FACTORS AT PLAY

PREPARATION

Grade Levels: 3-6
This activity would be most effective if delivered in (3) separate 30-40 minute periods.

Prerequisites
Before beginning this activity, create 4 white poster boards with a brown tree trunk drawn on each one. Also prepare 25 green leaves cut out of green construction paper.

Materials Needed
Students will need:

- Markers or crayons
- Scotch tape
- 8 ½ x 11" paper
- A chalkboard or some other way to display information

Group Leader will need:

- Copy of the Cyberchase episode "The Icky Factor"
- Green construction paper cut into 50 large leaves
- Four white poster-size boards with a brown tree trunk drawn on each one

Academic Goals
Children will:

- Children will become familiar with the basic concept of factors.
- Children will become familiar with the more complex process of prime factorization.
- Children will learn that some numbers have more than two factors, and some numbers do not.
- Children will experience a connection between visual art and a math process.

Social Goals
Children will:

- Children will have opportunities to work in small groups, as teams.
- Children will develop their group speaking skills as they provide feedback on each other's work.
- Children will develop their listening skills, allowing peers to speak and share opinions

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STEPS

Activity 1:

Introductory Activity (30-40 minutes):

1. Watch the entire Cyberchase episode “The Icky Factor.” Ask the students to pay close attention to when the students solve puzzles by using factors.

2. Discuss briefly how the kids in the show were able to solve different puzzles. Ask the students if they can explain what factoring is, based on what they learned from the Cyberchase episode. If needed, use an explanation similar to the one used in the "The Icky Factor" episode: factoring is figuring out which numbers can be multiplied to equal another number. Ask the students to identify when the Cybergang used factoring to solve a puzzle in the episode.

3. Ask the students to think of the example in the episode when Digit and the kids are trying to free Icky from the cage. Initially Digit thought the number was 13 but when the kids tried to make equal rows they kept having some pieces left over. Explain to the students that although this wasn’t included in the episode, the only factors of 13 are the numbers 1 and 13. Ask the students if they know what numbers like 13, since its only factors are the number 1 and itself, are called. Explain that 13 is a prime number and that a prime number is a number where the only factors are 1 and the number itself. Tell the children that they will learn more about this later in the activity.

Learning Activities: (15 minutes)

1. Explain that now they will watch a short clip from "The Icky Factor" episode. If you can't show the video clip from the Web, cue the video about three minutes into the episode to the scene that begins with Digit saying, “What’s up is this.” End the clip when Digit says, "I'm a genius."

2. After watching the scene where Digit has to sort 36 objects into four different boxes, ask the entire group to stand. Remind the group about the scene in the episode when Digit needed to equally divide the 36 objects into four different boxes and the about the activity the children did with their desks in the "For Real" segment, explain that the students will now arrange themselves into equal rows to practice making factors.

3. Ask 12 students to stand up and arrange themselves in factors of 12. After they select an arrangement ask any students who are seated to suggest a new arrangement. After the students have formed several arrangements explain that in each case they formed rectangles: 3 x 4, 6 x 2, and 1 x 12.

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4. Explain that the students must now arrange themselves in rows that do not have anything left over for their total number. For example, if you have 24 students they can get in 2 rows of 12. When they have arranged themselves ask them to guess what the equation is that the rows represent. For this example it would be 2 x 12 = 24. Write the equation and the drawing on the board.

NUMBER	DRAWING	FACTORS
24	XXXXXXXXXXXX XXXXXXXXXXXX	2 x 12

NOTE: If the number of kids in a group is a prime number, meaning it has only itself and one as the factors, kids can see that the only arrangement is a rectangle with a width of 1 and a length equal to the given number. After completing this arrangement ask two children to act as one so the number can be factored.

5. Ask the children to rearrange themselves again so they come up with a different factor—with nothing left over--of the total number of kids. This time a group of 24 may come up with 3 rows of 8 or 4 rows of 6. For each formation ask them for the equation. Continue asking the children to rearrange themselves until they have represented all of the possible factors. Write each equation and drawing on the board.

NUMBER	DRAWING	FACTORS
24	XXXXXXXXXXXX XXXXXXXXXXXX	2x12
	XXXXXX XXXXXX XXXXXX XXXXXX	4x6
	XXX XXX XXX XXX XXX XXX XXX XXX	3X8
	XXXXXXXXXXXXXXXXXXXXXXXX	1X24

6. Ask the group if 5 is a factor of 24. After soliciting some answers you can ask the students to arrange themselves or ask a student to try and draw 5 as a factor of 24 on the board.

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XXXXX
XXXXX
XXXXX
XXXXX
XXXX

Ask the students why 5 is NOT a factor of 24. If needed explain that they cannot make a rectangle because there are some left over pieces and there is not enough to make a complete row.

7. Review all of the different factors of 24, and reiterate the concept of factoring: Finding two numbers that when multiplied equal the given number.

Activity 2:

Introductory Activity (15 minutes)

1. If you can't show the video clip from the Web, cue the tape about 18 minutes into the episode to the scene where the Cybergang has found Icky and are trying to free him from the cage and the kids say, "Cool, what's the combination?"

2. After watching the scene where Digit and the kids crack the combination on the Cyberslug's cage, divide the group into four teams, and have each team assigned to a work area.

3. Explain that each group will be given a number that they have to factor, just like the Cybergang did to free Icky. Assign each team one of the following numbers: 32, 36, 48, and 60.

