LESSON SCENARIO 07:
ALGEBRAIC EXPRESSIONS

Topic: Algebra

Level: Age 13 - 14

Foreknowledge: Elementary mathematics operations, solving linear equations with one unknown

Correlation: Everyday life, Geometry

LEARNING OUTCOMES

- **Students will have acquired an understanding on how Algebraic Expressions in one variable (x) are being formed;**
- **Students will be able to "construct" and "deconstruct" an algebraic expression, by following an out-of-the box, non-formal methodological path.**

TEACHING METHODS

- **Practical work/ forming geometrical patterns using matches**
- **Hands-on activity**
- **Work in pairs or groups**

KEY WORDS

- **Variables**
- **Algebraic Expressions**
- **Numerical Expressions**

RESOURCES

- **Matches**
- **Tables provided within the worksheet document**

ACTIVITY 1: The teacher introduces some short tasks (40 minutes)

EXERCISE:

TASK A (15 minutes)

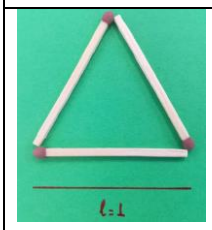
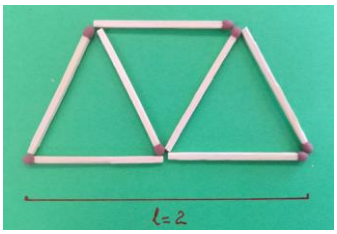
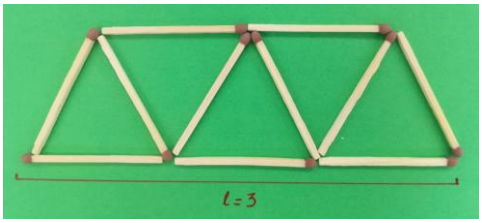
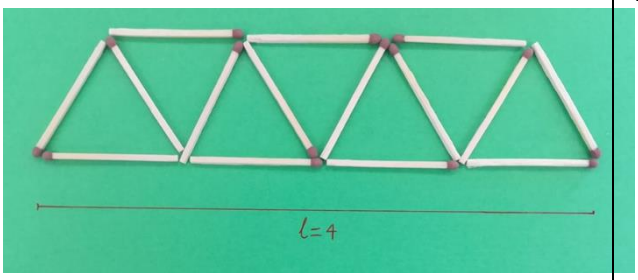
The teacher divides the students in pairs or groups of three whilst sharing one set of matches to each group. Subsequently, the teacher provides the students with the Worksheet "Algebraic Expressions" and explains (if needed) the terms Variables, Algebraic Expressions and Numerical Expressions that can be found on the handed-out worksheet. Furthermore, the teacher explains the table given within STEP A of the worksheet.

As indicated in the guidelines of the task, the teacher explains to the students that the incorporated table is being composed of three columns: the first column depicts a triangular pattern made of matches; the second column should give the length of the pattern depicted in the first column whilst the third column should give the corresponding number of matches needed for the creation of the pattern depicted in the first column.

Slightly after the teacher proceeds with the provision of a tip to the students: "As you might have observed" the teacher utters, "when filling in the table, based on the length of each pattern we count different number of matches. In other words, the number of matches depends on the length of the pattern", thus indicating the correlation of variable "L" with the number of matches.

Accordingly, the teacher asks the students to use the set of matches that was previously given to them, with the aim to construct the patterns of the first column. Particularly, the teacher asks the students to come up with as many set-ups as possible, by increasing the length of the pattern by one unit each time. Students end up with the following table

ANSWER:

	LENGTH OF THE PATTERN *(L)*	NUMBER OF MATCHES
	1	3
	2	7
	3	11
	4	15
. . .	. . .	. . .
. . .	Variable “L”	

