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the secret of nature.
A desirable math study is the series of training process
to find out the secret of nature,
and the most significant conponents
to be dealt with when compiling a math textbook
are the comprehension in learning about nature,
humans and society.

General Mathematics
Secondary Courses
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72 Volumes / Guide Book

The Global Standard of Mathematics Education

General Mathematics
Secondary Courses

David Ann, Ph. D.

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72 Volumes / Guide Book

The Global Standard of Mathematics Education

General Mathematics
Secondary Courses

David Ann, Ph. D.

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We are setting up the global standard of mathematics education.

PREFACE

Mathematics can be characterized as endeavors to find the hidden patterns behind the nature.
The contents of mathematics education, in essence, should be devised in an effort to engrave creativity in every individual with a different set of talents through the basic understanding of humanity and nature.
Mathematics is the subject dedicated to finding the hidden patterns behind the nature. Once you discover the pattern, you will be able to create something that'll bring happiness. Humans are part of nature. Therefore, the hidden patterns to making people happy must be embedded in the nature. Let's say a person has been diagnosed with cancer. It's a life-or-death matter for the said person. This implies that the nature has a problem too because what makes up the nature has gotten a problem.

As such, the nature has an incredible self-sustaining mechanism to find cure for its own problems. Cure for cancer does not look apparent to our eyes but it is an undoubted truth that it exists as one or the other form of chemical compounds. Cure for cancer is not an object of creation but rather an object of discovery. Today, global pharmaceutical corporations with worldly presence are not tied inside the office. The researchers of those pharmaceutical corporations spend most of their time in the Amazon rainforest.

They pick up the hidden patterns of the nature by getting in touch with various living organisms.
The nature only discloses itself to those who come near it.
People have the tendency to believe that bacteria are insanitary and dangerous. They have a belief that bacteria can adversely affect their health even to the point of causing death. But this allegation is contrary to the truth. Of course, colon bacteria do upset the stomach. Tuberculosis and cholera are two of the well-cited examples of bacteria-caused epidemic. However, bacteria are also critical to humans' survival and reproduction.

Imagine a benign bacteria tribe that is living inside a human's body. One day, the air, the land and the river the bacteria are occupying start to be polluted. The cause of such tragedy is stress and overconsumption of polluted food. Upon sensing imminent threat, the bacteria start to attempt every method that could guarantee their survival. Their struggle becomes conspicuous in the form of a disease. When people are diagnosed with an illness, they immediately look for a hospital.
Their visit to the hospital is entailed by a prescription and medication. However, the medicines people consume are lethal to the bacteria tribe.

Normally, bacteria tribe allocates a guard for their own protection. So when something foreign comes near them like those lethal medicines, the guard will unquestionably analyze it by tasting or smelling it. The guard will indeed fall to the fate of death upon encountering those medicines.
But before their death, they will scream: “It is a lethal object. Everyone close your mouth and don't smell it or taste it!”

When people find their disease not dwindling despite their medication, they will take even stronger medicines. While people take stronger pills, the bacteria guard reinforces their guard, increasing their numbers and wary of foreign substances. Everyone shuts their mouth with solemnity and an iron will not to let lethal medicines enter them. What happens afterwards is a surprise to everyone.
Even though the bacteria guard has been keeping their mouth shut, they all start to perish. It is indeed because the lethal medicines seep through the bodies of bacteria.
“Closing your mouth is of no use! The lethal medicines can easily penetrate our body.”

Finally, it is a moment of extinction for the bacteria tribe. Every member of the bacteria tribe comes to the final emergency meeting. Bacteria tribe leader declares with solemn voice. “Everyone, wear your suit of armor and all together we will attack with everything we have.”
This means the advent of super bacteria. Exceptionally serious indeed. ‘Super bacteria’ which is immune to antibiotics has come to be perceived as a new disease that threatens the survival of humanity. A new approach to targeting such creation is necessary.

