LESSON SCENARIO 15: SPECIAL PRODUCTS

Topic: Algebra

Level: Age 14 -15

Foreknowledge: Monomials and polynomials; operations with monomials and polynomials; area of quadrangles; volume of parallelepipeds

Correlation: None

LEARNING OUTCOMES

- Recognize special products
- Learn how to calculate them
- Understand the origin of factors in a special product

TEACHING METHODS

- Practical work
- Hands-on activity
- Group work
- Brainstorming

KEY WORDS

- Binomial
- Trinomial
- Squared
- Cubed

RESOURCES

- Paper
- Rulers
- Coloured markers
- Scissors
- Play dough
- Knife

ACTIVITIES

INTRODUCTION TO THE LESSON (5 minutes)

The teacher reminds the students what a binomial is. Then he/she asks them to write the formula for: square of a binomial and cube of a binomial.

Teacher: "As you can see, three factors come out from the square of a binomial, while four factors come out from the cube of a binomial. We will try to understand why, and we will try to memorize the factors."

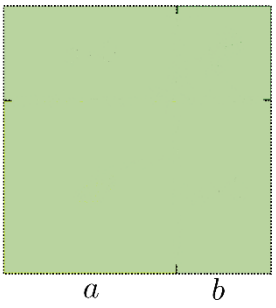
The teacher divides the class in groups, depending on the total number of students (optimum is 4/5 students per group)

HANDS-ON: PART 1 (15-20 minutes)

The teacher asks each group to:

1) Draw a square

2) Divide one side of the square in two different parts, named a and b, as in the first figure on the right

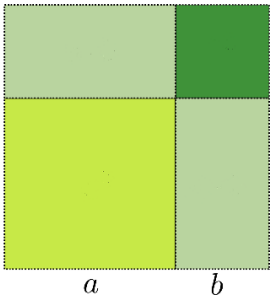


3) Calculate the area of the square in terms of a and b [i.e. area = $(a+b)^2$]

4) Draw two lines, parallel to the sides of the square, so as to obtain four parts (two squares and two rectangles) as in the second figure on the right.

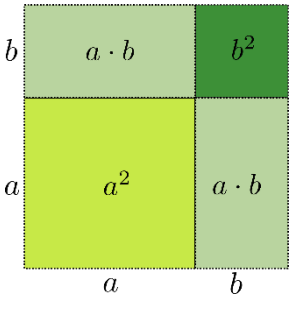
5) Calculate the area of the four figures, in terms of a and b, and add them all, as in the third figure on the right.

6) Compare the result obtained in step 3 with the one obtained in step 5.



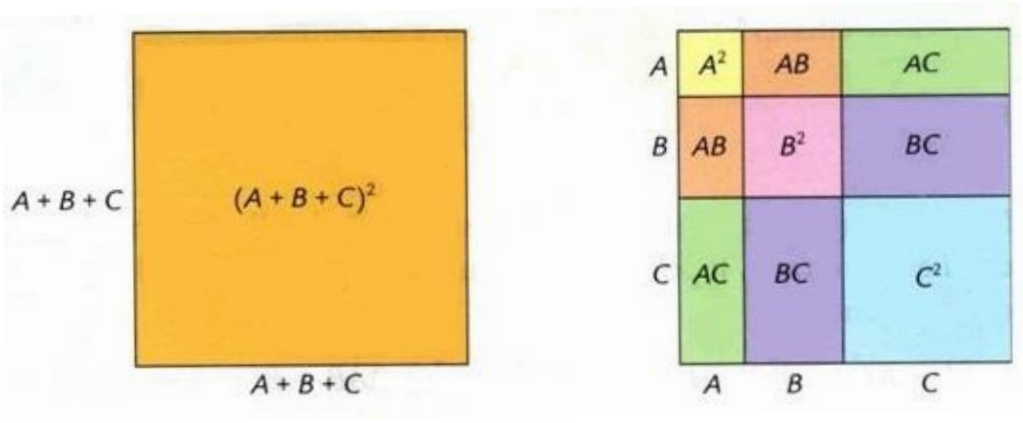
The comparison will lead to the formula: $(a+b)^2 = a^2 + b^2 + 2ab$

The teacher asks the students to transform the above formula in a statement: "The square of a binomial is equal to: the square of



the first term plus the square of the second term plus the double product of the first and second term."