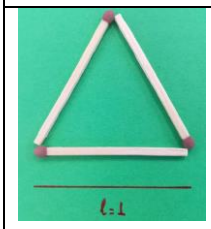
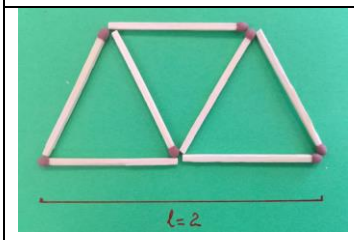
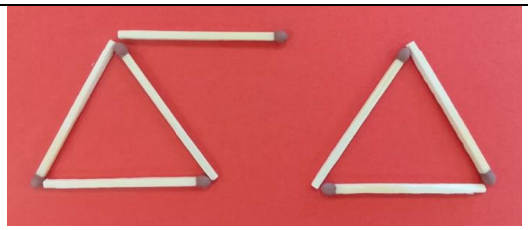
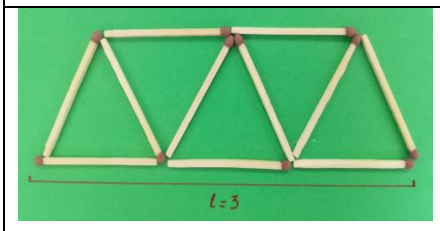
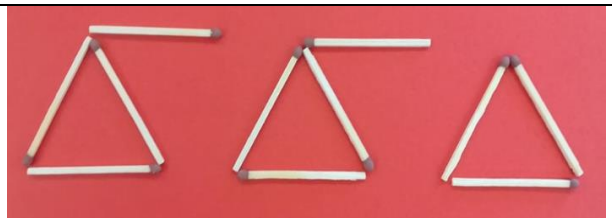
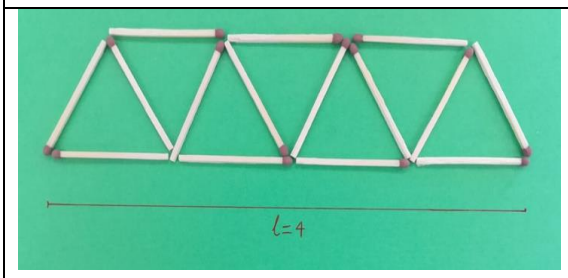
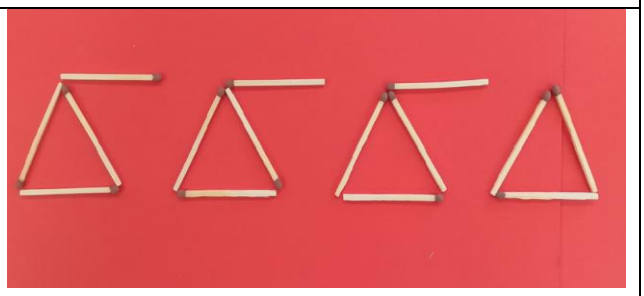
TASK B (15 minutes):

After the completion of task A, students should have concluded that there is a hidden formula that correlates length and number of matches. In case they haven't, the teacher should ask the students directly.

Accordingly, the teacher presents to the students the next mission; now, their target will be to explore which is the secret formula that each time connects the length of the pattern with the number of matches. In other words, students should create a formula that is capable of giving as an output the number of matches for any value of length we introduce as an input. At this stage, the teacher could give an example of such formula, e.g M= 5L-3. In this way, the teacher makes the linkage with the methodological process of TASK C, which comes slightly after

TASK C (10 minutes)

The teacher asks now the students to try to visualise the patterns depicted within the previous table in an alternative way, as showed within the Column B of the table given under STEP C. In this way, students, working in pairs or groups, will be guided towards the "systematization" of the task. This 'alternative' way of depiction separates the two basic components that are embedded in all the patterns; the ending triangle (appears only once in each pattern) and the triangle with an extra match on the angle on the top (and which appears more than once in the patterns with a length which is greater (or equal) to three):

Column A : Pattern	Column B : Alternative way of depicting the Patterns of Column A
	
	
	
	

Thereupon, the teacher raises the question: "Is/Are there a/some specific component/s that show up in all the deconstructed figures?

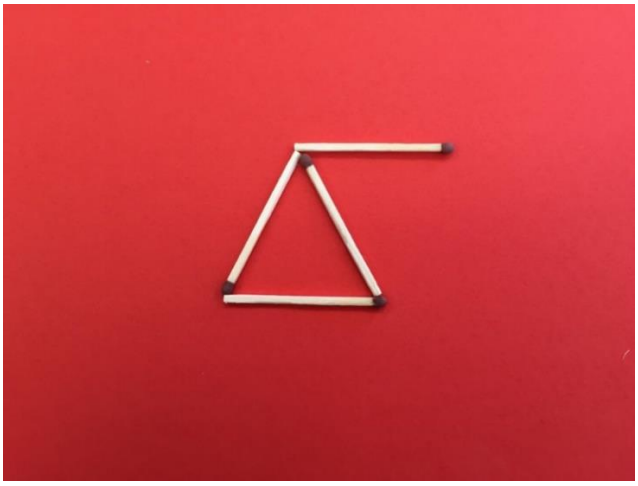
ANSWER:

Yes, there are two basic components which are embedded in all the patterns; an ending triangle (appears only once in each pattern) and the triangle with an extra match on the top angle (and which appears for more than once in the patterns with a length which is greater (or equal) to three.

