

Logic & Puzzles: UNIT 2
Transformations

Life is change. Life is transformation. Transformations happen continually, all around us. A 150-ton blue whale begins life as a microscopic cell. A one-hundred-foot-tall oak tree is first an acorn.

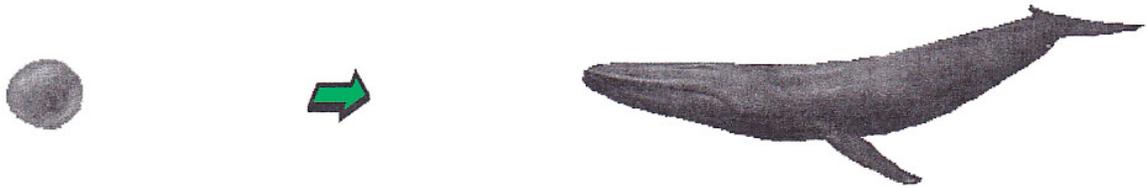


In our own lives, sometimes events fly past us while we stand still. Other times, surroundings which do not change provide us with opportunities for inner growth.

1. What transformations within your own life have been significant? These may be positive or negative, within you or around you.

This unit focuses on transformations, but not anything so complex as the transformation of an acorn into an oak tree, or a cell into a whale. Instead, we will look at simple transformations. You will be asked to decide what caused a transformation. There will often be more than one good answer to each question!

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Let's start with the very first transformation a cell makes on its way to becoming a whale.



A cell does not transform directly into a whale. The first thing it does is very simple: it becomes two cells.

You can see this transformation happen under a microscope.

How does one cell become two cells? Science has given us the answer. It appears later in this unit, and perhaps you know it already. But take a moment and ask what a cell might do to become two cells. If you know the correct answer, consider that another answer (while incorrect) might also make sense.

1. Did the cell gather stuff around it and create a new cell?
2. Did the cell find another cell just like it?
3. Did the cell divide to become two cells?

For this unit, looking for an answer is more important than finding the right answer. Note that each answer above - 1, 2, and 3 - identifies a rule which explains what happened.

So what do you think?

2. If one cell becomes two, what do two cells become? Why?

Science tells us that one cell divides into two, and so therefore two cells divide into four. Four cells then divide into eight and so on. Answer#3 above was the correct one.

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3. If one cell becomes two, what do two cells become? Why?

ANSWER: Two cells become four cells. Rule: each cell divides into two cells.

Notice that the answer includes a rule. We apply the "divide" rule to one cell and we get two cells. We then apply the same rule to two cells and we get four cells.

Science tells us that cells divide, so for the question above we have just one right answer. In the following puzzles however, there are lots of possible answers, but no single right answer. For each answer that you give, you will need to include the rule. Let's work out another example.

For this example -- and for the first several puzzles at the end of this unit - we will examine the following transformation:

abc becomes abd.

It is for you to decide what happened to abc that caused it to become abd. If you think the **c** in it became **d**, that is just fine. Someone else might interpret the change as a replacement of the entire "object" **abc** with **abd**. So pause for a moment to decide how **abc** became **abd**.

O.K., now that you've thought of a rule, consider the following question.

4.) If abc becomes abd, what does pqrs become? Why?

Most people answer **pqrt**. When asked why, they usually say that last letter of **abc** is "bumped up" by one to get **abd**, and if you bump up the last letter of **pqrs**, you get **pqrt**.

Does this mean **pqrt** is the right answer? Not necessarily. While there is something compelling and important about **pqrt** being the most common answer, it is not the right answer. There is no right answer.

On the following page are some alternative answers to this question. At this point - and before turning the page - I urge you to pause here and think: what else could **pqrs** become?

