

## **Title: Out of This World Functions!**

### **Brief Overview:**

Space is a topic that interests many students. These activities will introduce them to the concept of “functions”. Through problem solving, students will apply their knowledge of patterns and mathematical operations to find the “rule” for the series of numbers represented.

### **Links to NCTM Standards:**

- **Mathematics as Problem Solving**  
Students will demonstrate their ability to solve problems in mathematics including problems with open-ended answers, problems which are solved in a cooperative environment, and problems which are solved with the use of technology.
- □ **Mathematics as Communication**  
Students will demonstrate their ability to communicate mathematically. They will read, listen, and discuss mathematics with the correct language and include the signs and symbols of the strand.
- □ **Mathematics as Reasoning**  
Students will demonstrate their ability to reason mathematically. They will make conjectures, gather evidence, and build arguments.
- □ **Mathematical Connections**  
Students will demonstrate their ability to connect mathematics topics within the discipline and with other disciplines.
- **Number Sense and Numeration**  
Students will demonstrate their ability to describe and apply number relationships using concrete and abstract materials. They will choose appropriate operations and describe effects of operations on numbers.
- **Concepts of Whole Number Operations**  
Students will demonstrate their ability to choose an appropriate operation that fits the sequence of numbers.
- **Patterns and Relationships**  
Students will demonstrate their ability to recognize numeric and geometric relationships and will generalize a relationship from data.

- **Algebra**

Students will demonstrate their ability to perform algebraic operations and will be able to model algebraic concepts using concrete materials.

**Grade/Level:**

Grades 4-5

**Duration:**

2-3 lessons

**Prerequisite Knowledge:**

Students should have working knowledge of the following skills:

- Numerical patterns
- Basic operations of a calculator
- Basic mathematical facts
- How to complete a table
- Copying, continuing and describing patterns
- Building patterns when given a description
- Creating patterns

**Objectives:**

Students will:

- use the constant arithmetic feature on the calculator.
- identify patterns by using the constant arithmetic feature on the calculator.
- recognize and identify rules for functions.
- apply their knowledge of functions to problem solving situations.
- state and write a number sentence for the function rule.
- apply appropriate operation for a given function.
- recognize whether a combination of numbers follows or does not follow the rule.
- identify patterns within functions.
- create and solve story problems.
- work cooperatively in groups.
- write to persuade.
- use inductive thinking in problem solving.

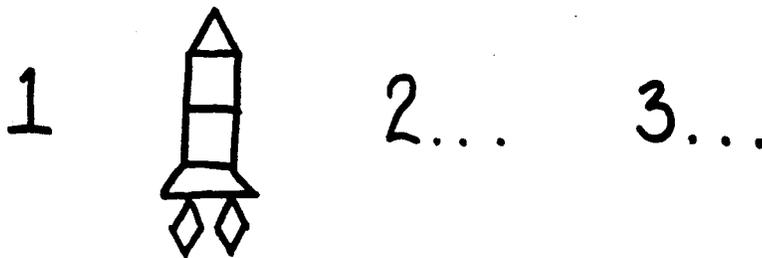
## Materials/Resources:

- Calculator (with a constant arithmetic feature)
- Student worksheets
- Teacher resources
- Pencils
- Function machine (teacher resource sheet #1)
- Index cards
- Shoe or cereal box for function machine
- Pattern blocks for cooperative groups
- Overhead pattern blocks
- Overhead projector/ transparencies/ visa markers

## Development/Procedures:

### Task 1: Ready For Lift-Off?

- To introduce “Out Of This World Functions” unit, we suggest you begin with a literature tie-in. Using a general picture book or short video about space will engage student’s interest about this unit of study.
- Now allow students to work with patterns using pattern blocks. Model one rocket out of overhead pattern blocks. Have students copy your example using their pattern blocks. If it takes 6 blocks to build 1 rocket, how many will it take to build 2 rockets, 3, and so on? Allow students to work with the manipulatives and then develop a function table on the overhead with student input.



### Task 2: Calculating Patterns

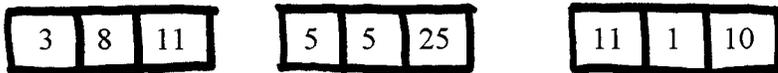
Students will identify patterns by using the constant arithmetic feature on a calculator.