The teacher then asks each group to repeat step 1 to 6, this time dividing the side of the square in three parts, named a b and c (see figure below)



The comparison will lead to the formula

$$(a + b + c)^2 = a^2 + b^2 + c^2 + 2ab + 2ac + 2bc$$

The teacher asks the students to transform the above formula in a statement: "The square of a trinomial is equal to: the square of the first term plus the square of the second term plus the square of the third term, plus the double product of the first and second term, plus the double product of the first and third term, plus the double product of the second and third term."

HANDS-ON: PART 2 (15-20 minutes)

The teacher gives each group a play dough cube. Then asks each group to:

1) Divide each side of the cube in two parts, named a and b, by marking it with a little notch.

2) Calculate the volume of the cube, in terms of a and b

3) Cut the cube in slices with a knife, following the notches.

4) Calculate the volume of the 8 solids obtained (two cubes and 6 parallelepipeds) in terms of a and b, and add them all

5) Compare the result obtained in step 2 with the one obtained in step 4.

The comparison will lead to the formula: $(a + b)^3 = a^3 + b^3 + 3a^2b + 3ab^2$

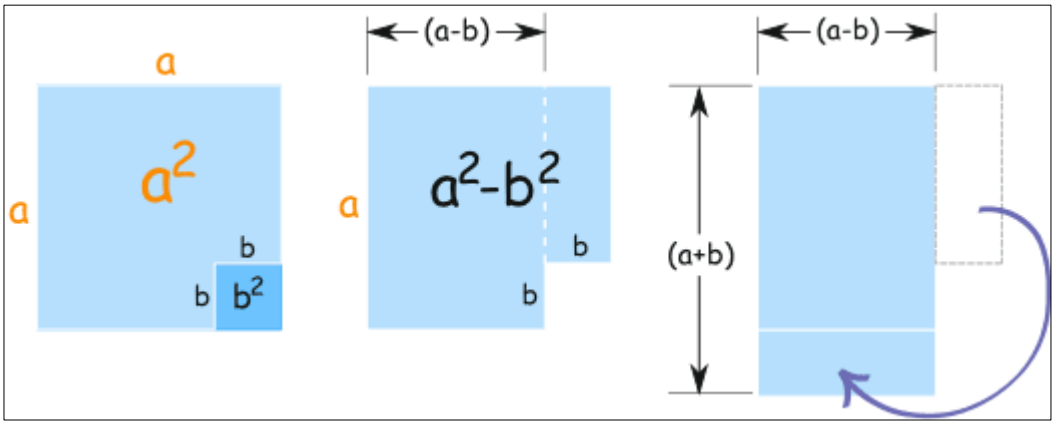
The teacher asks the students to transform the above formula in a statement: “The cube of a binomial is equal to: the cube of the first term plus the cube of the second term, plus three times the square of the first term by the second term, plus three times the first term by the square of the second term.“

For a better comprehension of this part, see the video at the following link: https://youtu.be/rXoPaRDYNTQ

