S.T.E.M.

MAGAZINE

STEMFest ABSTRACTS Due

10 Reasons Not To *YELL*

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Wayne Carley

February 2015

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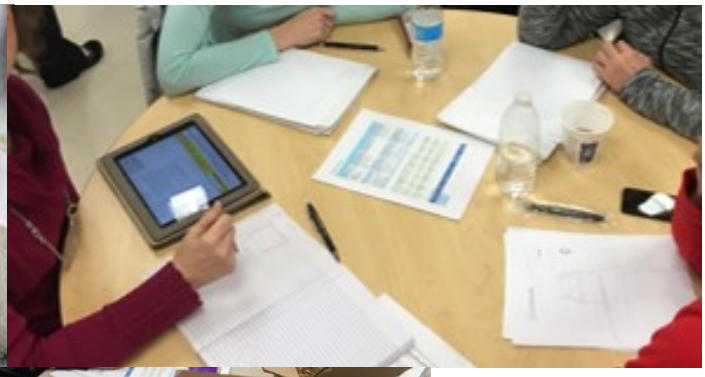
STEM Innovations

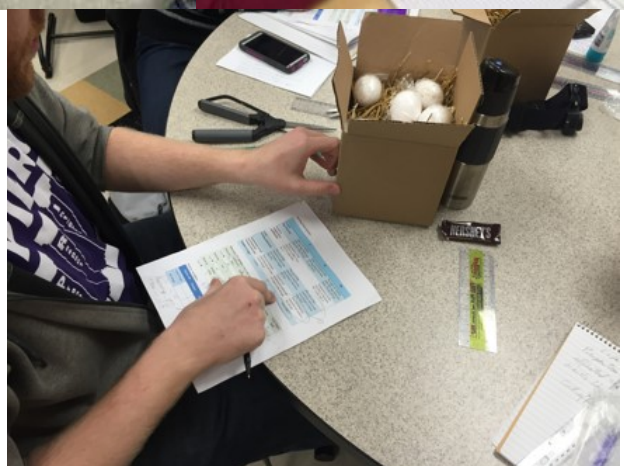
A Math and Science Partnership Initiative in Northwest Indiana

Dear Educators,

The second half of the school year is well under way and so is year 2 of the MSP grant STEM Innovations program! Hopefully by now you have taught the lessons you created during the summer institute and have administered your student surveys. If not, please contact Dr. Sorge at bsorge@iupui.edu to request your surveys and to let him know if you are able to participate in a classroom observation-an optional but critical part of the grant.

Check out our teachers in action working on the *Saving Pelicans* engineering activity during the December 4th professional development session. This lesson plan is available for our science teacher members in NSTA-search for it and save it to your NSTA library!





Please mark your calendars for the final professional development session:

- March 19, 2015.

SAVE THE DATES! STEM Innovations 2015 Summer Institute is August 3-7, 2015. Watch your email for registration and location information.

Have a Great February!
Your STEM Innovations Team

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Article submissions welcome from you and your students■

Topic for April: Why is STEM important to me?

- 1000 words
- Word.doc format, to wayne@stemmagazine.com
- Your first name and school (parental permission)
- Deadline: March 15, 2015

This Month

dr. judy *Willis*

dr. richard *Larson*, MIT

Michael *Linsin*

wayne *Carley*

Abstracts

S.T.E.M. Magazine Inc. is a non-profit monthly education publication for teachers, students, their parents and administrators. CEO Wayne Carley is the publisher and senior editor for all content in S.T.E.M. Magazine.

S.T.E.M. Magazine believes that the key to success in seeing higher graduation rates, improved testing results, student inspiration and a strong work-force rests in the hands of the teacher. The example and inspiration of individual educators carries tremendous weight on a daily basis, greatly impacting the quality and effectiveness of the classroom environment.

Our mission: Encourage curiosity and inspiration, the foundation of every career passion.

