ALABAMA PRISON ARTS + EDUCATION PROJECT

THE WARBLER

AN EDUCATIONAL WEEKLY

ISSUE
03
APRIL 24, 2020

Dear Student, Artist, Thinker,

This week's newsletter is focused on the interconnectedness of math and nature. The world around is filled with plants, animals and geologic formations that show us geometric shapes that we might just think belong in a math textbook. Honeycombs are hexagons. There are rock formations in the northern part of Ireland called the Giant's Causeway that are also hexagons. They are exactly the same shape as a honeycomb, but one is rock and one is organic. Even the back of a box-turtle has hexagon patterns. Why is something that is a shape we might have learned about in school showing up in nature? What are other things we see that have that same shape? What does it mean?

We fill our days with questions. What time is it? Have you seen *Raiders of the Lost Ark*? Did you read *The Great Gatsby*? We also ask a lot of questions that begin with "why." Why do clouds have different shapes? Why do people DO that? The "why" questions often become the launching pad for humans to explore and understand what surrounds us. Why are there so many patterns in nature that are hexagons? It is a matter of efficiency. The shape allows the thing, whatever the thing, to function better. Which can lead to another question: how does any shape influence how something works?

Asking questions and digging for answers is like setting up a life-long incredible path of falling dominoes. One leads to the next and to the next and to the next. Curiosity is just that. The questions never stop and any person can spend their whole life asking "why" and delight in all the weird and unexpected things you can learn. On that path, people also make the most remarkable discoveries.

We hope you learn some new facts this week. We also hope you will start looking at everything around you and seeing shapes and patterns. There is a new addition to the newsletter called "The Random-Nest," inspired by questions. Each week there will be information on something, often functional in nature. It will be random. And, it will be related to building your nest.

Kyes Stevens and the APAEP Team

"The difference between the poet and the mathematician is that the poet tries to get his head into the heavens while the mathematician tries to get the heavens into his head."

G.K. CHESTERTON // writer and philosopher

WORDS INSIDE

FROM "WHY IS THE HEXAGON ..."

polygon | a plane figure with at least three straight sides and angles, and typically five or more.

diameter | a straight line passing from side to side through the center of a body or figure, especially a circle or sphere.

predominant | present as the strongest or main element

FROM "THE MYTH OF ...

pernicious | having a harmful effect, especially in a gradual or subtle way

virtuoso | a person highly skilled in music or another artistic pursuit

malleable | easily influenced; pliable; able to be hammered or pressed out of shape without breaking or cracking

• • •

HISTORY

How are Fibonacci numbers expressed in nature?

BY ROBERT LAMB

Is there a magic equation to the universe? A series of numbers capable of unraveling the most complicated organic properties or deciphering the plot of "Lost"? Probably not. But thanks to one medieval man's obsession with rabbits, we have a sequence of numbers that reflect various patterns found in nature.

In 1202, Italian mathematician Leonardo Pisano (also known as Fibonacci, meaning "son of Bonacci") pondered the question: Given optimal conditions, how many pairs of rabbits can be produced from a single pair of rabbits in one year? This thought experiment dictates that the female rabbits always give birth to pairs, and each pair consists of one male and one female.

So, two newborn rabbits are placed in a fenced-in yard and left to, well, breed like rabbits. Rabbits can't reproduce until they are at least one month old, so for the first month, only one pair remains. At the end of the second month, the female gives birth, leaving two pairs of rabbits. When month three rolls around, the original pair of rabbits produce yet another pair of newborns while their earlier offspring grow to adulthood. This leaves three pairs of rabbit, two of which will give birth to two more pairs the following month.

The order goes as follows: 1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, 144 and on to infinity. Each number is the sum of the previous two. This series of numbers is known as the **Fibonacci numbers** or sequence. The ratio between the numbers (1.618) is frequently called the **golden ratio** or number.

At first glance, Fibonacci's experiment might seem to offer little beyond the world of speculative rabbit breeding. But the sequence frequently appears in the natural world, intriguing scientists for centuries.

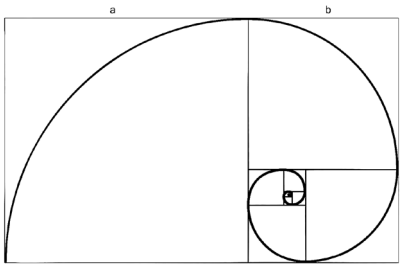
You won't find Fibonacci numbers everywhere in the natural world — many plants and animals express different number sequences. And just because a series of numbers can be applied to an object, it doesn't necessarily imply there's any correlation between figures and reality. As with numerological superstitions like famous people dying in threes, sometimes a coincidence is just a coincidence.

