How to Build a Solid Math Foundation

Victor L.

Principal,
Queen Elizabeth Academy

Regardless of how one feels about the subject, it is undisputable that Math is a necessity in school. Thus, it is important to train oneself in the basic foundations in order to become successful in the later grades, pushing yourself into life after high school. There are 4 basic components in math: basic skills, tougher concepts (gr. 10-12), variations in questions, and problem solving. This article will address each of these points, and hopefully clarify a path of instruction, helping you succeed in Math in school.

The major concern for math is that it is a cumulative assignment. Each grade is a building block to the next, and without a strong knowledge of the previous grades material, your understanding becomes shaky, and will eventually fall. Making sure that each grade is rock solid in understanding is crucial in maintaining success in future years. As an example, math tests often check for understanding of previous concepts in most steps of the question, only asking for understanding of the current year's topic in the first couple steps.

Basic Skills

The basic skills in math are by far the easiest to master – mentally, that is. This requireshours of determination and practice, but rest assured, the product will come in the end.

Grades 7 to 9 focus on basic skill set that are explored fully in the later high school years. Concepts such as: adding and subtracting fractions, reducing fractions, collecting like terms, exponents, etc are all taught and drilled. These skills are relatively easy from a perspective of mental fortitude. This is the main reason why many students ignore them: they do well on the test, then push them aside, never to reconnect with it. This is a fallacy. You can be sure that these skills will come into play later on in high school. When so-called "careless mistakes" start happening, it serves as an indicator that the student has growing gaps in understanding, and may begin to have severe repercussions on grades.

A major focus in grade 10 is factoring. This skill is the single most important skill for students pursuing math in the future. Almost all components in grade 11 and 12 will have some form of factoring in it. It may not seem like factoring, but the same concepts will be there. This is why it is critical to master the current skills before moving forward. If your understanding is poor in grade 10, it will snowball into disaster by grade 11 and 12.

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Basic Skills

The only solution is hard work and determination. There is no shortcut. However, there are some steps one might take.

First, identify the skill gap that the student is experiencing. A basic method might be to run through a grade 9 test or review package, and mark it accordingly. The areas where low marks are afforded are the areas in which the student has gaps of understanding.

You can find textbooks in the library (grade 9-10) and try to close these gaps by practicing the extra questions provided in the textbooks. A rough estimate of 100-150 questions per type will be sufficient to close the gap. However, it is not enough to simply answer the question correctly. The tell tale sign that the gap is successfully closed is speed. If a student can answer a question correctly within a respectable amount of time, the goal is reached and we can move on. If not, more practice is needed. Be aware, this task will require devotion and hard work

These skills do not come easy.

Tough Concepts (G11-12)

The biggest idea behind these tougher questions is understanding the simple question of "why". In the higher grades, question parameters change fluidly, and therefore the student's understanding must be holistic enough to change with the question. If they only memorize a certain process or formula, they will fail. Flexibility only comes with full understanding of the concept.

The Learning Pyramid developed by the NTL Institute out of Maine states that people learn best when they can teach others what they have learnt. This is true for math – if you can explain in plain English what and why you are doing what you're doing, you will be fine. For example, what does it mean to "solve for x"? (Answer: solving for 'x' will locate a point where the graph crosses the x-axis). If a student can explain that, it indicates that there is a strong understanding of the concept. Obviously, this will take some time for the student to sift through the material, but once they can truly learn the concept, they will have learned it for life.

Here's an example: Students often find graphing difficult in grade 11 (Unit 2, Transformations), when students have to move a graph around a grid, stretching and shrinking it, using parameters as an equation. Using this example, the student needs to understand, in plain English, what each parameter does. In addition to this, what if the parameter uses a fraction rather than a regular number to stretch the graph vertically? If the student can understand this and ask the "why" behind it, he will know that multiplying a regular number will make the graph "larger", whereas multiplying a fraction will make it "smaller", which relates directly to vertical stretch and shrink.

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Practicing a Variety of Questions

Oftentimes, the student will say to himself, "I did all the homework, but the test was totally different!" This is more common than you might think. The reason behind this is because the questions the teacher asks are not cookie cutter questions. Math can be restructured and reformatted to test the same concepts, but from a different perspective. This leads to unexpected questions which often confuse students, leaving them with no idea how to answer.

