

NUMBER CONCEPTS SESSION

Activity: Divisibility Rules

Objective: Explore place value and number sense and how they lead to the rules for divisibility.

Materials: One calculator per pair of participants
Newsprint or chart paper
Markers
Base ten materials
Hundreds charts (several for each group)

Procedures:

1. List numbers on the board. Ask students to tell you which numbers from the list are divisible by 2. Ask how they know which numbers have 2 as a factor.
2. Ask students if they know any other rules for divisibility (such as divisible by 5 if it ends in 0 or 5 and divisible by 10 if it ends in 0).
3. Give students a hundreds chart and ask them to find all the numbers that are divisible by 2. Students should then find the numbers that are divisible by 3. Students should then find the multiples up to 100 of four through 12. (A calculator could be used for this.) Encourage students to find original ways of recording their data. (Refer back to Multiple Tower's Activity.)
4. Share the students' results. Ask for any patterns they have found.
5. Ask students if they can find rules to explain what numbers are divisible by 2 - 12. (Students will probably generate rules for dividing by 2, 5, and 10)
6. Give students a number such as 354 that they have not considered and ask if it is divisible by 2. Ask students how they know it is divisible by 2. Ask students why they only need to look at the ones digit. (The ones digit is the only digit that could make a difference because all groups of 10 are divisible by 2, all groups of 100 are divisible by 2, etc.) Let students model with base 10 blocks and discuss this with several examples.
7. Repeat this process with 5 and 10 to discover why we only look at the ones place to test for divisibility with these numbers.

8. To explore divisibility by three, use the number 234 and ask students to take the hundreds one at a time and do the exchanges necessary to divide each hundred into three equal groups. How much is left over out of each hundred? (one unit) Next tell students to take each ten one at a time and divide each ten into three groups. How much is left out of each ten? (one unit) The ones place has 4 leftover ones which will not be divided up.
9. In looking at the leftovers, we have two leftovers from the hundreds, three leftovers from the tens, and four leftovers in the ones place. Since all of 234 has been divided into three equal groups, except the leftovers, we must see if the leftovers can be divided by 3. If we add up the digits of the number 234 (which match the number of leftovers) and this sum is divisible by 3, then the whole number is divisible by 3.
10. In contrast, 235 is not divisible by 3 because $2 + 3 + 5 = 10$ which is not divisible by 3. Remember--the 2, the 3, and the 5 now represent the leftovers after making groups of 3 in each place value position.
11. Once students have had ample time to explore the divisibility rule for 3 and really understand why it works you could encourage them to come up with the divisibility rule for 9: (An integer is divisible by 9 if and only if the sum of its digits is divisible by 9. For example, 738 is divisible by 9 because $7 + 3 + 8 = 18$ and 18 is divisible by 9.) The reason that this works is the same as why the divisibility rule for 3 works. Each hundred and each ten will give you one leftover when divided by 9.
12. During exploration ask these questions:
 - How do you know which numbers have 2 as a factor?
 - What other rules for divisibility do you know?
 - How did you decide to record your data?
 - Is there another way to organize your data?
 - What patterns did you notice as you found the multiples of 2 - 12 from your hundreds chart?
 - Why do you only need to look at the ones digit to see if a number is divisible by 2? 5? 10?
 - Can you state the divisibility rule for 2? 5? 10?
 - What is the divisibility rule for 3?
 - Why does the divisibility rule for 3 work?
 - What do the digits that you are adding represent?
 - When you're modeling the rule of divisibility for 3, why do you divide one hundred at a time and one ten at a time?

- Why don't you divide the ones when you are modeling the divisibility for 3?
- What is the divisibility rule for 9?
- Why does the divisibility rule for 9 work?

13. To summarize ask questions like these:

- Why would knowing the divisibility rules be helpful?
- What is the divisibility rule for 2? 3? 5? 10? 9?
- Why does the divisibility rule for 3 work?
- Why does the divisibility rule for 2 work?
- Why does the divisibility rule for 5 work?
- Why does the divisibility rule for 10 work?
- Why does the divisibility rule for 9 work?

Extensions:

1. Explore the divisibility rules for 4, 6, 7, 8, 11, and 12.
2. Explore the relationship between the divisibility rule for 10 and the divisibility rule for its factors 2 and 5.

Assessment:

1. Questions:
(See summary questions)
2. Observations:
 - Did students recognize the multiples of 2 - 12 on the hundreds chart?
 - Were students organizing data?
 - Were students using base ten materials correctly?
3. Tasks:
 - Brainstorm a list of situations when knowing the divisibility rules would be helpful.
 - Write in your journal what the divisibility rules are and why they work.