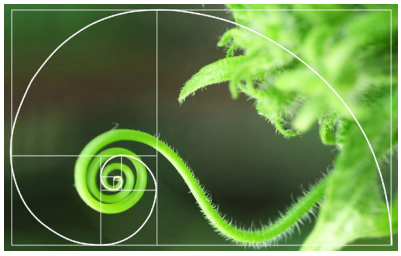
But, Fibonacci numbers appear in nature often enough to prove that they reflect some naturally occurring patterns. In some cases, the correlation may just be coincidence. In other situations, the ratio exists because that particular growth pattern evolved as the most effective. In plants, this may mean maximum exposure for light-hungry leaves or maximum seed arrangement.

Here are a few examples:

Seed heads, pinecones, fruits and vegetables: The array of seeds in the center of a sunflower looks like spiral patterns curving left and right. Amazingly, if you count these spirals, your total will be a Fibonacci number. Divide the spirals into those pointed left and right and you'll get two consecutive Fibonacci numbers. You can decipher spiral patterns in pinecones, pineapples and cauliflower that also reflect the Fibonacci sequence.

Flowers and branches: Some plants express the Fibonacci sequence in their growth points, the places where tree branches form or split. One trunk grows until it produces a branch, resulting in two growth points. The main trunk then produces another branch, resulting in three growth points. Then the trunk and the first branch produce two more growth points, bringing the total to five. This pattern continues, following the Fibonacci numbers. Additionally, if you count the number of petals on a flower, you'll often find the total to be one of the numbers in the Fibonacci sequence. For example, lilies and irises have three petals, buttercups and wild roses have five, and delphiniums have eight petals.





The golden ratio is expressed in spiraling shells. In this illustration, areas of the shell's growth are mapped out in squares. If the two smallest squares have a width and height of 1, then the box to their left has measurements of 2. The other boxes measure 3, 5, 8 and 13.

Honeybees: A honeybee colony consists of a queen, a few drones and lots of workers. The female bees (queens and workers) all have two parents, a drone and a queen. Drones, on the other hand, hatch from unfertilized eggs. This means they have only one parent. Therefore, Fibonacci numbers express a drone's family tree: he has one parent, two grandparents, three great-grandparents and so forth.

The human body: If you look in the mirror, you'll notice that most of your body parts follow the numbers one, two, three and five: one nose, two eyes, three segments to each limb and five fingers on each hand. The proportions and measurements of the human body can also be divided up in terms of the golden ratio. DNA molecules follow this sequence, measuring 34 angstroms long and 21 angstroms wide for each full cycle of the double helix. ●

HowStuffWorks.com, June 24, 2008.

This article has been edited for space.

SCIENCE

Why is The Hexagon Everywhere?

BY KASHYAP VYAS | Interesting Engineering, May 10, 2018

Simply put, a hexagon is a shape with six sides. This 6-sided polygon is everywhere in nature, but some of the aspects of this shape are still mysterious. Paying more attention to the details present all around us, however, could help us uncover more information about how hexagons operate in the world.

Saturn: If one were to see the North Pole of Saturn from space, they could see a hexagonal cloud formation over the planet. Even scientists today can't answer why this cloud resembles a hexagon. Although there are some theories about it, none have been verified. Want to know another piece of interesting information? Each side of Saturn's Hexagon measures more than earth's diameter!

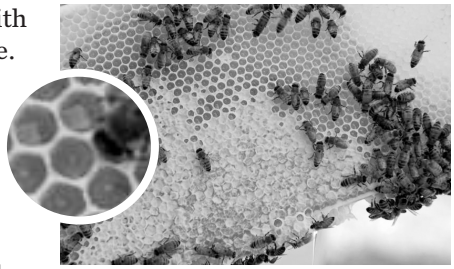
Bees: The number of packed hexagons inside of a beehive is truly a marvel. For centuries, scientists were confused on why bees chose a hexagon, as opposed to a square or circle. The answer comes in the form of packing efficiency. If a series of circles are packed on top of each other, there are empty spaces in between them. The best way for these empty spaces can be avoided is by changing the shape to a hexagon.

Dragonfly Eyes: If you look closely at a dragonfly, its eyes are compound: a collection of tiny eyes, each of which functions as an individual visual receptor. To make up the complete set, over 30,000 hexagonal eyes are packed together. The result is a vision that scientists call ultra-multicolor, which is the most advanced type found in nature so far. In comparison, human vision is tri-color. We have three types of light-sensitive protein in our eyes, called opsins. A dragonfly has 30 different kinds of opsins in its eyes. Therefore, the color differentiation abilities of a dragonfly are far superior to ours. This is possible because of the high packing efficiency of the hexagonal shape.

The Giant's Causeway: This tourist spot in Ireland is named after a popular myth in which a giant called Fionn built these columns as a ring to fight a Scottish giant named Benandonner. But science has a different story to tell. The rock formation is actually a result of the rapid cooling of lava. When molten lava cools, it contracts. This contraction leads to crack formation, and the hexagonal structure is the result of crack formation under maximum energy release.