Super bacteria cannot be cured with antibiotics. This problem owes itself to humans themselves. This is because over-usage of antibiotics has triggered the bacteria to find themselves a way to withstand. Again, mathematics is a subject to find hidden patterns behind the nature. If you do, you can make something to make people happy. Then, what are some of the things that can make people happy? People of today are lonely.

They are awaiting something that will solace their loneliness. The most recent such item would be the smartphone. Also, people have thirst for anything that can extend their life span so they could live long and healthy lives. What are some of the examples? One of those items is new medicines, that cure diseases that were previously impossible to cure.
Another example would be prescriptive tools such as MRI, ultrasonic waves and CT.

Health and emotional issues are highly inter-related and all add up to allowing happy lives.
Every machinery or technological devices that bring happiness are included in the field of high-tech industry. Mathematics is a ‘source technology’ for all high-tech industry. The level of a country’s mathematics skills is equivalent to the level of a country’s competence. Today, all first world countries have exceptional level of mathematics.

The most ideal mathematics education refers to endeavors to find the hidden patterns behind the nature. Before you do that, you first have to observe and starts from the very effort to find those patterns in animals and plants. Biologists are people who find patterns in animals and plants.
The nature consists of plants and animals.

If you observe them well, you would be able to uncover a distinctive, original pattern in all of them. A pattern is innately differentiated characteristic that every plant and animal has. In order to bring this act of observation into a field of mathematics, you have to be able to draw out those patterns. It is the biologists’ role to find those hidden patterns so the field of mathematics can begin.

If you find those patterns, then you have to find bigger patterns that encompass a group of patterns. However, it is not a very easy task. But if you can tag those patterns with a certain number or a sign, then the process of finding bigger pattern becomes a lot easier. People often think that numbers are just a tool to help you calculate and that languages are only as useful when you make an equation.

However, numbers and languages both have a much bigger role than that. Numbers and languages are key features in ‘idealism’ that mathematicians support. Physicians state the following.
‘If us physicians have not utilized numbers and languages of mathematics, we could not have even begun to collect our thoughts.’

Idealism of mathematics is an equation, to easily put. If you turn various possibilities of numbers into a language, what you'll have in the end would be an equation. Long sentences that contain numbers can be easily turned into an equation if you utilize a language.
You need to understand what the following sentence implies. ‘The use of language has brought convenience to the field of mathematics.’ The difference between calculation and mathematics stems from this very idea.

The patterns of animals and plants are very sophisticated, quite hard to realize the overarching pattern. If you can tag every pattern you find with a number or a word, you can turn the pattern into a form of an equation. Then, the overriding pattern becomes apprehensible. As such, numbers and Languages are powerful tools that mathematicians use in the process of finding the hidden pattern behind the nature.

Once we find the pattern through observation and tag them with a number or a language, we finally have the chance to discern the pattern itself. Patterns in plants and animals are so small that they seem to be very constant. However, if you discover the pattern, the structure of nature is finally disclosed.
Figuring out the structure of nature indicates that you have found out the movement of nature.
When you compare one pattern with another, you will be able to sense the movement of all patterns.
People can touch anything in front of them that has substance. Chemists name all objects that have substance. They can express them as a chemical equation or draw them out as a chemical structure.
Chemist, then, can be considered as a person who can draw out the pattern in those substances.
Therefore, chemist is a person who can handle the structure of nature.

Once you find the overriding pattern, you have to find the overarching rule. Because you have to figure out the reason why the structure of nature is created and goes extinct in order to find out the hidden pattern behind the nature.
Every living organism has a consistent pattern. There is yet another pattern within one pattern.
A pattern and its destruction always exist side by side which makes it difficult for us to pinpoint the pattern of movement. Furthermore, a pattern might be multi-dimensional which makes external detection rather difficult.

There seems to be some sort of a rule inside pattern but no one can be completely sure of what that pattern is precisely. All organisms try to sustain its original form. In order to stay the same, invisible power and rules are necessary. A person who deals with the invisible world of power and rules in the nature is called a physician.

In order to discern patterns, destruction of patterns and patterns that appear within another pattern, people need to have sophisticated minds.

