The Magic of Mathematics

Summary

Through teacher presentations, a video, and hands-on activities, students will uncover the value of looking for patterns. They will discover that not only do patterns help us solve mathematical problems but they apply to other disciplines as well. Students will explore how math relates to music, magic, games, weaving, and Cherokee baskets. They will find that patterns are used extensively to explain, create, and predict.

Time Frame

5 class periods of 45 minutes each

Group Size

Small Groups

Life Skills

Thinking & Reasoning, Communication, Employability

Materials

ITV video from Nebraska Mathematics and Science Coalition, *Patterns are Everywhere*
Three dice
21 toothpicks
a deck of cards and a handkerchief or cup to cover the dice
enough pennies so that each group of two in your class can have ten pennies
have each student bring a silly instrument, like pan lids, a kazoo, mason jars with lids etc.

Background for Teachers

The teacher needs to learn the "Math Magic", and a twelve count rhythm. Math Magic: This is a set of math magic tricks that use the patterns of cards or dice to do the magic. The tricks are simple yet impressive because the students want to know the magic.

Intended Learning Outcomes

1) To solve a variety of problems including open-ended problems, puzzles, application, patterning, and extended problem-solving projects. 2) Formulate a plan to solve a problem by using a pattern.

Instructional Procedures

Day One

(Introduction)
To introduce this topic, show the first segment of the video *Patterns are Everywhere.* Stop the tape at the place where Helen says, "Now for something completely different." Talk about the card trick pattern in the tape. Discuss the pattern that made the trick work. Things like keeping the rows together and dealing them out so the cards would be in different rows the next time. Tell the students that you are a math magician and that you have some magic tricks for them.
The students will need to gather in a semicircle around a table or desktop. (I have them sit on the desks and then stand or sit on the seat behind). Tell the students that the magic you do is not trickery, it is all done with math. There are patterns and problems that you use to do the trick.
You can choose to share some of the math tricks but try to make them come up with the math, don't

just "give" it to them. I always share the Fibonacci sequence with them, but I don't necessarily share the others. Do the tricks about two times each. This helps the students understand that the answers vary from each trial. On the second Fibonacci be prepared to multiply a really big number. As you go through this magic show reiterate the message in the first segment of the video. 1) Math is the science of patterns. 2) Helen changed the possibilities from twelve to one in order to find his card. 3) Patterns explain things. 4) Patterns are used to create, predict and explain.

1. Trick number one: While your back is turned a student rolls three dice onto a table. Ask them to add the faces of the three dice. Pick up one die and add the number on the bottom. Roll this dice again and add the roll to the total. You turn, quickly pick up the dice, shake them (dramatize, say the dice are talking to you and hold them to your ear), then tell them their total.

NOTE: it is a good idea to have other students in the class add along with the student to make sure of the ending total. (Remind the students as you pick up the dice, that you don't know which die was rolled.)

What you do is look at the dice just before you pick them up, and add the faces yourself. Then add seven to the total of the faces and this is the student's number. This works because the top and bottom of every die adds up to seven.

2. Trick Two: While your back is turned you have a student roll then stack the dice. This stack must stay the same throughout each trial. The student adds the top two faces that touch, the bottom two faces that touch, the bottom face, but not the top face. You turn around, cover the dice, and pull out the correct amount of toothpicks from your pocket.

(You have 21 toothpicks in your pocket, this is what the total would be if all the faces were added together. As you cover the stack of dice you take note of the top die face. Carefully count this many toothpicks into your pocket then pull out the rest. The student counts the toothpicks and finds them to be her number.)

3. Trick Three: With a deck of cards (I use Rook cards so the students don't think I have a trick deck), count out twelve cards onto the table. Have a student come forward and turn over four of the cards. Put the rest of the cards on the bottom of the deck. Using the cards that are face up count from that card to ten placing the counting cards face down beside the card. For instance if a three were face up, you would lay a card next to it face down and count four, then lay down another and count five...to ten.

After doing this and getting four face down piles; write a prediction on a piece of paper and hand it to a student. Have a student add the number on the face up cards (all numbers over ten count ten). Count this many cards off from the top of the cards in your hand, turn the last one face up. This card will match the prediction you made on the paper.

You carefully sneak a peek at the bottom of the deck before or after dealing the twelve. This is the card on your prediction. This works because after counting out twelve cards you now only have forty in the deck. The counting of the face down cards leaves off the amount of the card facing up. When you add the card faces and take these cards off from the pile in your hand you are now at what used to be the bottom of the deck, and it is the predicted card.