Turtle Shells: These slow-moving animals are protected with a hard shell that is made of one of the toughest compounds found in nature. But have you ever observed the pattern on the shell?

If you look closely, you can see that the entire shell is formed from individual hexagonal subunits. The hexagon is one of most efficient geometrical shapes that can cover curved surfaces with minimal material wastage. After the inner hexagonal layers are formed, the shell is completed with filler shapes that constitute differently sized polygons.



Bubbles: A bubble raft is nothing but an array of bubbles packed close together, often seen as the foam on the surface of soapy water. But, on second glance, each bubble has the shape of a hexagon, with some irregularities. When accommodating this many bubbles, the surface tension of each bubble will try to co-exist with the adherent bubble by spending the least amount of energy. This leads to an array of hexagonal structures.

Snowflakes: Snowflakes are tiny droplets of water that are frozen in midair. They come in different shapes and sizes, but the most predominant shape is the hexagon. This is because of the orientation of water molecules themselves. Water is composed of two hydrogen molecules and one oxygen molecule, which change orientation with temperature. When water undergoes a phase change to ice, two water molecules come together to form a hexagon. The overall shape of the snowflake is a hexagon, and the internal structure of the water molecules also resembles a hexagon.

The Human Body: You may not notice the hexagon in yourself, but there are actually billions of them in our body in the form of carbon. Everything begins with carbon. This element is even present in our DNA. If you were to study the atomic structure of organic material like the human skin, you would find a series of carbon hexagon chains nicely packed together. ●

The Giant's Causeway in Ireland (top) — the hexigonal rocks were formed from the rapid cooling of lava. A beehive made up of hexigons which scientists discovered was for packing efficiency (below).

Images from Wikimedia Commons, Don Hankins on Flickr

This article has been edited for space.

MATHEMATICS

Sudoku

#5 PUZZLE NO. 4056914

	2		7	1				
		5				1	3	2
		6			2			
			5			8		4
3								7
9							6	
			4			5	1	
							9	8
7			8		9			

©Sudoku.cool

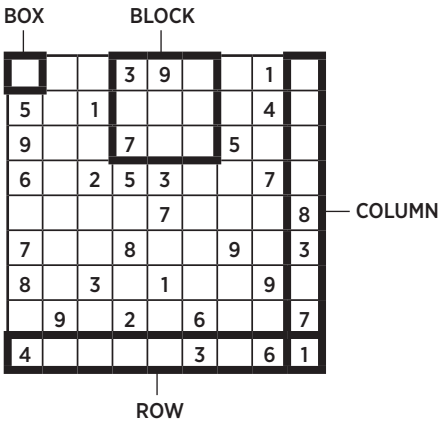
#6 PUZZLE NO. 4057016

		8		7				
	3					4		1
4			9					3
		9		8	5		7	
				4				
8					6			
7			8				4	
1		4					5	
	6			1				2

©Sudoku.cool

SUDOKU HOW-TO GUIDE

1. Each block, row, and column must contain the numbers 1–9.
2. Sudoku is a game of logic and reasoning, so you should not need to guess.
3. Don't repeat numbers within each block, row, or column.
4. Use the process of elimination to figure out the correct placement of numbers in each box.
5. The answers appear on the last page of this newsletter.



What the example will look like solved

2	4	8	3	9	5	7	1	6
5	7	1	6	2	8	3	4	9
9	3	6	7	4	1	5	8	2
6	8	2	5	3	9	1	7	4
3	5	9	1	7	4	6	2	8
7	1	4	8	6	2	9	5	3
8	6	3	4	1	7	2	9	5
1	9	5	2	8	6	4	3	7
4	2	7	9	5	3	8	6	1

"Mathematics is the cheapest science. Unlike physics or chemistry, it does not require any expensive equipment. All one needs for mathematics is a pencil and paper."

GEORGE PÓLYA // mathematician

DID YOU KNOW?

The oldest-known living land animal is a **tortoise named Jonathan**, who is 187 years old. He was born in 1832 and has lived on the island of St. Helena in the Atlantic Ocean since 1882.

Wombats are the only animal whose **poop is cube-shaped**. This is due to how its intestines form the feces. The animals then stack the cubes to mark their territory.