Wayne Carley
Publisher

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STEMfest 2015 includes:

1)International Conference on Science, Technology, Engineering and Mathematics Education and Innovation (STEMcon) (Skilling a Nation's Future)

2) 3rd World Conference on Safety in Science, Industry and Education (Safety First)(Hosted in Partnership with the Laboratory Safety Institute)

3) 9th Global Conference on Power Control and Optimization (Creating a Lean Culture)

4) LSI Two Day Safety Training Course

5) International Conference on Transnational Collaboration – International Trade, Bids and Tenders in STEM

6) STEMfest Science Fair and Education Expo 7) Women in Science Networking Seminar

8) Launch of STEM Ambassador Program 9) Ride2Learn Community Bike Ride

10) GameJam and AppDay

11) 14th International Conference on Clean Energy 2015 (Hosted in partnership with the International Association for Hydrogen Energy)

12) International Meetings Industry Forum on Science, Technology and Engineering Conferences 2015

13) 2nd International Conference on Hybrid Energy and Technologies 2015 (Hosted in partnership with the Asia Pacific Society for Solar and Hybrid Technologies)

14) 2nd President's and Vice Chancellor's Forum

15) Association Executives in STEM Forum

16) 8th International Conference on Crop Science

Visit www.stemstates.org for more information

10 Reasons Why You Should Never, Ever Yell At Students

By Michael Linsin

Without spot-on classroom management, dealing with unruly students can be maddening. It's easy to lose your cool. When you do, when you yell, scold, and wag your finger, you're often rewarded with immediate improvement.

A thorough dressing-down can stop misbehavior in its tracks. But the price is exorbitantly high. **Yelling is a costly mistake.**

Here's why:

1. Improvement is temporary.

Yelling only works in the moment. Like a playground bully, it's used to intimidate students into compliance. The only reason why it works is because the teacher has an unfair size and/or authority advantage.

2. It doesn't change behavior.

Behavior only changes when students want to behave better–which is the result of strict accountability combined with a teacher they like and trust. In the end, yelling causes more misbehavior, not less.

3. It weakens your influence.

Yelling will cause students to secretly dislike you, distrust you, and desire to disrupt your class. Let's face it. Even one revengeful student can make your life miserable. You need your students on your side.

4. It replaces real accountability.

Teachers who yell tend to do so instead of following their classroom management plan. Students learn quickly that if they can endure their teacher's outburst, they can be on their way without being held accountable.

5. It sabotages real accountability.

Teachers who lecture, yell, or scold while escorting students to time-out, drive a wedge through the

teacher/student relationship, causing anger and resentment. So instead of sitting in time-out and reflecting on their mistake, your students will be seething at you.

6. It causes students to tune you out.

When you yell, you train your students to listen to you only when you raise your voice. In other words, they learn that unless you're shouting, you must not really mean it. Before you know it, you'll be giving directions like a carnival sideshow barker.

7. It's stressful.

Yelling is a sure sign that you let misbehavior get under your skin. It's an expression of frustration, of taking behavior personally, and of trying to get even with students. It's also terribly stressful. It's bad for your health. And it makes teaching a cheerless slog.