This sophisticated mind can be nurtured without limit by acquiring a refined taste in the humanities.
If we can cultivate classic taste for the humanities through reading so that we can understand societies that we do not live in, we will have the ability to see the invisible, hear the inaudible and gain insights into the world we've never been.

The humanities is a story about people's lives. It is about how creative people's lives were throughout their life and how beautiful their death was when the moment came.
The humanities is about life and death.By studying the humanities, people will gain new perspectives on profound subjects such as life and death, creation and extinction, time and space and finally the past, present and the future. Therefore, they can analyze the world of patterns that impact other patterns. If people can find the hidden pattern behind nature, they can understand the secret behind life and death of plants and animals. They can also understand the secret to creation and extinction of the nature.

Mathematicians are people who devise a prediction mechanism to make projections on what will happen to living organisms by finding hidden patterns behind the nature.
The most ideal mathematics education will enable you to cover fields of expertise in natural science such as biology, chemistry and physics. Biologists are people who find pattern by observing the nature and draw it out. Chemists then do their job of naming those that are visible, tangible and have forms. Physicians take care of the field of power and mechanisms that explain the process all living organisms maintain to keep their unique forms.

Mathematicians are people who devise a prediction mechanism to make projections on what will happen to living organisms by finding out hidden patterns behind the nature.
This is the very reason why we call mathematics the essence of natural science.

Comprehending the world of chemistry for the structure of nature and the world of physics for power and mechanism is vital to find out hidden patterns behind the nature.

We need to also understand the world of fractals (chemistry) and the world of chaos (physics).
The world of chemistry and physics always maintain a structural relationship. At the same time, mathematicians figure out hidden patterns behind the nature by looking at both the world of chemistry

and physics and speculating on what will happen to one organism and how big it will grow before it suddenly gets smaller and disappear.

Setting the standard of global mathematics education starts with the formulation of mathematics course curriculum. There is a basic premise all mathematics education specialists and education policymakers universally embrace when they write mathematics textbooks.

The purpose of education is not to simply deliver contents but to empower children to achieve their potentials to the fullest with their given talents and allow the seed of creativity take its sprout and flourish. The most ideal mathematics education can only be achieved through humanism toward humans. Mathematics education starts from understanding humanness.

Children are all born with unique set of talents. This talent comes from their parents' genes. Children's talent is a seed of creativity in different words. Seed of creativity is what you are born with, and not something that can be artificially instilled. This is where mathematics education comes in. It allows for the seed of creativity to sprout, blossom and finally bear fruits.

Then, what is creativity? Creativity is the ability to see the invisible, hear the inaudible and gain insights about the world we've never been to as if we have. In sum, creativity is the capacity to predict and survive.

We should guide children to see, hear many things and go to many places for the most ideal mathematics education. Internalizing the nature is very important in mathematics education Moreover, we should let children visit the world that they have never been to by encouraging them to read books.

Therefore, the two factors to keep in mind when writing mathematics textbooks based on the most ideal standard of mathematics education are internalization of the nature and a complete understanding of humans and society.

What will the fruits of creativity look like, once we have educated children in a desirable way to nurture their seeds of creativity?

Countries seek to nurture engineers of newest industrial technologies with the most ideal mathematics education. At an individual level, the most ideal mathematics education enables children to select the jobs that fit their talents and serves as a compass to guide them to the right career path.

In order to establish the most ideal mathematics education and write mathematics textbooks, you should have full understanding of all subfields of mathematics.

Then, what condition must be fulfilled for a subjec to be classified as a subfield of mathematics?
It must be able to be drawn out. It must be able to have patterns that can be observed from the nature. Once the pattern is found, then you need to tag a number or a language to eventually come up with a predictive mechanism.

The most ideal mathematics education must contain four areas. Those are areas of picture, number and language, pattern and prediction.

