whether to go or not? A stop sign. So if our street in Infinity goes past the *Simples'* house, we are going to have a stop sign so that we can safely cross the intersection to the other side of the street. What do you think that we are going to find on the other side of the intersection? Decimals!"
3. Let's take a look at a different street in Infinity – one that has just one house for the *Simples* family, and then on the other side of the intersection, decimals." <Lay out the smallest house. Place the three hierarchical people in the house. Put a 9-bar in the belly of the units person and lay out the hierarchical numeral 9. Place the stop sign to the right of the house.>
4. Once we cross the street, we no longer see houses. People who live on this side of the street live in apartments. These apartments hold only one person each." <Lay out the tenth's apartment>.
5. "Notice that here, occupants put their family name on the outside of the building, not on a mailbox." <Place a light-blue tenth person in the apartment.> "This fellow's last name is tenth."

<Place a 3-bar in the belly of the tenth.> "His name is 3-tenths."

6. <Lay out the hierarchical numeral .3 and again say "3-tenths".>
7. How would we name the people on this street in Infinity? Would we say, 'Nine-stop-three-tenths'? No! In Infinity, they don't actually have STOP signs. They have AND signs." <Flip the STOP sign over to reveal the AND sign.> "When you see an AND sign, you know that you are crossing the street from the wholes side, where 3-person families live in houses, to the decimal side, where each person lives in his or her own apartment. We would name the people on this street, 'Nine *simples* AND three-tenths', or just 'Nine AND three-tenths'."
8. <Practice this with several other numeral configurations. Return at the end to 9.3>
9. "Sometimes there are multiple apartments in a single apartment building. One day, 3-tenths learned that someone was moving in next door! A new neighbor! Do you know what the neighbor's last name is? Hundredths!" <Place the hundredths' apartment so that it overlaps with the tenths' apartment, covering the name "tenths". Place a pink hundredths person in the apartment and place a 2-bar in the belly. Retrieve the hierarchical numeral .02. For now, do not stack it with .3.>
10. "Notice that we can't see the name "tenths" any more. We can only see the last name of the person living in the end apartment. So we name all of the people living in the apartment building using only their first names AS IF they were whole numbers in families, BUT we only say the last name of the person in the last apartment." <Stack the hierarchical numerals: .32> "We would call this 32-hundredths. We know that it is really 3-tenths and 2-hundredths, but we call it 32-hundredths. So if we named everyone on this street in Infinity we would say 'Nine and thirty two hundredths."
11. " What if 2-hundredths got a neighbor? What will that person's last name be?" <Proceed with laying out the next apartment as with 2 hundredths. When it comes time to naming the 3-digit decimal, it is sometimes helpful to take the three bead bars out of their belly-slots and lay them on the rug below the apartments. Read those three numbers as if they were whole numbers: 3-2-6 becomes three hundred twenty six. Then place them back in the belly slots in the apartments, and they become three hundred twenty six- thousandths.>
12. <Practice this with several other numeral configurations.>

Suggested Follow-Ups / Extensions

Any of the follow-up activities suggested for the first lesson would reinforce the concepts covered here. However, this lesson is typically given to older children, so not all will appeal to these older children. The one with greatest appeal has proven to be allowing children to draw their own Streets in Infinity on butcher paper or even legal-sized copy paper, writing and reading the number that they have drawn. If then posted in the hallways, it provides a point of interest and discussion for children who have only seen whole number Streets in Infinity. Children will sometimes also get this material out and invent their own stories.

Points of Interest

1. Hearing "the rest of the story".
2. Personification of numbers.
3. Diversity of housing – apartments vs. houses
3. Building and reading really, really small numbers.
4. If foam people are used, the beauty of the materials.
5. Drawing as a follow-up.