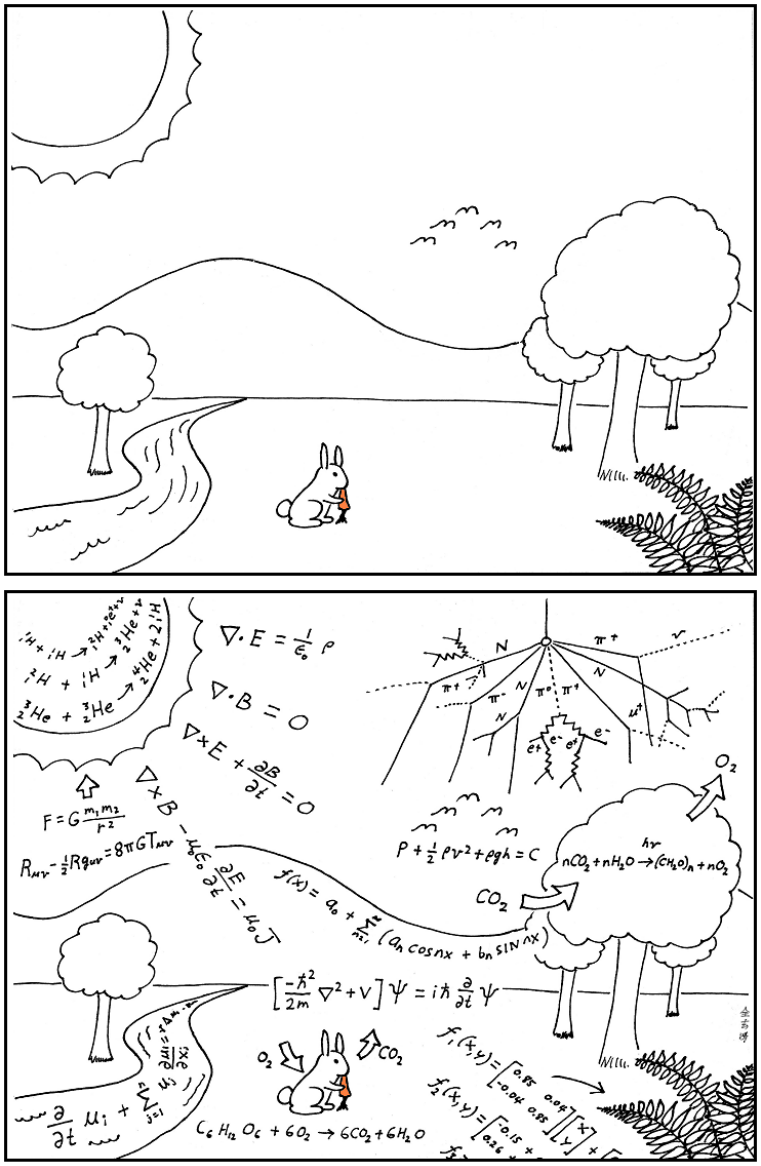
Tigers' **skin is actually striped**, just like their fur. Also, no two fur patterns are alike.

The earth's circumference is **24,900 miles**.

In a room of just 23 people there's a 50% chance that two people have the **same birthday**. With 75 people in the room, there's a 99% chance!

Prime numbers help Cicadas survive! Cicadas incubate underground for long periods of time before coming out to mate. Sometimes they spend **13 years underground**, sometimes 17. Why? Both those intervals are prime numbers and biologists now believe cicadas adopted those life-cycles to minimize their contact with predators with more round numbered life-cycles.

Source: "101 Fun Facts You Never Knew, Guaranteed to Totally Blow Your Mind" by Parade, *Parade Magazine*, 16 Dec. 2019. "Understanding the Birthday Paradox" BetterExplained.com, 26 Apr. 2007. "Interesting and Amazing Math Facts" The Calculator Site, 21 Oct. 2019.



This is how scientists see the world.

Idiom

"Spill the beans"

Meaning To leak a secret

Origin This one's a bit tricky, as there is no clear-cut answer. The consensus is, however, that this is most likely derived from an ancient Greek voting process, which involved beans. People would vote by placing one of two colored beans in a vase, white typically meaning yes and black or brown meaning no. This meant that should someone spill the beans, the secret results of the election would be revealed before intended. Hence, spilling the beans is related to revealing secret information.

Source: "7 Everyday English Idioms and Where They Come From" by Kate Lohnes. Britannica.

THE HEART OF THE BLUE WHALE, THE LARGEST ANIMAL ON EARTH, IS FIVE FEET LONG AND WEIGHS **400 POUNDS**. THE WHALE IN TOTAL WEIGHS 40,000 POUNDS.

FOR COMPARISON, AN ELEPHANT'S HEART WEIGHS AROUND **30 POUNDS**. AND A HUMAN HEART? A MERE 10 OUNCES.

OCTOPUSES HAVE **THREE HEARTS**.

Source: "101 Fun Facts You Never Knew, Guaranteed to Totally Blow Your Mind" by Parade, *Parade Magazine*, 16 Dec. 2019.