- Provide each student with a calculator with a constant arithmetic feature.
- Refer to Teacher Resource 1.
- Have students complete Student Resource 1.
- Copy the Student resource Sheet 1 on an overhead so you and the students can review their assignment. (You can simply write in their answers.)

### Task 3: Explore The Function

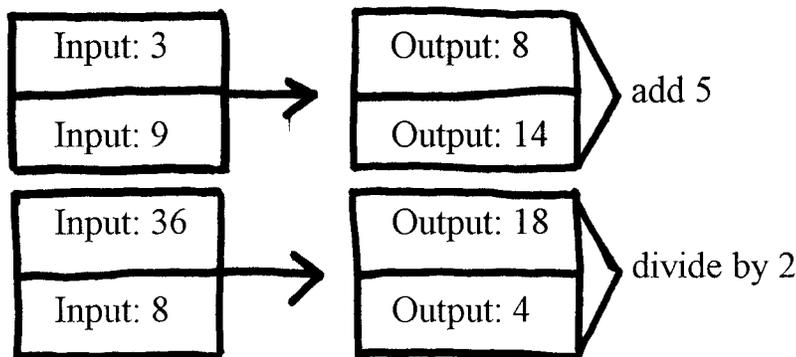
Students will recognize and identify rules for functions using a function machine. They may also want to use the calculator to complete the patterns and function tables.

- Create a function machine to have in the room.  
*Directions: Choose a container for your machine.*  
*Make two openings in the box (one for input and the other for output).*  
*Label the openings.*
- Use the index cards to write the input on one side and output on the other side. When you put the card into the input show students the input #. When it comes out the output side, show students the other #. Have them state the given rule.
- Explain to students that they will be working with a function machine.
- Provide students with examples using the function machine.
- Explain what a function is and the parts of a function: input, output, and rule. For example:



(Have students determine the operation used in each example.)

- Introduce the first number as input and the third number as output. Have students find the rule.



- Create a table of input and output numbers. Have students complete the table and find the rule. (This could be done on an overhead or on a chalk/white board.)

#### Task 4: Flight Patterns

To help students grow confident with functions, they will apply what they know about the function machine to complete tables and write rules in the form of a number sentence.

- Use an example of a function table and allow students to determine the pattern between the numbers. The students will then continue the pattern and then state the rule. (Tables can be written on an overhead.)

<u>A</u>	<u>B</u>	
7	21	
8	24	
9	27	
10	30	RULE: _____
—	—	
—	—	
—	—	

- Students will now complete Students Resource Sheet 2, “Flight Patterns.”

#### Task 5: Launch Codes

This next activity will engage students to think inductively by finding a relationship among three numbers. To extend this process, students will also be expected to know which combinations follow the rule and which ones do not follow the understood rule.

- Use several combinations of numbers. Group them so that the first series of combinations follow the rule and the second series of numbers do not follow the rule. (Ex:)

CORRECT  
RELATIONSHIP:      1                      3                      2  
                                 4 5                      1 2                      9 7

INCORRECT  
RELATIONSHIP:      3                      11                      8  
                                 3 7                      2 3                      5 5

- Engage students in the numerous rule possibilities. Explain to the class that each series of numbers in the correct relationship group have a certain rule. Tell them they need to take 2 of the numbers, perform a basic operation, and they will end up with the third number.

ANSWER:  $1+4=5$        $1+2=3$        $2+7+9$

- Students will now complete Student Activity Sheet 3.

### **Performance Assessment:**

Students will be assessed on their ability to read the prompt, interpret the data, solve the problem, and set up a table. A scoring tool can be found on Teacher Resource Sheet 3. Student Resource Sheet 4 is the prompt.

### **Extension/Follow Up:**

There is no way we could ever cover or express all the possible ideas or activities that could complement this function unit. Here are just a few suggestions of activities that are cross-curricular and can be used in your classroom. But please...

allow your minds to SOAR into another dimension.