ACTIVITY 2: The teacher introduces the main exercise (50 minutes):

This is the time in which the teacher introduces the QUESTIONS of the task:

QUESTION 1: How many matches are you counting for the basic component?



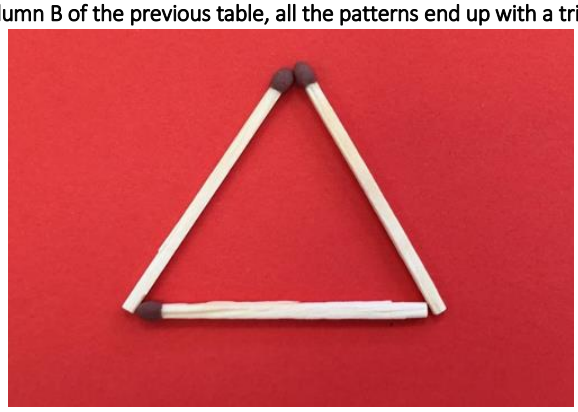
BASIC COMPONENT OF THE PATTERN

ANSWER 1: 4 matches in each basic component

QUESTION 2: How many times is the basic component being repeated in each of the cases? Use the Table that comes after the TIP to record your answers. Don't forget to consider the TIP below while recording your answers.

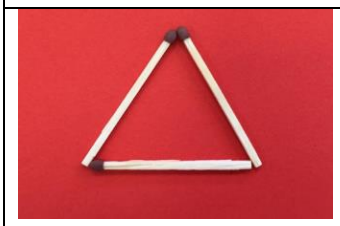
At this stage, the teacher gives further explanations regarding the TIP given after the Question 2 of the worksheet, thereby highlighting that the last part of each deconstructed pattern is missing the match on the top, something that students should consider while creating the final formula by subtracting one unit in the final expression. In other words, the last triangle should be treated as a basic component, given that the students will remember to subtract one unit from the final number

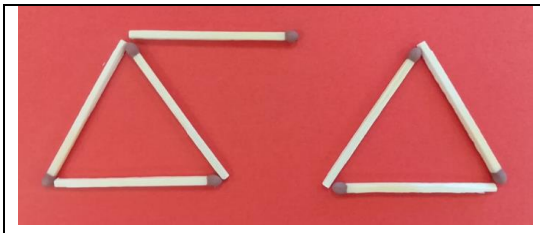
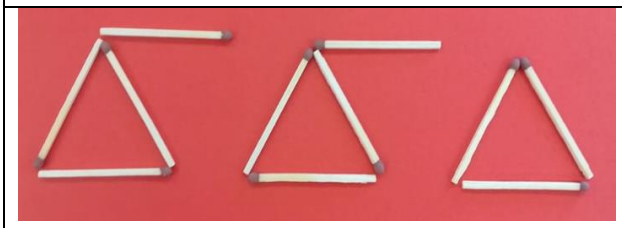
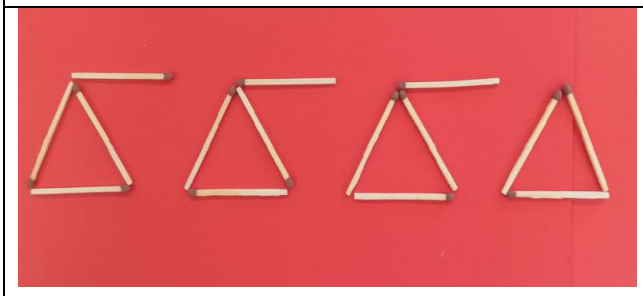
TIP: As you can see in Column B of the previous table, all the patterns end up with a triangle:



This triangle is obviously missing one match if we compare it with what had been defined as "basic component of the pattern". However, we may also consider it as a basic component by necessarily subtracting one unit (-1) in our final algebraic expression.