ART + CULTURE

The Fish

BY ELIZABETH BISHOP

I caught a tremendous fish
and held him beside the boat
half out of water, with my hook
fast in a corner of his mouth.
He didn't fight.
He hadn't fought at all.
He hung a grunting weight,
battered and venerable
and homely. Here and there
his brown skin hung in strips
like ancient wallpaper,
and its pattern of darker brown
was like wallpaper:
shapes like full-blown roses
stained and lost through age.
He was speckled with barnacles,
fine rosettes of lime,
and infested
with tiny white sea-lice,
and underneath two or three
rags of green weed hung down.
While his gills were breathing in
the terrible oxygen
—the frightening gills,
fresh and crisp with blood,
that can cut so badly—
I thought of the coarse white flesh
packed in like feathers,
the big bones and the little bones,
the dramatic reds and blacks
of his shiny entrails,
and the pink swim-bladder
like a big peony.
I looked into his eyes
which were far larger than mine
but shallower, and yellowed,
the irises backed and packed
with tarnished tinfoil
seen through the lenses
of old scratched isinglass.
They shifted a little, but not
to return my stare.
—It was more like the tipping
of an object toward the light.
I admired his sullen face,
the mechanism of his jaw,
and then I saw
that from his lower lip
—if you could call it a lip—
grim, wet, and weaponlike,
hung five old pieces of fish-line,
or four and a wire leader
with the swivel still attached,
with all their five big hooks
grown firmly in his mouth.
A green line, frayed at the end
where he broke it, two heavier lines,
and a fine black thread
still crimped from the strain and snap
when it broke and he got away.
Like medals with their ribbons
frayed and wavering,
a five-haired beard of wisdom
trailing from his aching jaw.
I stared and stared
and victory filled up
the little rented boat,
from the pool of bilge
where oil had spread a rainbow
around the rusted engine
to the bailer rusted orange,
the sun-cracked thwarts,
the oarlocks on their strings,
the gunnels—until everything
was rainbow, rainbow, rainbow!
And I let the fish go.

WRITING PROMPT
Think about a time when the simple beauty of a thing took you over. It could have been an animal, like Bishop's fish, or perhaps some other thing in the natural world: a cloud, an old tree, a river on a cool summer day. Maybe a particular song or even just a person's voice. Write about that moment, when beauty and your respect for it made you stop whatever you were doing to appreciate it.

Word Search

O	E	O	O	P	A	E	R	A	I	N	B	O	W
U	L	C	A	L	M	D	L	G	N	O	I	B	S
L	S	O	E	R	E	I	C	V	I	V	A	V	W
O	N	U	S	E	L	C	W	L	A	I	S	U	I
M	Y	M	L	G	W	O	B	S	L	N	L	W	V
O	R	D	A	L	P	L	C	E	N	C	L	V	E
X	O	E	D	T	E	V	R	K	R	A	I	P	L
Y	T	L	E	C	A	N	D	N	S	E	G	L	G
G	C	K	M	L	A	B	O	A	T	E	L	L	A
E	I	C	I	D	H	I	I	L	J	A	W	H	H
N	V	E	T	C	I	A	E	E	N	G	I	N	E
K	D	P	R	T	A	R	N	I	S	H	E	D	L
O	P	S	A	N	C	I	E	N	T	K	O	O	H
P	E	O	N	Y	S	E	L	C	A	N	R	A	B

OARLOCKS
SULLEN
BOAT
TARNISHED
ENGINE
VICTORY
OIL
BAILER
BARNACLES
ANCIENT
RAINBOW
SPECKLED
PEONY
HOOK
JAW
SWIVEL
GILLS
SWIM
OXYGEN
MEDALS

 The technical brilliance and formal variety of Elizabeth Bishop's (1911-1979) work — rife with precise and true-to-life images — helped establish her as a major force in contemporary literature.

THE ENVIRONMENT

Math Predicts Oil Spill's Path Through Ocean

Mathematical methods help predict movement of oil and ash after environmental disasters, and could aid clean-up efforts.

BY GULF RESEARCH INITIATIVE | March 15, 2012

When oil started gushing into the Gulf of Mexico in late April 2010, friends asked George Haller whether he was tracking its movement. That's because the McGill University engineering professor has been working for years on ways to better understand patterns in the seemingly chaotic motion of oceans and air.

Meanwhile, colleagues of Josefina Olascoaga at the University of Miami were asking the geophysicist a similar question. Fortunately, she was.

For those involved in managing the fallout from environmental disasters like the Deepwater Horizon oil spill, it is essential to have tools that predict how the oil will move, so that they make the best possible use of resources to control the spill.

Thanks to work done by Haller and Olascoaga, such tools now appear to be within reach. Olascoaga's computational techniques and Haller's theory for predicting the movement of oil in water are equally applicable to the spread of ash in the air, following a volcanic explosion. They report their findings in the journal *Proceedings of the National Academy of Sciences*.

"In complex systems such as oceans and the atmosphere, there are a lot of features that we can't understand offhand," Haller explains. "People used to attribute these to randomness or chaos. But it turns out, when you look at data sets, you can find hidden patterns in the way that the air and water move."