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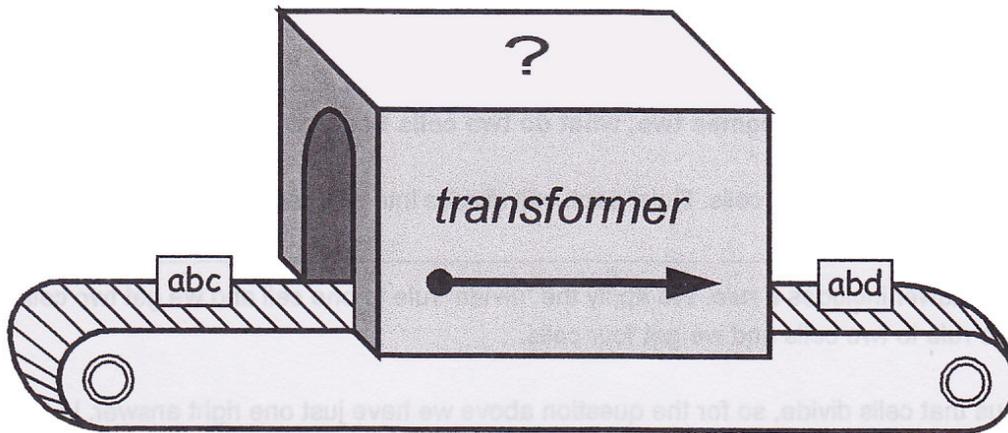


Figure 1. abc → abd transformer

The crux of the question “what else could **pqrs** become?” is your decision why **abc** became abd. What does the transformer in Figure1 do? What are some alternatives to **pqrt**?

How about **pqrd** (replace the last letter with a d)? Or **pqst** (bump up all but the first two letters)? Or even **pqrs** (change every c to a d ... since **pqrs** has no C's, the transformer does nothing to it)?

What is wrong with these answers? I kind of like **pqrη** (reverse the last second-to-last letter and replace the last letter with it).

But is it really a good answer? How about **pqtu**? Or **dddd**? How about abd? Maybe the transformer just changes everything to abd.

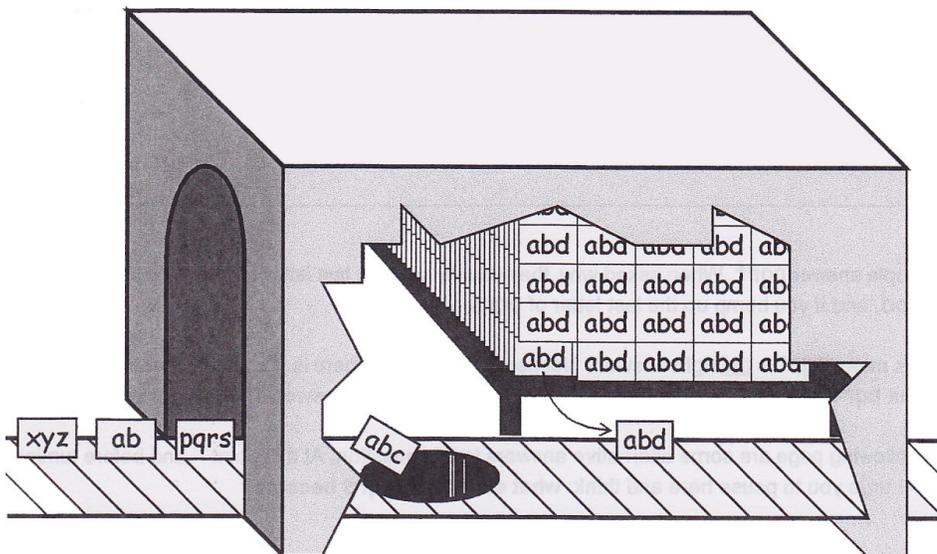


Figure 2. Everything → abd transformer

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What do you think of the alternative answers on the previous page?

5. Do you think some of the answers (such as **pqrt) are better than others (such as **pqrd**)? Why or why not?**

I think that in a sense, none of the answers is better or worse than any other. Each is the result of a chosen rule for the initial transformation $abc \rightarrow abd$. And since we are not giving points for popularity or for how pleasing your favorite answer is to someone else, we cannot say which answer is better or worse.

However, most people would find **pqrt** to be a good answer and **pqrd** and **dddd** to be a not-so-good answer. Why? I will use an analogy with real life.