The field of picture is consisted of shapes, patterns, weights and measures and dimensions (time and space). The field of number and language is consisted of number, calculation and equation.
The field of pattern is consisted of the world of fractals and chaos. Lastly, the field of prediction is consisted of number of possibilities, analyzing tables and graphs and relationship.
For every chapter, you must contain the objective of why we are learning such mathematical theory, the foundational basis of how it has to be formulated as well as examples of technologies where it is applied and utilized.

2017. 3
David Ann, Ph.D.

CONTENTS

PREFACE 3

The Global Standard of Mathematics Education 16

1. Mathematics, a Science to Unveil the Mysterious Laws in Nature 18
2. Desirable Mathematics Education, Which is about Revealing Nature's Secrets 43
3. Understanding Nature, Human and Society 67

General Mathematics Secondary Courses 92

1. Grade 7 Field of Mathematics 94

GM 0701 Making Cryptograms and Decoding Programs Using Prime Number and Factorization 96

GM 0702 Understanding Number Representation System and the Number Theory, the Number-Operating System 106

GM 0703 The Use of Letters That Made the Practice of Mathematics Easier and the Separation between Arithmetic and Algebra 114

GM 0704 The Idea of 'Knot Theory' That Defines and Examines Life on Earth and Characteristics of Space 120

GM 0705 Understanding Functions and Graphs, a New World That Reflects Phenomena 128

GM 0706 Methods to Analyze, Interpret and Make Predictions from the Given Information 136

GM 0707 Understanding Mysteries of Nature and General Knowledge System 142

GM 0708 Secrets of Nature and High Tech Industrial Technologies Underlying Geometrical Construction 150

GM 0709 Understanding Euclid's「Geometry Theory」and the Idea of Plane Geometry 158

GM 0710 The Importance of Knowledge in Liberal Arts in Determining Rules in Patterns 164

GM 0711 Plato's Geometric Model which Explains How Humans and the Universe Work 172

GM 0712 The Structure of the Nature as the World of Fractals Comprised of Enlargement and Reduction of Figures 180

2. Grade 8 Field of Mathematics 186

GM 0801 The Garden of Eden That Pythagoras Mentioned and the World of Sophisticated Rational Numbers 188

GM 0802 Ancient Mathematics, a Beautiful Language That Nature Has Created 196

GM 0803 Idealism, the Main Factor That Designs the Nature 204

GM 0804 Algebra, a Theory That Deals with Mathematical Structure Utilizing Symbols 210

GM 0805 Understanding and Applying Time and Space Embedded in the Magnetic Resonance Device 218

GM 0806 Understanding Order Relations of Real Numbers, Vertical Line and Inequation 226

GM 0807 Applying Simultaneous Inequality and Linear Programming, the Driving Force of Modern Society 232

GM 0808 Optimization Theory That Solves the Problem of Scarcity and Selection 240

GM 0809 Mysteries of Nature Appeared in Logic Geometry and Triangle 248

GM 0810 Probability That Represents Coincidental Events and Uncertainties in Numbers 254

GM 0811 Human's Happiness and Mathematical Properties Embedded in Probability 262

GM 0812 Ways in Which Humans and the Nature Selects; Adding Values and Maintaining One's Species 270

3. Grade 9 Field of Mathematics 276

GM 0901 The World of Irrational Numbers with Nature's Mysterious Number Arrangements and Regularities 278

GM 0902 Analytic Geometry and Plane Coordinates That Algebraically Prove Figures 286

GM 0903 Basic Theory of Gauss Algebra and Different Methods in Extracting Square Roots 294

GM 0904 Interactions between Humans and Nature Revealed through Statistics 300

GM 0905 Understanding Greek Philosophy and the Garden of Eden That Puts High Values on the Relationship between Humans and the Society 308

GM 0906 The World of Circles and Lines That Designs Nature 316

GM 0907 Limitations of Astronomy and the Secrets of Nature in Waves and Vibrations 322

GM 0908 Three Problems of Impossible Construction That Has Been Solved with the Advent of Transcendental Functions 330