Over the past decade, the team has developed mathematical methods to describe these hidden structures that are now broadly called Lagrangian Coherent Structures (LCSs), after the French mathematician Joseph-Louis Lagrange.

"Everyone knows about the Gulf Stream, and about the winds that blow from the West to the East in Canada," says Haller, "but within these larger movements of air or water, there are intriguing local patterns that guide individual particle motion."

Olascoaga adds, "Though invisible, if you can imagine standing in a lake or ocean with one foot in warm water and the other in the colder water right beside it, then you have experienced an LCS running somewhere between your feet."

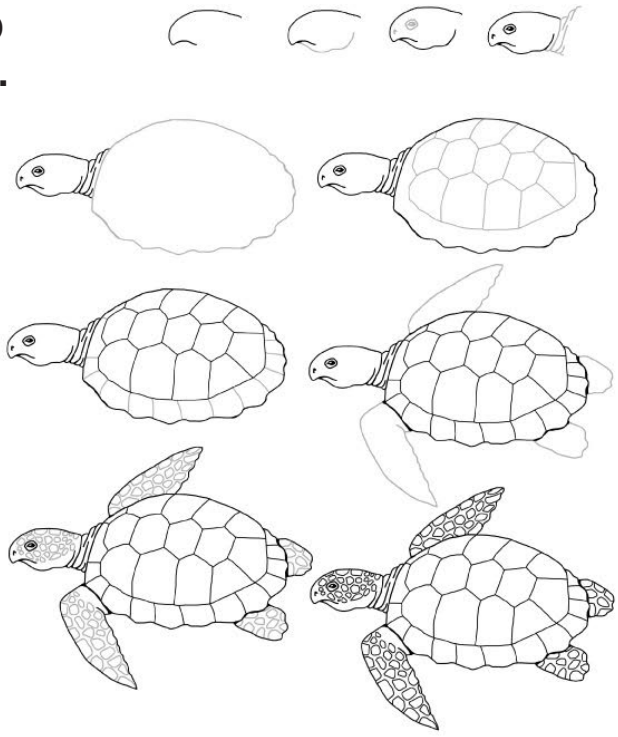
"Ocean flow is like a busy city with a network of roads," Haller says, "except that roads in the ocean are invisible, in motion, and transient." The method Haller and Olascoaga have developed allows them to detect the cores of LCSs.

In the complex network of ocean flows, these are the equivalent of "traffic intersections" and they are crucial to understanding how the oil in a spill will move. These intersections unite incoming flow from opposite directions and eject the resulting mass of water.

When such an LCS core emerges and builds momentum inside the spill, we know that oil is bound to seep out within the next four to six days. This means that the researchers are now able to forecast dramatic changes in pollution patterns that have previously been considered unpredictable.

So, although Haller wasn't tracking the spread of oil during the Deepwater Horizon disaster, he and Olascoaga were able to join forces to develop a method that does not simply track: it actually forecasts major changes in the way that oil spills will move. The two researchers are confident that this new mathematical method will help those engaged in trying to control pollution make well-informed decisions about what to do. ●

HOW TO DRAW ...



HEALTH & WELL BEING

The Myth of "I'm Bad at Math"

BY MILES KIMBALL AND NOAH SMITH | *The Atlantic*, October 28, 2013

"I'm just not a math person." We hear it all the time. And we've had enough. We believe that the idea of "math people" is the most self-destructive idea in America today. The truth is, you probably are a math person, and by thinking otherwise, you are possibly hamstringing your own career. Worse, you may be helping to perpetuate the pernicious myth of innate math ability, which is harming underprivileged children.

Sure, math ability is genetic to some degree. Terence Tao, UCLA's virtuoso mathematician, publishes dozens of annual papers and helps international researchers with their theories. Essentially, none of us could ever be as good at math as Terence Tao, no matter how hard we tried. But here's the thing: We don't have to! For high-school math, inborn talent is much less important than hard work, preparation, and self-confidence.

Again and again, in our experiences as math professors, we have seen the following pattern repeat itself:

1. **Different kids with different levels of preparation** come into a math class. Some of these kids have parents who have drilled them on math from a young age, while others never had that kind of parental input.
2. **On the first few tests, the well-prepared kids** get perfect scores, while the unprepared kids get only what they could figure out by winging it—maybe a solid B.
3. **The unprepared kids**, not realizing that the top scorers were well-prepared, assume that genetic ability was what determined the performance differences. Deciding that they "just aren't math people," they don't try hard in future classes, and fall further behind.
4. **The well-prepared kids**, not realizing that the B students were simply unprepared, assume that they are "math people," and work hard in the future, cementing their advantage.

Thus, people's belief that math ability can't change becomes a self-fulfilling prophecy.