8. It's difficult to defend.

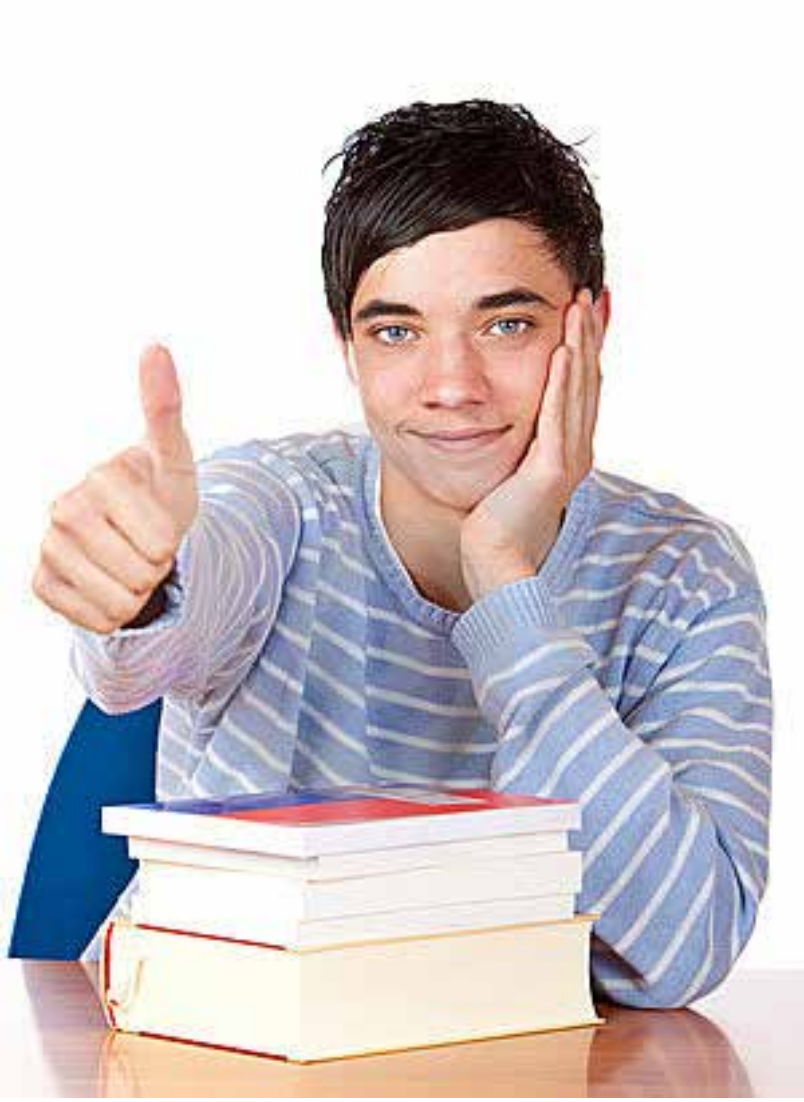
Yelling at students is near the top of the list of parent complaints. And it's difficult to defend. "I'm sorry, I just lost my cool" is about the best you can do. The fact is, no misbehavior, and no level of disrespect, warrants yelling at students.

9. It's graceless.

Have you ever seen yourself on video losing your cool? Probably not, but one thing is for sure: it ain't pretty. You might as well grab a megaphone and shout, "Hey everybody–students, fellow teachers, administration–I don't have control of myself or my class!"

10. It provides a poor model.

Students are more influenced by what you do than by what you say. When you yell, react emotionally to misbehavior, or otherwise lose your composure, you provide a poor model for your students for how to behave when things don't go their way.



Instead Of Yelling…
No matter how frustrated you may get with your students or yourself, yelling should **never** be an option.