GM 0909 Euclid's 'Geometry Theory' and Non-Euclidian Geometry 338

GM 0910 Chaos Theory and the World of Physics That Can Be Explained by Probabilities 344

GM 0911 The Essence of Mathematics Education, Learning from the Nature and Understanding Humans and the Society 352

GM 0912 A Desirable Mathematics Education Which Helps to Discover the Mysterious World of Nature 360

4. Grade 10 Field of Mathematics 366

GM 1001 Chaos Theory and Fuzzy Control Theory at the Center of Sciences in the 21C 368

GM 1002 Mathematics, a New Foundation Stone and Propositions to Cultivate Judgementand Extinction 376

GM 1003 Understanding of Decartes' Mathematical Thinking and Gauss' Fundamental Theorem of Algebra 384

GM 1004 Equations without an Algebraic Solution and Challenges of Modern Algebra 390

GM 1005 The Real World That Blooms Beautifully in the Virtual World 398

GM 1006 Boolean Algebra, the Frame Used in Realizing Artificial Intelligence through Computers 406

GM 1007 Understanding Quadratic Formulas and Integer Square Roots That Brought about the Great Algebra 412

GM 1008 Insight of Hamilton and Quaternion, Which Gave Ideas for Complex Space 420

GM 1009 Algebraic Approach of the Functions: the Foundation of Analytics 428

GM 1010 Mysterious Number Arrangements in the Nature and the Formation and Extinction of Life Forms 434

GM 1011 Plausible Inference and Mathematical Induction That Investigates the World of Discrete Mathematics 442

GM 1012 The Real World Made from the Virtual World through Time and Space 450

5. Grade 11 Field of Mathematics 456

GM 1101 Human Desire That Is Guided by the Law of Scarcity and Seeks Utility Maximization 458

GM 1102 Understanding of Discrete and Continuous Data and Their Applications 466

GM 1103 The Nature and Error of Sample Survey Which Can Save Time and Cost 474

GM 1104 The Matrix That Reflects Non-Commutative World with Reversed Sequence 480

GM 1105 Limits and Progressions, the Final Destinations of Numbers and Sizes with Fixed Rules 488

GM 1106 The Linear World That Appears in the Insect's Eye View 496

GM 1107 The Curved World That Appears in the Bird's Eye View 502

GM 1108 Napier's Log That Extended the Lives of Astronomers in the 17C 510

GM 1109 Trigonometry and Original Technology of Radio Communications That Move within a Circle 518

GM 1110 The World of Differentiation That Measures an Extremely Short Period of Time 524

GM 1111 The World of Differentiation That Travels through Time Using the Concept of Velocity 532

GM 1112 The Idea of Calculus of Variation That Enriched the Concept of Differentiation 540

6. Grade 12 Field of Mathematics 546

GM 1201 The Concept of Velocity and the World of Quadratic Curve That Enriched the Field of Mathematics 548

GM 1202 Vector, Algebraic Interpretation of the World of Invisible Laws and Forces 556

GM 1203 Big Data Theory and Markov Chain Model, the Core Technology of Information-Oriented Society 564

GM 1204 The Ideal World for People Who Create the World with New Time and Space 570

GM 1205 Unknown Variables of Simultaneous Equations, the Determining Factors of Axis in the World of Dimensions 578

GM 1206 Various Methods in Applying Linear Algebra and Graph Theory 586

GM 1207 Polar Coordinate System That Drew Orthogonal Coordinate System out of the Circle into the World 592

GM 1208 The Unreachable World of Limits That Never Seem to Get Close 600

GM 1209 A Differential Equation Which Represents the Interpretation of Infinitesimals and the Changes in Nature 608

GM 1210 Pigeon Hole Principle and Fixed Point Theorem That Proved Existence 614

GM 1211 The World of Differentiation Underlying in the Principle of the Lever and the Law of Planetary Motion 622

GM 1212 Chemistry and Physics Structurally Related to Mathematics at the Center of Natural Sciences 630

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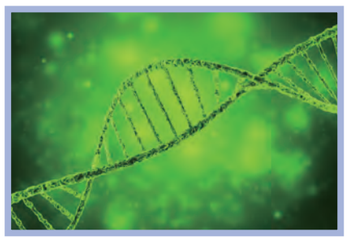

The Secondary School curriculum is composed of level 7 to 12 and each level per grade is made up of 12 sub-units.
Each sub-unit is composed of a total of more than 7 specific topics including the three parts that are included in the elementary school curriculum.

