What's the Rule?

Objectives

This number game (from math teacher Lola May) makes use of several techniques that are helpful in establishing a special atmosphere for group problem solving. These techniques can be used singly or in combination in many classroom contexts. This particular game has been used as a time-filler when there is ten minutes left in class after the day's work has been completed. Some generalizations:

- Students are given a problem with a solution that is a bit unconventional. This helps to level the playing field somewhat.
- The unconventional problem also promotes lateral thinking skills. Students have to break out of their regular pattern of using 'normal' arithmetic to find the answer.
- The process requires two or three different, perhaps unrelated steps for completion. This also helps to level the playing field in that one part of the solution may be easier for some students, another part easier for others.
- The situation is set up in such a way that students are working together, but only in a limited way. That is, this is an oral exercise, but the student with the first correct answer essentially just provides another clue for everyone else without giving away the whole process and ending the game.
- Since partial answers are recorded, partial successes are acknowledged. All students can get at least part of the correct answer.

Procedure

Write a two-digit number on the board, then an arrow, then another number derived from the first. For example, 23 → 56. This transformation follows a specific rule or rules that the teacher has determined beforehand. The object for the students is to figure out exactly what those rules are. If a student thinks she knows the answer, give her another starter number, say 45 →, and ask her to supply the *new number*. She should only give the new number; she should *not say anything about the process or the rules*. This would spoil the game for everyone else. If she is correct, write her correct answer: 45 → 920. This is the acknowledgment that she understands the correct process. If she is partially correct, write the part that is correct: 45 → 9, but indicate that something is missing. If she is incorrect, leave the answer blank for another student to try or give the answer as another example. *Never discuss the process until everyone has figured out the rules, until time is up, or until you feel the game has gone on long enough.*

As the game proceeds, put up more starter numbers and wait for students to attempt answers. If a student has figured out the correct answer, he can be kept involved by providing clues for his classmates. Simply give him another starter number to figure out. Judicious choice of starter numbers can provide helpful clues or surprising results. In the above example, 56 → 1130, while 20 → 20! When everyone has the answer, as a reward, ask the first student to explain the process.

Here is a summary of the above example:

23 → 56	• If nobody has an answer, give another example using the same process.
45 → 920	• Wow! This is not just addition!
	• Now somebody may notice that 4 * 5 = 20 and look back and notice that 2 * 3 = 6. This reveals the possibility that the problem is a bit unconventional.· This also might lead to the observation that 2 + 3 = 5 and 4 + 5 = 9.· Problem solved. Add the digits for the first part; multiply the digits for the second part.
56 → 1130	• 5 + 6 = 11 and 5 * 6 = 30
20 → 20	• 2 + 0 = 2 and 2 * 0 = 0

Remember, one object here is to give students the chance to shine without spoiling the problem-solving job for everyone else. When a student has worked through the logic outlined in brackets above, give her a new number. She works out the answer, it is written on the board, and she has demonstrated her knowledge without giving away the process. If she gets part of the answer, that is good. That *part* gets written on the board for all to see. Depending on the process chosen, the teacher may have to start off with several examples before any of the students solves it.

Here is another example. This is a *much more difficult* problem, and should *not* be presented until the students have had much more experience, gradually preparing them for something this devious. Otherwise, it may be much too frustrating, and they will never want to play the game again.

37 → 5279

Start with 37	• 37	
Add 15 to the given number:	• 37 + 15 = 52	
Next, add those two digits together:	• 5 + 2 = 7	• Now you have 527
Finally, add the last two digits of 527:	• 2 + 7 = 9	• The result is **5279**

If, during the 'adding digits' stage, the result is a two-digit number, just use the units digit for the final answer.

Here's another example in which that situation arises:

10 → 2572

Start with 10	• 10	
Add 15:	• 10 + 15 = 25	
Add those two digits:	• 2 + 5 = 7	• Now you have 257
Add the last two digits:	• 5 + 7 = 12	• Just use the final 2
The result:	• **2572**	

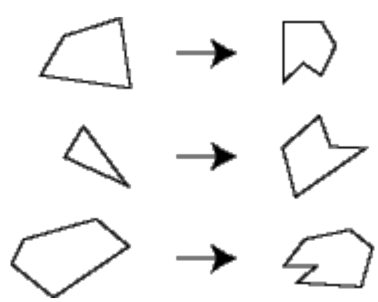
This keeps the final answer at four digits for consistency. This is not really necessary. The correct answer *could* be 25712 if you prefer.

Remember, if a student gets *part* of the answer correct, display that *part*. In this way, even the weaker students get something correct. In fact, in this example, the weaker students often figure out the first step (adding 15) before the stronger students who are searching for something more complex. (This can be helpfully humbling!)

Extensions

Most any arithmetic operation can be used, though division and square roots can lead to problems if you want to stick to whole numbers. Students can be thrown for a loop by playing this game with addition and multiplication repeatedly, then suddenly introducing squares or cubes.

Here is a two-dimensional version: Start with a polygon and end with another polygon. For example, if the starting figure is a convex quadrilateral, the derived figure could be a concave hexagon by adding two sides and 'turning in' one vertex.



For another math exercise that uses a similar classroom technique, see **What's the Bug?** For a wider-ranging exercise, see **Before and After**, an exercise that deals with more complex, real-world changes. How does a green pepper change to become part of a salad? How does a freshly dead clamshell become gray and smooth and pitted?

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