    - The factors of 32 are: 1x32, 2x16, 4x8
    - The factors of 36 are: 1x36, 2x18, 3x12, 4x9, 6x6
    - The factors of 48 are: 1x48, 2x24, 3x16, 4x12, 6x8
    - The factors of 60 are: 1x60, 2x30, 3x20, 4x15, 5x12, 6x10

4. Each team attempts to determine all of the factors of their number (meaning, sets of two factors like 32=2 x 16) on a piece of paper.

5. When everyone is done, ask one member from each team to come up to the board and write all of the two factor equations of that team's number.

6. Give the other teams an opportunity to agree that all the factors of the number are listed or pose a "challenge" if they think that factor equations are missing.

Learning Activities (30-40 minutes)

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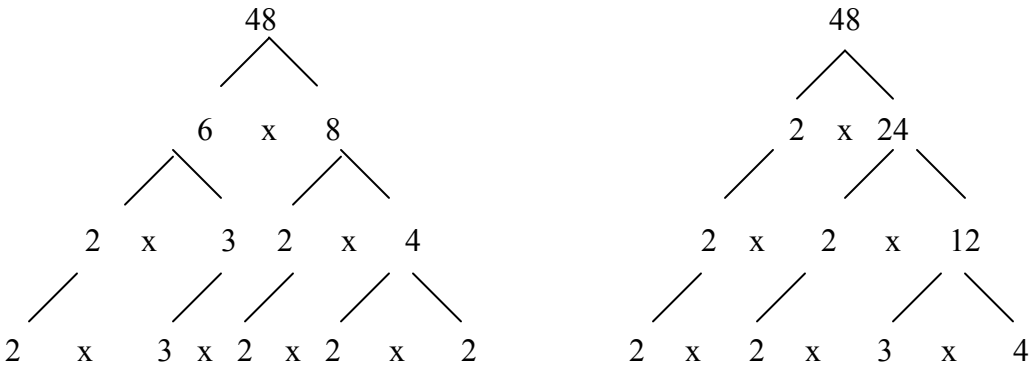
1. Let's look at the numbers 2-12 and their factors. Ask the students to give the factors for each number and write them on the board. For example:

2	1X2		
3	1X3		
4	1X4	2X2	
5	1X5		
6	1X6	3X2	
7	1X7		
8	1X8	2X4	
9	1X9	3X3	
10	1X10	2X5	
11	1X11		
12	1X12	2X6	3X4

2. Have the students examine the results and ask them what they notice. Explain that some numbers have exactly two factors. These are the prime numbers - so 2, 3, 5, 7 and 11 are prime numbers. Have them name another prime number that was not included in this list of numbers, for example 13. Explain that if the number has more than two factors it is a composite number - so 4, 6, 9 and 12 are composite numbers. Ask them to name another composite number, for example 14.

3. Explain that each group will have to do a complete prime factorization of their number, in the form of a tree, on a piece of poster board. Explain to the students that prime factorization is when you name a number as a product of prime factors. Each factor has to be a prime number. If it is not a prime number continue to factor it until all the factors are prime. Explain to your students that they can think of this as the leaves on a Weeping Willow tree where the top of the tree is the original number and as they go down the branches each leaf contains the factors of the original number. They continue until all the factors are prime numbers and the prime factors of a number will always be the same regardless of the factors they chose originally. On the board, recreate the below example of the prime factorization of 48. Explain that even while 48 is factored two different ways the prime factors are the same.



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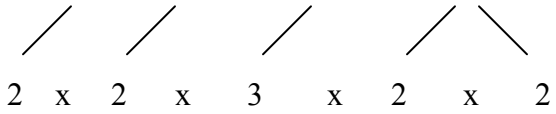

Ask if the students can see that the prime factors are the same. Explain that 48 could also be factored into 3x16 and you could also factor 24 into 4x6 or 3x8. Regardless of what factors they choose to start with, the prime factors of 48 would still be 2x3x2x2x2.

NOTE: Prime factors are usually arranged in ascending order. This makes it easier to check.

4. Explain that the students will now create their own "trees" by factoring the top number. The first layer of "branches" will be the two-factor equation. The next layer of "branches" will be the factorization of those equations, until the factorization contains only prime numbers. Again, prime numbers are numbers where the only possible factors are 1 and the number itself.

5. Each team then writes each of their factor equations on a leaf, using the pieces of green construction paper, one equation per leaf (for example, "2 x 3").

6. Write each of the original numbers on top of each tree trunk on the poster board (one number per each poster board).

7. Ask each team to put their pile of leaves in the appropriate order on their tree on the poster board. Ask the student to use tape to attach the leaves to the poster board.

8. As an entire group review each tree and determine if all the equations are in the correct place. If an equation is out of place ask the students why it is out of place. Ask them how the tree needs to be changed so the equation is in the correct place.

9. Then, dismantle the trees and re-assign the numbers so that each team is given a new number that they need to factor.

8. Each team then has to set up its "factor tree" with its newly assigned number on the poster board tree trunk, in the right order, so that the proper equations flow from the proper number.

9. Once again have the entire group review all of the factor trees to make sure the leaves are in the right place.

Follow-up Activities:

1. Have the children visit the Games Central section of the Cyberchase Web site and play pattern and factoring games like "Score the Pour" and "Double the Donuts."

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CREDITS

This AFTERSCHOOL EXCHANGE activity was developed by Melissa Donohue in connection with the Thirteen series CYBERCHASE.

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