We all have a natural ability to look at a situation and evaluate what is going on, even if we don't have much information. In fact, we do this all the time, every time we meet someone new, every time we encounter a new challenge. In this case the situation or challenge is $abc \rightarrow abd$, and we must evaluate what is going on: what is the rule. Once we know the rule, we can determine what **pqes** becomes. I can't help but wonder whether someone who suggests **dddd** might also have a hard time dealing with other real-life challenges.

So is the best answer always the most common? To this, too, I have to say no. For this example, **pqrt** is both an easy answer to come up with, and it probably the best answer. But some of the following puzzles may have easy answers which are quick and acceptable, and other answers which are more difficult to come up with, but are more satisfying.

Again, there is an analogy with real life. Sometimes, we encounter challenges for which there is a quick and obvious solution that will do the job for now, but there is also another more insightful solution which is better and more permanent.

Can you think of any such situations?

6. What challenges can you think of that might have an easy solution which works, but a more difficult or insightful solution which works better?

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Puzzles

For the following puzzles, *take your time*. Also, try to approach each puzzle as unique and unrelated to any other puzzle. Try not to assume that the answer to one puzzle will resemble the answer to another.

Let's start with some puzzles based on our initial transformation **abc**→**abd**. Hint: don't feel that the rule you picked for one question needs to apply to all of these. Feel free to give multiple answers.

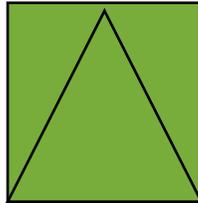
- 7. If abc becomes abd, what does cab become? Why?**
- 8. If abc becomes abd, what does cba become? Why?**
- 9. If abc becomes abd, what does srqp become? Why?**
- 10. If abc becomes abd, what does pxqrx become? Why?**
- 11. If abc becomes abv, what does pqrs become? Why?**
- 12. If aqd becomes abc, what does pqc become? Why?**
- 13. If beq becomes bqe what does abcdefpqr become? Why?**
- 14. If eqe becomes qeq, what doe abcdcba become? Why?**
- 15. If eqe becomes qeq, what does aaabccc become? Why?**
- 16. If eqe becomes qeq, what does eqg become? Why?**

The rules of transformation can also apply to shapes as well. Again, it is for you to decide what the rules are that cause the transformation.

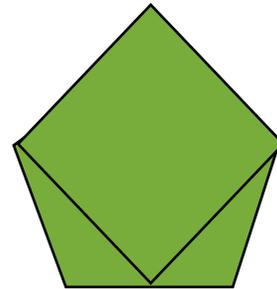
If  becomes  what does  become? Why?

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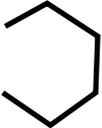
As before, there is a common answer. Most people would say it becomes a square, the rule being that every shape is reduced to a shape with one less side. But there are other rules as well. Perhaps the square's corners are cut off from the midpoint of the side between them to the opposite corners, like so:



This rule would make the five sided shape become kite-like:



Here are some others. Take your time with these, and remember to apply different rules to each puzzle if you think you need to.

17. If  become  what does  become? Why?

18. If  becomes  what does  become? Why?

19. If  becomes  what does  become? Why?

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20. If  becomes  what does  become? Why?
21. If  becomes , what does  become? Why?
22. If  becomes  what does  become? Why?

Here are some transformations in cryptography (code breaking). Each has its own key which you must refer to in order to solve the puzzle. In each puzzle, every character in the code represents one letter. Codes 1 and 3 are examples of Caesar cyphers, in which the entire alphabet is transformed or shifted. Caesar cyphers are named so because Julius Caesar allegedly used them to communicate with his generals.

23. Code: SGHR Key: a=b b=c c=d...
24. Code: FMSG Key: a=z b=y c=x...
25. Code: PF Key: p=a or i and f=s or g
26. Code: ILQLVKHG Key: I=i (Hint: This key is incomplete, but it does follow a rule. Think of the order of the alphabet and of where each letter is in relation to each other.)