The topics in each of the 12 units per level are as shown below

① What is the purpose of learning this unit?
② What process was undertaken in making mathematics theories presented in the unit?
③ What is the logical reasoning behind the mathematics theories presented in the unit?
④ Why did the mathematicians express their mathematics theories through these unique graphical representations?
⑤ How are mathematics theories expressed?
⑥ What are arguments among the mathematicians raised in the process of making the mathematics theories?
⑦ How would the mathematics theory shown in the unit serve as a resource technology of high tech industry?

General Mathematics Secondary Courses

- Grade 7 Field of Mathematics
- Grade 8 Field of Mathematics
- Grade 9 Field of Mathematics
- Grade 10 Field of Mathematics
- Grade 11 Field of Mathematics
- Grade 12 Field of Mathematics

Numbers are invisible. They exist only in our head like a dragon or other ‘imaginary’ animals or something. But in fact, numbers are everywhere and of great significance in this ‘real’ world.

General Mathematics Secondary Courses

1. Grade 7 Field of Mathematics

GM 0701 Making Cryptograms and Decoding Programs Using Prime Number and Factorization

GM 0702 Understanding Number Representation System and the Number Theory, the Number-Operating System

GM 0703 The Use of Letters that made the Practice of Mathematics Easier and the Separation between Arithmetic and Algebra

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GM 0711 Plato’s Geometric Model which Explains How Humans and the Universe Work

GM 0712 The Structure of the Nature as the World of Fractals Comprised of Enlargement and Reduction of Figures

General Mathematics 144

Mathematics harbors poetry literature and fairy tales in its heart

Field of Mathematics

Making Cryptograms and Decoding Programs Using Prime Number and Factorization

David Ann, Ph.D

GM 0701

GM 0701

Making Cryptograms and Decoding Programs Using Prime Number and Factorization

Category : Number Theory
Target Grade : Grade 7
Math Theory : Prime Factorization

Prime number is one of the most important concepts in the contemporary math.
Prime numbers are defined as the natural numbers bigger than 1, whose divisors are only 1 and itself.
Scholars compare prime numbers to atoms because both are the indivisible basic unit in the world of math and science each.
The contrary concept would be composite numbers, which can be described as a multiplication of two integers other than 1 while prime numbers can't be.
So from ancient Greek period, people have been somehow fascinated by the very purity and succinctness of prime numbers.

GM 0701 Making Cryptograms and Decoding Programs Using Prime Number and Factorization

1. What is the purpose of learning this book?

The real world we are living in is actually the world where, according to Pythagoreans, “numbers are the essence and source of all things.” Calculation, which is also called the science of math, upholds this whole world like a pillar. If modern time mathematicians were born now, who couldn’t really apply the complex mathematical theorems and proofs into the real life, they would be surprised that this world is run by numbers.

Numbers are invisible. They exist only in our head like a dragon or other ‘imaginary’ animals or something. But in fact, numbers are everywhere and of great significance in this ‘real’ world.
For example, 12: a year consists of 12 months, a day consists of 12 hours A.M. and 12 hours P.M. each, and if you take a look at the piano, one octave consists of 12 semitones.

Most mathematicians say that the world of numbers is like Plato’s world of “Idea.”
And some say that, due to human brains’ unique structure, the concept of numbers can even transcend time and space. Then why are numbers so great, fantastic and important in the area of math, as those mathematicians put?

If we put numbers as the main character in the world of math, we can better figure out what they are all about.
Otherwise, it is nothing but blind belief about math to say ‘numbers do exist.’
Therefore, it is very important to understand how the ‘invisible and abstract’ concept of number actually works in this ‘real’ world, as well as to figure out what on earth numbers actually are.