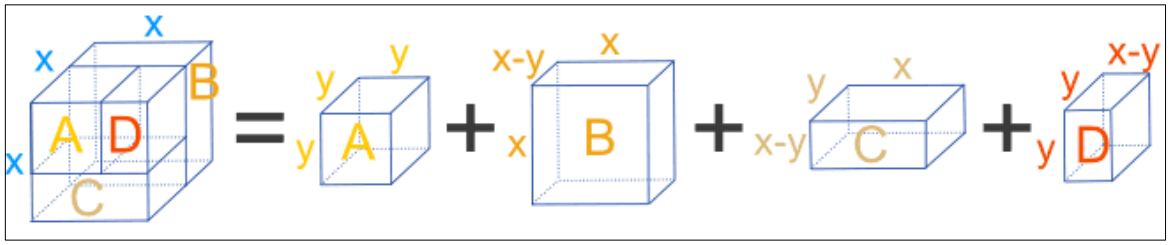
LAST TASK (5-10 minutes)

The teacher gives each group the following pictures:

PIC. 1



PIC. 2



Then asks the students to find out the special products the pictures are related to.

A discussion follows (brainstorming phase).

EVALUATION

1. HOW MANY SPECIAL PRODUCTS DO I KNOW?

2. DO I UNDERSTAND THEIR UTILITY?

3. CAN I APPLY THEM?

The students must answer these questions in 5 minutes:

Choose the correct answer (only one choice is correct):

1) From $(3+2x)^2$ comes out: □ $9+4x^2$ □ $9+4x^2+12x$ □ $9+4x^2+6x$ □ $9+4x^2+36x^2$

2) From $(1+x^2+2x)^2$ comes out: □ $1+x^4+4x^2$ □ $1+x^4+4x^2+4x^3$ □ $1+x^4+4x^2+x^2+2x+2x^3$ □ $1+x^4+4x^2+2x^2+4x+4x^3$

3) From $(2+x)^3$ comes out: □ $8+x^3$ □ $8+x^3+6x$ □ $8+x^3+12x+12x^2$ □ $8+x^3+12x+6x^2$

4) From $(2+x^2)(2-x^2)$ comes out: □ $4+x^4$ □ $4-x^4$ □ $4+x^4+4x^2$ □ $4+x^4-4x^2$

INCLUSIVENESS GUIDELINES

Every student is different and their needs for the material might vary. Below you will find several tips that could make mathematics lesson more inclusive for students who struggle with learning disorders.

- **When giving assignments to classroom try to break them into small pieces of information. Avoid the double tasks in the instructions. Remember that in case of operations/exercises with multiple steps, it is critical to help learners decompose the steps.**
- **You can use checklists for your students to make sure they have done all the steps**
- **Make sure the font, line spacing, and alignment of your document is accessible for students with learning disorders. It is recommended to use a plain, evenly spaced sans serif font such as Arial and Comic Sans. Others: Verdana, Tahoma, Century Gothic and Trebuchet. Spacing should be 1.5 and try to avoid justification in the text.**
- **At the end of each activity, take some time to ask the students what they have learnt to acknowledge every step in their learning process**
- **Make sure that the material the students manipulate is easy enough to grasp**
- **While using different media (paper, computer and visual aids) choose different background than white which can be too bright for students with learning disorders. The best choice would be cream or soft pastel but try to test different colors to learn more about student's preference.**
- **To stimulate short and long-term memory prepare for all the students in the classroom an outline describing what they are going to learn on this lesson and finish it with a resume of what has been taught. In this way they will strengthen the ability to remember information.**

EXAMPLE:

1. Start every lesson with a short "CHECK-IN"

- **Today, we will study the topic (name of the topic)**
- **I will tell you about: (name 3 keywords connected with the topic)**
- **Then I will present exercises: (name the exercises form the student book)**
- **Then we will do exercises (explain the way student will be working: ex. together with teacher / in pairs /individually)**
- **Once the exercises will be done [To continue]**

2. Then finish lesson with a short "CHECK-OUT"

- **During the lesson we learn about (topic of the lesson)**
- **The most important things were: (name 3 keywords connected with the topic)**
- **We were able to do… (tell about the work student done during the lesson)**
- **We will explore the topic next time when we will learn about (name the following topic)**

It is a small adjustment that will take 5 min from the lesson but can make a great difference in the way that the material will be remembered. Try to create this as a routine habit.