4. Trick Four: Have a student write a Fibonacci sequence on the board. You challenge someone with a calculator to add the column faster than you can. Give them a head start, then turn and quickly write the answer.

A Fibonacci sequence is one where the last two numbers are added to give you the next number. For instance 1,1,2,3,5,8, 13 etc. One and one are added to get two then two and one added to get three, then three and five etc.

The students can pick any two number to start the sequence. He/She needs to have a column of ten numbers. Have the other students in the class add along to make sure each successive number is correct.

As you turn around you find the fourth number from the bottom. Fibonacci sequences have a pattern.

All you need to do is multiply the fourth number from the bottom by 11 and this will give you the total for the sequence. There is a trick to multiplying quickly by 11. Say you wanted to multiply the number 189734 by 11. Write down the last digit, then add the last two digits together, then the next two, the next two, and so on until you get to the first digit then write it down.

Now a little slower. Write down the 4. Then add 4 and 3. Then add 3 and 7 and carry the one. Add the 1, 7, and 9, then carry the one. Add the 1, 9, 8 and carry the one, add the 8, 8, 1 and carry again. (If you didn't carry here you would just bring down the final 1) Add the 1 and 1. The answer is 2087074.

Day Two

Play the next segment of the video *Patterns are Everywhere.* Stop the tape when the game is won and Helen says, "Think about it and try it later." Pass out ten pennies to each group of two students. Have them figure out what the pattern for winning the game is and write it down. On the back of the paper have the students write about all the places that they see, use or are affected by patterns. This may be from the brick pattern in the front of their house to the pattern on a bedspread, or a grading pattern in school. This should be at least half of a page.

Day Three

Play the next segment of the video. Stop the tape when Dr. Snyder says "Modern drummers..." and the word CREATE comes up on the screen. Talk about the ideas in this segment.

There were two types of patterns that were in the weaving. One came from the dye and the other from the weave of the warp and weft threads. The square in the bottom of the Cherokee basket represents the four corners of spiritual knowledge. Discuss the spirit pact of the basket, the square, the triangles, the circle, and the symmetry. It was also important that the piece was finished at the same place it was started. What meaning might this have? Life is a circle and we end up back at the beginning, could be a possible answer.

In groups of four have the students create a polyrhythm. Give each group time to explain their rhythm and perform it for the class. (For the twelve-count music measure you do the following. The students write down the numbers 1 to 12 at the top of the paper. Under each count they write the instrument they want played. They are to mix up the rhythm so that people are not playing at regular intervals of two, four, three etc. Have them play instruments like a humming comb, oatmeal drum, pan lids, desk top, anything that makes noise-even their own noise sound that they can personally make. They perform their music for the class, repeating the twelve counts 3 times.)

Days Four and Five

Show the rest of the video. Go through some sequencing problems with the students. You can make up your own or, "Crossing the River With Dogs", has some good ones. Have the students work with you to find the pattern and the next three numbers in the following sequences. There may be more than one possible solution, be sure to check each answer. After working a couple of problems together have them work independently.

(a) 64, 32, 16, 8, 4... pattern is divide last term by 2
(b) 3, 9, 27, 81, 243...multiply by 3
(c) 1, 2, 6, 24, 120...multiply by consecutive integers
(d) 10, 9, 18, 17, 24, 23...subtract one, multiply by 2.
(e) 1, -2, 4, -8, 16, -32...multiply by -2
(f) 5, 7, 12, 19, 31, 50...Fibonacci.
(g) 5, 9, 14, 20, 27, 35...add consecutive integers.
answers (a) 2, 1, 1/2 (b) 729, 2187, 6561 (c) 720, 5040, 40320 (d) 46, 45, 90 (e) 64, -128, 256 (f) 81, 131, 212 (g) 44, 54, 65.

Extensions

Gather local weather data and have your students discover the local weather patterns. Discuss food chains and have the students discover the pattern of energy loss for each successive level.

Show the Walt Disney Mini Classics video 'Donald in Mathmagic Land.'

Assessment Plan

Have an educational bowl. The groups create patterns of numbers, (great for geometric sequences) and challenge the other groups in the class. Make contact with another class that has taught this lesson and have the classes challenge each other over the Internet.

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