Prime number is one of the most important concepts in the contemporary math.
Prime numbers are defined as the natural numbers bigger than 1, whose divisors are only 1 and itself.
Scholars compare prime numbers to atoms because both are the indivisible basic unit in the world of math and science each.
The contrary concept would be composite numbers, which can be described as a multiplication of two integers other than 1 while prime numbers can’t be.
So from ancient Greek period, people have been somehow fascinated by the very purity and succinctness of prime numbers.

In math, prime numbers are the ‘basic unit of composition.’ That is, in order to understand the characteristics of a certain number, we need to know its prime factors.
This is like figuring out how much of which atoms are in a certain matter and how they are connected in order to understand its characteristic and use it for an appropriate purpose.

And we also study prime factorization in order to make decoding programs as well, because prime numbers do have something to do with it. Then how is a code made?

It's made using the unique characteristics of prime numbers. In the contemporary so-called IT world, codes are really important. In order to understand the significance of codes, we need to know well about information, industries and societies of this IT world first.
And fortunately, we have the best teachers right around us who can teach us about all of them – ants and bees. So why don't we ask them the questions and get the answers?
Since math is basically a study to discover and understand secrets of the nature, it's the best way to study math to learn from the nature.

2. What is the logical basis of the mathematical theories introduced in this book?

We use 'the sieve of Eratosthenes' to distinguish prime numbers among natural numbers. The sieve of Eratosthenes is a method that eliminates non-prime numbers, checking every natural number - from 1 forward - whether it has any divisors smaller than itself - except 1.
That is, at first we eliminate 1 because it's not a prime number.
Leave 2 because it's a prime number, and 3 as well for the same reason. Then eliminate 4 because it has 2 as a divisor, and go on to 5 and so on.

Prime factorization means describing a certain number as product of prime numbers only. If we don't care about the order of those prime numbers in a multiplication, there is always only one form of prime factorization per number. So, we say prime factorization is 'unique,' which is an essential and important characteristic of it – the unique prime factorization theorem.

You may think 1 is the most typical prime number, but it's not even a prime number. As mentioned before, the prime number is defined as a natural number whose divisors are only 1 AND itself, which means it should have at least two divisors (1 and itself). But 1 has only 1, OR itself.
Moreover, we don't consider 1 as a prime number because if 1 counted as a prime number, prime factorization would not be unique anymore. That is, there can be numerous form of prime factorization, making prime factorization mathematically totally useless.
Let's take an example of 6. In accordance with the unique prime factorization theorem, there is only one form of prime factorization – $6=2\times3$. But if 1 were a prime number, there can be limitless forms like $6=1\times2\times3$, $6=1\times1\times2\times3$ ··· and so on.

If you go over 100, you can find that the frequency of prime numbers showing up decreases drastically. Then you might assume there would be no more prime numbers from a certain moment. But wrong.
There the number of prime numbers is unlimited, which is proven by the ancient Greek mathematician Euclid.

He first assumed that the number of prime numbers is limited and that there would be the biggest prime number and then proved the limitlessness of prime numbers.
Well, let's say M is the biggest prime number and create a new unknown number p.

$$p=2\times3\times5\times7\times\cdots\times M+1$$

Then p is surely not a product of M.
The natural number p is either a prime number or composite number.

If p were a prime number it would contradict the assumption that M is the biggest prime number, and if p were a composite number, which can be described as a multiplication of prime numbers, there must be another bigger prime number that M.
So, this time, it contradicts the assumption that M is the biggest prime number. Therefore, the number of prime number is unlimited.

The sequence of prime numbers has been one of the most difficult conundrums in the history of knowledge pursuit.
About 150 years ago, Bernhard Riemann, the German mathematician, strived to solve the problem harder than anybody else and suggested diverse ideas on combinations of prime numbers.
This idea, so called 'Riemann hypothesis,' offered a lot of questions for mathematicians after him to struggle with.
Why have a lot of mathematicians been struggling with the problem which doesn't even seem to be connected our daily life?