ANSWER 2:

PATTERNS	NUMBER OF REPETITIONS OF THE BASIC COMPONENT OF THE PATTERN	NUMBER OF MATCHES	VALUE OF VARIABLE L
	DON'T forget to consider the final triangle as one of the répétitions in each case	Write the number of matches	Write the value of L for each case
	1	3 Or 3=4-1	1

	2	7 Or 7=4 + (4-1)= =(4+4)-1	2
	3	11 Or 11=4+4+(4-1)= =(4+4+4)-1	3
	4	15 Or 15=4+4+4+(4-1)= =(4+4+4+4)-1	4

The teacher proceeds with raising the following question (QUESTION 4) and asks the students to work in pairs/groups so as to come up with an answer in 3-4 minutes. Then the teacher along with the entire set of students discuss on the answer

QUESTION 3: Can you identify a systematic correlation between the number of repetitions of the basic component of a pattern and the variable "L"?

ANSWER 3: Yes, there is a specific correlation. Particularly, the number of variable L is always equal with the number of repetitions of the basic pattern. In other words, the number "4" appears within the equation as many times as is being denoted by the value of length, e.g. 1 time when the length = 1, twice when the length = 2, 3 times when the

length=3, and so on. Accordingly, our formula should contain a variable L, which could be inserted each time as an input. On the other hand, we shouldn't forget to subtract the one match from the final number of matches, in as much there is one "-1" that shows up in all the cases.

At this stage, the teacher formulates Question 4, whilst asking students to work in groups/pairs in order to come up with the final formula. Then, the teacher announces the answer to the entire groups of students.

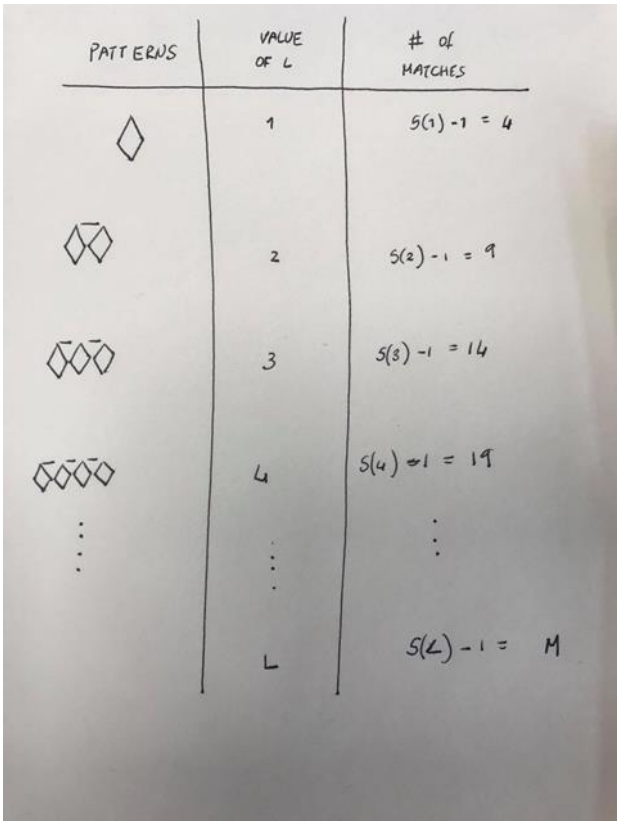
QUESTION 4: Consider your answers in the previous questions (1 - 3). You are now ready to form the requested algebraic expression which gives the final number of matches for ANY value of length (input) we might introduce at each time.

ANSWER 4: number of Matches (M)= 4L – 1

As a last step, and only if the time allows, the teacher asks the students to play with the matches in order to express the following algebraic expression, indicated within QUESTION 5:

Find a pattern, using the matches, in order to express the following algebraic expressions: M = 5L-1

ANSWER 5: Instead of triangles, students create patterns with rhombus along with one match on the top angle of each rhombus as a basic component, whilst the last component of the figures ends up with no match on the top of the rhombus. The one diagonal of each rhombus has the same length with the sides of the rhombus.



EVALUATION

1. Have I understood how the formula has been formulated?
2. Do I understand that every formula that I see has been created on the basis of a certain rationale?
3. Can I explain the way in which I have come up with this formula?
4. Can I apply a similar methodology to find a formula which is behind another problem with identical characteristics?

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 colours 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 the 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.