- Provide a variety of space-related literature so students can explore topics of interest and answer their questions about space.
- Creative writing prompt ideas:

*“The year is 2025 and Mars is a favorite vacation spot. Your family has decided to visit this planet. Write an imaginative story about what Mars is like, what you do during your visit and the beings you encountered during your stay.”*

*“NASA has chosen you as the first student astronaut. You must consider all the necessary equipment and supplies you will take on your voyage. You will be away from your family for three months. Write at least a two-page document explaining what you will take and why you chose the specific materials.”*

- Art  
Using a variety of media, students can create a picture of a space scene.
- Students can write their own problems based on classroom research about space and prior knowledge.
- Science Experiment  
Students can build their own rocket. The teacher may use resource material from NASA or other resource material.

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## Using the Constant Arithmetic Feature

1. Provide each student with a calculator that has a constant feature. We suggest that if you have an overhead calculator you may want to model the next steps.
2. Ask students to enter  $0+5=$  into their calculators.  
*(Note to instructor: 5 is the constant number in both examples.)*
3. Teacher instructs students to press the “=” key once...twice...three times. Display this on the overhead.

$$0+5=,=,=$$

4. Discuss the following questions:
  - What number did you end up with after you pressed the “=” key three times?
  - What happened to the number displayed as you continued to hit the “=” key?  
How do you know?

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5. Repeat steps 2-4 having students use the sentence  $1+5=$ .

$$1+5=,=,=$$

6. Using Student Response Sheet 1. Have students repeat the exercise recording their data on a table.

## Using the Constant Arithmetic Feature

**DIRECTIONS:** Complete the tables using the constant arithmetic feature. (Be sure to fill in the table *every* time you press the “=” sign.)

$$0+5=$$

Number of times = is pressed	1	2		
Display	5			

$$1+5=$$

Number of times = is pressed				
Display				

### FLIGHT PATTERNS

**DIRECTIONS: STUDY THE FLIGHT PATTERNS WITHIN THE ROCKETS. FIND THE RELATIONSHIP BETWEEN THE NUMBERS. AT THE BOTTOM OF EACH ROCKET STATE THE RULE. AFTER STATING THE RULE, COMPLETE EACH ROCKET SEQUENCE.**

A	B
5	7
6	8
7	9
8	10

Rule \_\_\_\_\_

A	B
40	35
41	36
42	37
43	38

Rule \_\_\_\_\_

A	B
25	175
30	210
35	245
40	280

Rule \_\_\_\_\_

A	B
12	4
24	8
36	12
48	16

Rule \_\_\_\_\_

# Launch Codes

All astronauts have to wait on the control tower for the countdown to lift-off. Lift-offs are controlled by complex computers that decipher codes. Only a certain relationship within a code will release a shuttle from the launch pad. It is your job to decide which rule will allow lift-off and which will not. After you find the rule that follows the correct code, write the rule.

*\*HINT- find the relationship among the 3 numbers in each set*

CORRECT RELATIONSHIP:    2 4        1 3        5 10  
                                      8            3            2

INCORRECT RELATIONSHIP:    11 3        2 7        8 3  
                                      5            3            7

RULE: \_\_\_\_\_

Now that you have found the direct relationship among the groups of numbers, circle any group that follows the rule that launched the shuttle from the previous example.

2 14            1 5            9 2            3 5            0 5  
7                6                18                7                0

1 1            7 9            9 4            12 1  
2                12                36                5

**EXTENSION:** Another country has cracked our code and can interfere with the lift-off. NASA is depending on you to create a new code for future explorations. Write your own launch codes that will follow a specific rule. Make sure that you provide enough information to solve the problem.

## SCORING TOOL

**Uses mathematical vocabulary in explanation.**

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**1            2            3            4            5**

**Identifies appropriate rule or number sentence.**

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**1            2            3            4            5**

**Identifies patterns.**

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**1            2            3            4            5**

**Uses tables, drawings, or diagrams to explain solution.**

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**1            2            3            4            5**

**Uses complete sentences to express ideas.**

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**1            2            3            4            5**

## Performance Assessment Prompt

**Jake Dixon is an astronaut that was chosen for a space exploration mission. While on this long journey, the astronauts had to keep a careful eye on the fuel gauge. On the first day, 75 gallons of fuel were used. By the end of the second day, a total of 150 gallons were used. The third day resulted in the use of 225 gallons. Because the same amount of fuel is being expended for each day, find the total fuel consumption by the end of day 15. If the shuttle could only hold 10,000 gallons, what would be the greatest number of days Jake could remain in space?**