The problem about the sequence of prime numbers has a great amount of potential utility with respect to modern science. Maybe you are already aware that security systems in banking and e-commerce are based on prime numbers.
Quantum mechanics and chaos theories also are closely related to prime numbers.

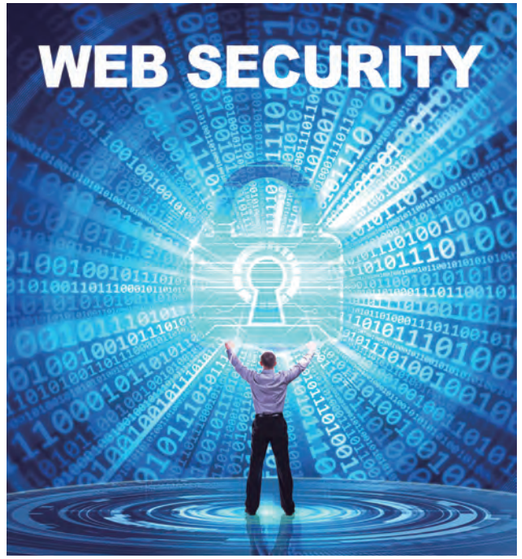
3. How can we apply what we learn from this book?

Theories related to number theories, which are one of the highlights of math, have been applied in various studies other than math. And especially these days, the development of code systems based on number theories has proved wrong that number theories are vague and not useful. Some of code researches based on number theories are so important that they are even militarily classified.

Given it is alleged that powerful Germany in the WWII was surprisingly defeated by the US because the US had the lead in the decoding competition, the importance of number theories couldn't be emphasized too much.

Even those who never studied number theories might have heard of 'Fermat's little theorem,' which is the basis of the code system called RSA (Rivest Shamir Adleman algorithm).

RSA was developed based on the fact that prime factorization is almost impossible for a number which is a product of very big two prime numbers. RSA is in reality impossible to decode without a new mathematically innovative discovery. Today code technologies have become indispensable for the contemporary IT society.



Codes are used for Digital Right Management (DRM) as well. Along with the development of the Internet numerous digital contents are created and spread. DRM is the service which protects the contents released through various channels from illegal users by means of code technologies and which preserves and manages the rights of the creators or other people involved that are caused by the use of the protected digital contents.

Also, organisms have special codes within themselves to the tiniest parts. We study codes in order to discover secrets of organisms as well as to take the lead in the IT society. As mentioned, math is a study that discovers secrets of the nature, which can be the key to people's happiness.

GM 0701 Making Cryptograms and Decoding Programs Using …

① Math Theory : Prime Factorization ② Category : Number Theory

Table of Contents

Ⅰ. Ants and Bees Will Teach You about the Information and Industrial Society

01. Their Hierarchical Societies to Spread Information Efficiently

02. The Ants' Dream World Looks Quite Similar to the Human World

Ⅱ. Codes Take Advantage of Prime Number's Special Characteristics

03. How to Describe Numbers and Understand Their System

04. Prime Numbers are Like Atoms of the World of Natural Numbers

Ⅲ. Origin of Codes and How Ancient Codes Developed

05. The Caesar Cipher - The First Organized Code of Humankind

06. The Vigenere Cipher - The Birth of Complicated Codes

Ⅳ. Mathematicians Wanted to Conquer the World of Prime Numbers

07. Common Factors and Common Denominators Assemble and Disassemble Numbers

08. Uniqueness of Prime Factorization Lets You Know about the Organization of Numbers

Ⅴ. What is the Number? - Prime Numbers as a Unit to Compose the World of Math

09. Codes Based on Number Theories and Modular Arithmetic

10. The Advent of Enigma and the Modern RSA System

Ⅵ. The Various Utilities of Codes in the IT Society and Genetic Codes

11. Code Technologies to Keep Information Safe

12. DNA Decoding Technologies Can Make You Live Longer