Completing homework is no longer enough to achieve above Ministry Standards. Answering the homework questions will give you a 65%, perhaps a 75% at best. In order to really excel in math, you must be targeting every single question possible which relates to that concept. The method in which to do this is called "Cleaning the Carpet". What needs to be done is an organization of the questions within the textbook relating that concept or chapter. Use multiple textbooks if possible. Categorize them into different types (should probably give some examples of different types). After you've done this, practice, practice, practice. Rest assured, if you practice enough, you will master anything your teacher can throw at you. Even with the huge amount of flexibility that teachers have, they are still limited by the grade level and concept.

Problem Solving

Problem solving is not a new concept, but in recent years, the Ministry has revamped its assessment and goals, and now have a heavier emphasis on thinking and inquiry. Essentially, to the bane of most students, this means truly understanding the concept, thinking outside the box, and applying the concept to a new situation. However, this can really be the factor in a 10% grade boost.

What is expected is that the student has such mastery over the skill, that they can take a completely new type of problem, dissect it, and successfully solve it. This is as difficult as it sounds, and even worse, it is extremely difficult to learn. You might consider it to be 'intuition', as much as it can be applied to math.

The first step is to write down everything you know regarding the question. Given information, formulas, end goals, and even layouts of the question are things to be noted. You will need everything you can get.

Remember, the answer is meant to be hidden! These questions are purposely created to confused and push critical thinking. They will require multiple steps with limited information – consider it searching in the dark. But don't give up easily – there are several things that you know for certain:
1) There is always a use for each piece of given information and
2) there will be multiple steps.
Don't expect anything easy!

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Problem Solving

Think to yourself, "How should I use this information given?" and, "Why did they give that information to me in the first place?" You will have formulas to work with. Think to yourself, "If I use this formula, what do I get out of it? Can I use that answer to get closer to my goal?" You will eventually peel away the layers of complexity. Don't stop here though, keep going. Ask, "How is this question different from the ones I am familiar with? How do I work around these differences?" Keep looking for a pattern – you'll find one.

Of course, these are all just tips and hints. The only real way to develop that math "intuition" is the same as everything else: practice. It may seem like a long road, but gaining problem solving skills are the best thing you can do to boost your grade, as well as picking up a lifelong skill that has practical uses. One great source is the Waterloo Mathematics Contest, which you can download off of their website. It contains the past tests, dating back 20 years, for multiple grade levels and difficulties. If you truly want to achieve over 90% in Math, work through some of these contest packages on a regular basis. Take your time! These questions will not be easy, but if you manage to complete them successfully, you will have reached a level of understanding that can finally give you those tangible results you want to see.

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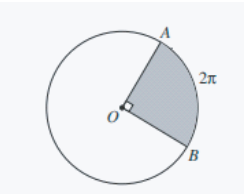
Effective Problem Solving Example



Find the area of the shaded region, if the arc length is 2π

Let me illustrate this with an example. The question above is a very challenging (contest level) type of question for grade 10. The "Arc" is the confusing part, because most students never get exposed to that in grade 10.

Step 1: Organize the information

Given (what do I have?): 1) 90 degrees for the region and 2) the arc is 2π
Goal (what am I trying to get?): the area of the shaded region
Formula: area of a circle: $A = \pi r^2$,
circumference of a circle: $C = 2\pi r$

The difficulty of this question is that the student doesn't have the radius, and cannot use any of the equations right away. It is not easy to develop a relationship between the arc and area either, so what should he do? If the student drills deeper, he will realize that he can't use the equation because there is no radius given!! So what is missing is essentially radius, and if the student can get the radius, everything will be solved!

Step 2: Mapping the Steps

Given: length of an arc	What I need: radius	Goal: area of the shaded region

Step 3: Ask effective questions

Using the tips given above, the student should ask: "What is each given used for?" His answer will be: the arc is to eventually used to locate the radius, so keep this in mind. But how about the 90 degrees? Why is the 90 degrees there, why not 50 degrees. So there is a reason for that, and what is its use? This happens to be the key to unlock the problem.

The 90 degrees indicates that, the student can get the circumference from the arc, because the entire circle is 4X longer than the arc! And with the circumference, the student will then be able to apply the formulas.

Step 4: Solving the problem

Circumference is 4 times the arc: 4 X = 8π
Then you can get radius out of the circumference, using the formula:
8π = r, and r = 4. You got radius! Intermediate step is achieved! Then get to the final answer, using the equation listed before:
$A = \pi r^2$, since r= 4, . $A = \pi(4)^2 = 16\pi$
But since you only want the shaded area,which is ¼ the size of the total area, it will be:

Done!