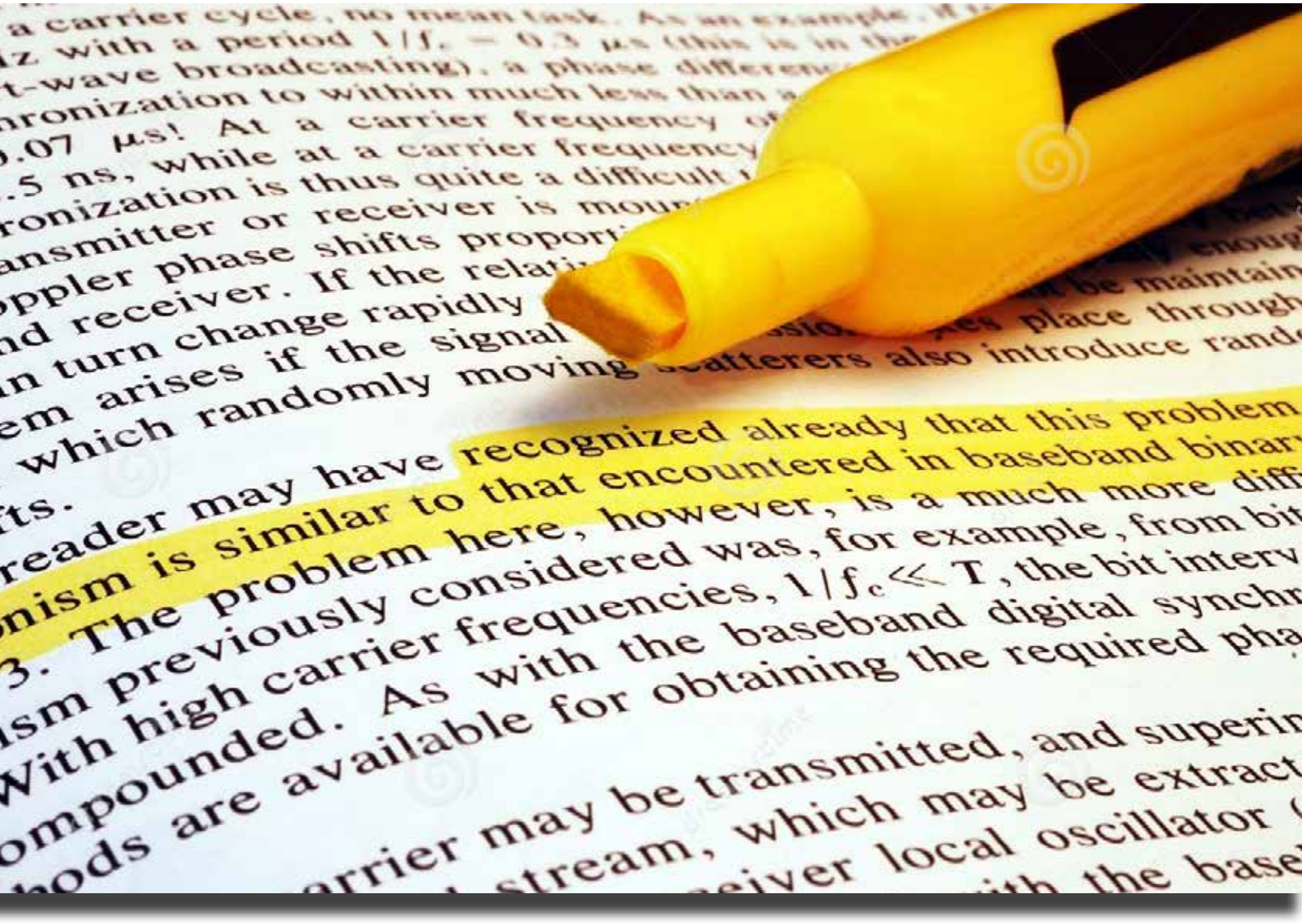
Although it often works in the moment, the cost of gaining momentary control is much too high.

So instead of being ***that*** teacher, the one with the reputation for yelling and for "being mean," why not be the one that every student wants as their teacher?

To start, create a classroom management plan that works–and stick with it. And then work on building influential relationships with students; the kind of personal leverage that causes them to want to behave.

Highlighting for Understanding of

Judy Willis, M.D, M.Ed.



"....participants discovered that they understood more .....each time they read it."

Complex Text

Most teachers enjoy challenging their students and extending students' critical thinking skills. Few joys compare with seeing a student grasp the big picture, connect and relate previous learning to something new, and discover the satisfaction of an "Ah-ha" moment.

However, with larger classes and more material to cover in less time, it's not always possible to engage in Socratic methods with empirical or inductive dialogue to bring students up to their potential as high level thinkers.

But brain-based research and **colored** marker pens can help teachers provide the necessary scaffolding and guide their students with to develop their powers of interpretation, analysis, and abstraction.

Many students are limited in their prior experience in higher cognitive analysis of complex written text. They have either been taught to the standardized test or are products of the digital-audio-visual era with its emphasis on immediate gratification without encouraging critical feedback. Sheridan Blau teaches in the departments of English and education at the University of California, Santa Barbara, where he also directs the South Coast Writing Project.

He believes that, "Over-instruction or giving predigested interpretations to students results in a limited conception of what competent readers go through to produce meanings from what they read.

