Std. 10 : Mathematics

Dear Students,

Our whole world is driven at the base by STEM (Science Technology Engineering Mathematics). If you look at the things that make your life comfortable or fun or safe or even allow you to live, you will find that STEM plays a big role everywhere.

Now, the language of the STE of STEM is the M – Mathematics! Mathematics has applications in every field.

There are many branches of mathematics. Branches that you are somewhat familiar with are Arithmetic, Algebra, Geometry, Trigonometry, Statistics, Probability.

There are so many more too. Here is a list of some branches of mathematics that you are probably unfamiliar with : **Number Theory, Combinatorics, Graph Theory, Linear Algebra, Differential equations, Abstract Algebra, Topology, Mathematical Logic and many more!**

All you deal with right now are the simple (yes, in the world of Mathematics, what you are doing is very very simple) concepts and straightforward world problems. But as you learn more there are applications in many fields – in fact, almost every field that you can think of.

What happens is, if Mathematics is something that you feel you are struggling with now, you may be thinking of dropping it after 10^{th}, because suddenly that option opens up. But that also closes many doors on certain specializations – even in the fields of Commerce and Humanities and Liberal Arts.

Getting better at Mathematics is not impossible. It needs hard work, concentration and a lot of practice. But once you decide that you are not scared of it and you are ready to take it on, you can do a lot of amazing things in the courses that you take ahead – projects, internships, jobs – you can do harder stuff than others (who run away from Mathematics) and you will be that much ahead of everyone else too! (You have to be – tough outside, smart inside, remember?)

Anyway, here is what you have to do for the Mathematics Subject Enrichment activity. It is broken down stepwise for your convenience.

Step 1 : Take a look at the list of 8 branches of mathematics that you are unfamiliar with.
Step 2 : Do your research on those.

- What is it, what are its applications? You can go Google this or ask ChatGPT or use whatever
- Now here's the thing – you must always remember that the suggestions that you get are not always 100% correct. So you can consider those as guidelines, but not as the ultimate truth!
- Cross check the information through various websites. Anyone can put information on the internet. Just because it's on the internet does not mean it is right. Try to find sites which always try to give correct information (Authentic, reliable sources)

Step 3 : As you are doing your research, you might get interested or intrigued by certain applications. Note those down. For example, differential equations are used to understand and predict how cancer cells spread! Prime numbers and modulus are used in cryptography - to make your information and connections secure - the s in the https://. As you read, something like that might catch your attention. **Find three such things and dig deeper.**

Step 4 : Prepare a presentation to explain those three things, one after the other. You should talk about what kind of mathematics is used and what it is used for. If you are talking about cryptography for example, you will first have to explain a bit what cryptography is and where it is used. Then, what kind of mathematics is used and what it is used for.

Step 5 : Record a video with the presentation and you in it. Tutorial links for this given further ahead, read on. Make sure your total presentation is between 2 to 4 minutes long (all three explanations combined)

SOME INFORMATION TO HELP YOU GET STARTED ON YOUR RESEARCH

Number Theory

What it is : study of properties and relationships of integers. It includes topics like prime numbers, divisibility, factorization, HCF LCM, modular arithmetic etc.

Applications : Cryptography, Internet Security, Computer Science, Error correction codes etc.

Combinatorics

What it is : counting, arranging, and selecting objects in a finite set. It involves studying discrete structures and the various ways elements can be combined, ordered, or chosen without repetition or replacement. Permutations, combinations, binomial coefficients, functions, graph theory etc.

Applications : Probability analysis, Optimization, Coding, Network analysis, designing experiments, game theory, computer science

Graph Theory
What it is : A graph consists of a set of vertices (also called nodes) connected by edges (also called links or arcs). Graph theory analyzes the properties, structures, and interactions within these graphs.
Applications : Computer science, All kinds of networks - computers, transportation, social etc, (calculating rumour spreading, popularity, spread of a disease etc.) internet searches, circuit design, scheduling algorithms, optimization, how to allocate resources in various tasks

Linear Algebra
What it is : Linear equations, Vectors, Vector spaces, Matrices etc.
Applications : Computer graphics, engineering, physics, data science, machine learning, economics, finance, statistics, artificial intelligence, mechanics, robotics, cryptography, computer aided design

Differential equations
What it is : equations about derivatives (rates of change)
Applications : Physics (motion, heat flow, electromagnetics), Engineering, Biology (biochemical reactions, interaction between neurons), Chemistry, Economics, medicine (how medicines distribute and work in the body), Earth science, Computer simulations etc.