The idea that math ability is mostly genetic is one dark facet of a larger fallacy that intelligence is mostly genetic. Psychology journals describe this as a self-fulfilling prophecy. For example, psychologist Patricia Linehan writes:

"A body of research on conceptions of ability has shown two orientations toward ability. Students with an Incremental orientation believe ability (intelligence) to be malleable, a quality that increases with effort. Students with an Entity orientation believe ability to be nonmalleable, a fixed quality of self that does not increase with effort."

The "entity orientation" that says "You are smart or not, end of story," leads to bad outcomes and may be responsible for much of the gender gap in mathematics.

Psychologist Carol Dweck presented these alternatives to determine people's beliefs about intelligence:

1. **You have a certain amount of intelligence**, and you really can't do much to change it.
2. **You can always greatly change** how intelligent you are.

They found that students who agreed with the second belief got higher grades.

Then Dweck explained to a group of poor minority high school students that intelligence is highly mallea-

RANDOM-NEST

Breathing Exercises for Relaxation

FROM UNIVERSITY OF MICHIGAN MEDICINE

Belly breathing

1. Sit or lie flat in a comfortable position.
2. Put one hand on your belly just below your ribs and the other hand on your chest.
3. Take a deep breath in through your nose, and let your belly push your hand out. Your chest should not move.
4. Breathe out through pursed lips as if you were whistling. Feel the hand on your belly go in, and use it to push all the air out.
5. Do this breathing 3 to 10 times. Take your time with each breath.
6. Notice how you feel at the end of the exercise.

4-7-8 breathing

1. To start, put one hand on your belly and the other on your chest as in the belly breathing exercise.
2. Take a deep, slow breath from your belly, and silently count to 4 as you breathe in.
3. Hold your breath, and silently count from 1 to 7.
4. Breathe out completely as you silently count from 1 to 8. Try to get all the air out of your lungs by the time you count to 8.
5. Repeat 3 to 7 times or until you feel calm.
6. Notice how you feel at the end of the exercise.

ble and can be developed by hard work and that learning changes the brain by forming new connections.

The results? Convincing students that they could make themselves smarter by hard work led them to work harder and get higher grades. The intervention had the biggest effect for students who started out believing intelligence was genetic.

But improving grades was not the most dramatic effect: Dweck also reported that some of the tough high school boys cried at the realization that they can control their own intelligence. It is no picnic going through life believing you were born dumb and are doomed to stay that way.

For almost everyone, believing that you were born dumb and are doomed to stay that way is believing a lie. IQ itself can improve with hard work.

So why focus on math? For one thing, math skills are increasingly important for getting good jobs these days—so believing you can't learn math is especially self-destructive. But math is an area where America's "fallacy of inborn ability" is the most entrenched. Math is the great mental bogeyman of an unconfident America. If we can convince you that anyone can learn math, it should be a short step to convincing you that you can learn just about anything, if you work hard enough.

We suspect America is more susceptible to the dangerous myth of genetic mathematical ability than other nations. While American fourth and eighth graders score quite well in international math comparisons, our high-schoolers underperform by a wide margin. This suggests that Americans' native ability is just as good as anyone's, but that we fail to capitalize on that ability through hard work. In response to the lackluster high school math performance, some influential voices in American education policy have suggested simply teaching less math or that algebra should no longer be required. The subtext here is that most American kids are simply not born with the ability to solve for x.

We believe that this approach is disastrous and wrong. First of all, it leaves many Americans ill-prepared to compete in a global marketplace. But even more importantly, it may contribute to inequality. A great deal of research has shown that technical skills are increasingly making the difference between America's upper middle class and its working class. While we don't think education is a cure-all for inequality, we definitely believe that in an increasingly automated workplace, Americans who give up on math are selling themselves short.

Too many Americans go through life terrified of equations and mathematical symbols. We think what many of them are afraid of is "proving" themselves to be genetically inferior by failing to instantly comprehend the equations (when, in reality, even a math professor would have to read closely). So they recoil, protesting: "I'm not a math person." And thus exclude themselves from quite a few lucrative career opportunities.

One way to help Americans excel at math is to look at East Asia. In his book Intelligence and How to Get It, Richard Nisbett describes how the educational systems of these countries focus more on hard work than on inborn talent:

1. **"Children in Japan go to school about 240 days** a year, whereas children in the United States have about 180 school days a year."
2. **"Japanese high school students** of the 1980s studied 3.5 hours a day, and that number is probably higher today."
3. **"When they do badly at something**, Koreans respond by working harder at it."
4. **"Persistence in the face of failure** is very much part of the Asian tradition of self-improvement. And East Asians are accustomed to criticism in the service of self-improvement in situations where Westerners avoid it or resent it."

It seems to us that an emphasis on hard work is a hallmark not just of modern East Asia, but also of America's past as well. In returning to an emphasis on effort, America would be returning to its roots, not just copying from successful foreigners.