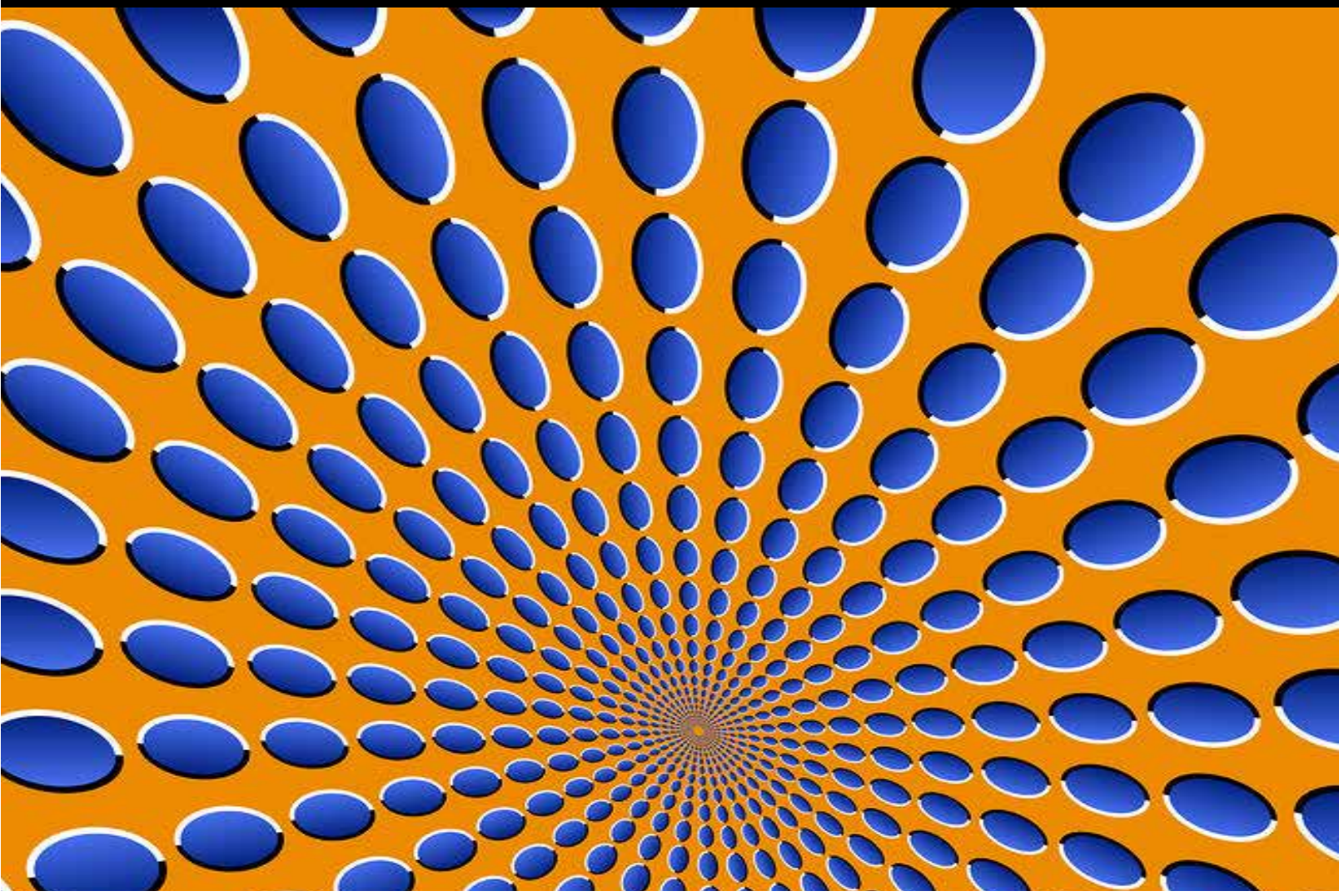
Most student readers function largely as welfare recipients in the economy of literary and other academic interpretation and instruction. We want to give students the experience of successfully interpreting difficult text, and liberate students from interpretive welfare.

The goal is to build in students a greater tolerance for difficulty or failure. Confusion represents a high state of understanding. The act of interpretation doesn't occur in reading unless you feel something is wrong – something makes you uncomfortable. From there you seek and reach a new perspective and the richest parts of the understanding and connection with the material."