Abstract Algebra
What it is : studying sets of different kinds (groups, rings), fields, vector spaces, lattices, modules, algebraic structures
Applications : Computer science, cryptography, Error detection and correction, symmetry, physics (to develop more theories and models) etc.

Topology
What it is : open sets, sets with structure, connectedness
Applications : Biology (studying proteins, effects of enzymes on DNA etc.) Computer science, physics, mechanical engineering, material science, robots, games and puzzles, fibre art

Mathematical Logic
What it is : reasoning and proofs with logical principles and symbols, recursion, analyzes the very foundation of mathematics
Applications : Computer science, Artificial intelligence, automated reasoning, philosophy of mathematics, linguistics, model checking, compiler design + physics, biology, psychology, law, morals, economics, practical questions, metaphysics, history, theology!

SPECIFICATIONS FOR THE PRESENTATION

Students must create a digital presentation of their research + a video of the presentation, as a part of Mathematics - Internal Assessment. Do note that **both** these submissions together count as a complete project and are compulsory.

The video part has the student explaining their presentation. Please follow the guidelines while creating the presentation.

The presentation must follow the given flow :

- Title slide
- Table of contents (Have hyperlinks on this slide to be able to go directly to that section on clicking). You can refer to this tutorial.
- **Any three** applications of Mathematics that appealed to you the most, one after the other.
- What each application that you have chosen, actually means.
- What kind of mathematics is used in each one, and what it is used for.
- References (list of hyperlinks to material that you have referred to)

After you make the presentation, you have to create a video of you presenting it. So you need to have a window of you speaking alongside the presentation. Check out the helpful links below.

- Instructions to record your presentation and Instructions to get your presentation
- You might want to edit the start or end, or add some effects! For that you can use THIS free app.
- Go through the guidelines at the very end of this circular. Always make it a habit to read through all the instructions before starting any project.

Summarizing - this is what you need to do
Step 1 : Think about the topic and plan it out
Step 2 : Do your research, create an awesome presentation
Step 3 : Practice presenting your presentation
Step 4 : Present your presentation and record it
Step 5 : Save your final video file properly
Step 6 : Submit your presentation + presentation video on the Announcements Classroom

The presentation and project will be assessed as follows :

Criteria	Weightage
Content : completeness and correctness	40%
Flow : sequence of storyline	20%
Presentation (good layout, readable, attractive etc)	20%
Narration (the way you present it)	20%

Things to keep in mind

- **Presentation should be between 30 to 40 slides.** Keep in mind the upper and lower limits. Have fun with it - there are images, transition effects you can try out. Make sure you keep it readable, sensible and attractive.
- Font sizes for the First page : Title - size 50, your name, class, ref no - size 30
- Font sizes for the other slides : Title - size 30, subtitles - size 24, more details - size 20
- Line spacing (default is ok) 1.15, paragraph spacing before 0, after 12
- **Your video should be 4 to 8 minutes long.** Keep in mind the upper and lower limits. Try to bring in intonation and expressions while you present your research, so that your listeners find it interesting. Do not have a monotone.
- Don't just read out everything on the slide. You do not have to put all the information you want to narrate on the slides. You can have the main points on the slides and additional things you want to say in your notes, which you can mention in the video.
- Be in your uniform when you are presenting. Do not sit in front of a window. Do a 30 sec trial recording to check your settings, sound etc. Be smart, be impressive. This is a very important skill to develop for your whole adult life - having a strong presence in virtual meetings and presentations. That is the way the world is going forward!

Additional Guidelines for Mathematics Project

You have to choose **any THREE topics or applications of Mathematics.** Here are the answers to your queries in advance. That's the Walnut Way!

- Can they be from the same branch of mathematics? **Sure**.
- Can they be from the same subtopic within the same branch of mathematics? **Absolutely not**.

📽️ **Create a PowerPoint Presentation** -- the instructions are given in detail in the above PDF.

🎥 **Record a single video** explaining each of the three topics you selected one after another. Be mindful of the time limits.