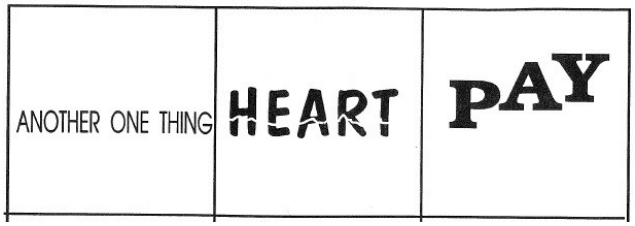
Besides cribbing a few tricks from the Japanese, we also have at least one American-style idea for making kids smarter: treat people who work hard at learning as heroes and role models. We already venerate sports heroes who make up for lack of talent through persistence and grit; why should our educational culture be any different?

Math education, we believe, is just the most glaring area of a slow and worrying shift. We see our country moving away from a culture of hard work toward a culture of belief in genetic determinism. In the debate between "nature vs. nurture," a critical third element—personal perseverance and effort—seems to have been sidelined. We want to bring it back, and we think math is the best place to start. ●

This article has been edited for space.

WORD PLAY

A Rebus puzzle is a picture representation of a common word or phrase. How the letters/images appear within each box will give you clues to the answer! For example, if you saw the letters "LOOK ULEAP," you could guess that the phrase is "Look before you leap."



Answers are on the last page!

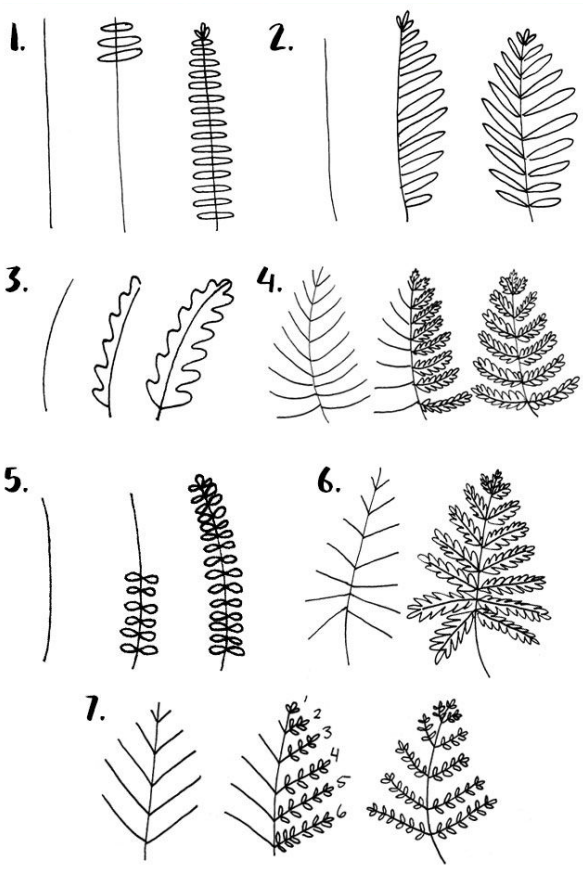
Words of Encouragement

"I know of no pleasure deeper than that which comes from contemplating the natural world and trying to understand it." — David Attenborough

If you stop to ponder any plant you see. If you truly look at it. The small details become apparent. Some plants are hairy, others are smooth. Some leaves are dark green, others are lighter. Some are seasonal herbs, while some are tall, woody long-lived species. Leaf shapes vary. Flower forms are diverse.

The weeds in a lawn; shrubs and bushes...trees in the distance, each began life as a small seed. They all have identifiable characteristics that make them what they are. Just as people are different from one another, so are the grasses. So are the shaded plants at the edge of a building. The lichens encrusting a church steeple. And they are all growing gloriously, there for us to observe. As Spring abounds, take time to look around you. Beauty surrounds you, hidden in mundane; the things you see every day. Even in that dandelion, growing just for you.

Wayne



HOW TO DRAW 7 DIFFERENT PLANTS

Answers

SUDOKU #5

4	2	3	7	1	5	6	8	9
8	7	5	9	4	6	1	3	2
1	9	6	3	8	2	4	7	5
6	1	7	5	9	3	8	2	4
3	4	2	1	6	8	9	5	7
9	5	8	2	7	4	3	6	1
2	8	9	4	3	7	5	1	6
5	3	4	6	2	1	7	9	8
7	6	1	8	5	9	2	4	3

SUDOKU #6

2	1	8	3	7	4	9	6	5
9	3	7	5	6	8	4	2	1
4	5	6	9	2	1	7	8	3
3	2	9	1	8	5	6	7	4
6	7	1	2	4	9	5	3	8
8	4	5	7	3	6	2	1	9
7	9	2	8	5	3	1	4	6
1	8	4	6	9	2	3	5	7
5	6	3	4	1	7	8	9	2

Brainteasers

Page 9 Rebus Puzzle:
1. One thing after another
2. Broken heart
3. Pay raise

Send ideas and comments to:

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