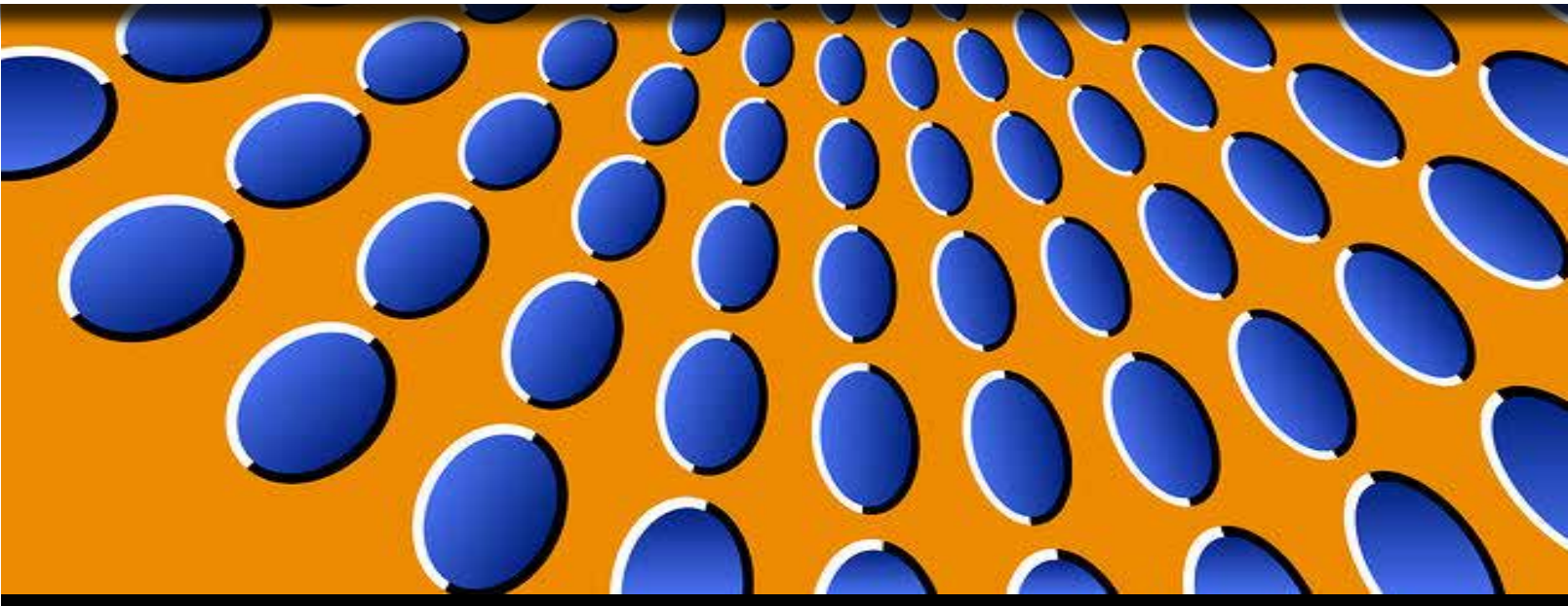
As part of the South Coast Writing Project, Blau demonstrated a teaching technique to the fellows in the writing project that I have subsequently applied to help students connect with and critically interpret not only literature, but also information in philosophy, psychology, and history texts. Blau's comprehension of text strategy reflect the way competent readers move haltingly and recursively toward the satisfactory interpretation of difficult text without "interpretive welfare."

To demonstrate the strategy, Blau gave the member of the workshop copies of a challenging, obscure poem that not a single member claimed to fully interpret after a single reading.

He next directed participants to use **three different transparent colored markers**, read the poem three more times, and each time underline any text we didn't understand. In his instructions, he noted that strong readers pay more attention to what they don't know because they think that what they notice, but don't quite understand, is worth pondering.



Great STEM Careers are not an illusion.



Not surprisingly, the participants discovered that they understood **more** of the poem each time they read it. The process of underlining focused attention on the phrases they would have skipped as "too hard." They persevered because they were obliged in color to return to these lines.

They found themselves enjoying the *"feel"* of the markers, the positive reinforcement of each insight, and the discovery that solving one piece of the puzzle helped them when they returned to earlier points of confusion.

The exercise went beyond simple reading and rereading, because there was the active, visually enhanced process of increased time spent with the complex lines by virtue of slowing down to highlight them.

In addition, looking at the decreasing amount of text underlined with each color was encouraging and built confidence. That experience provided a set of self-management skills , concentration, persistence and courage— in the face of intellectual difficulties. By extrapolation I have used the colored pen technique to light the way for students to reach higher levels of thinking, abstraction, and conceptualization regarding the material they read in other subjects where interpretation is important.

As one would expect, the scaffolding afforded by the colored markers eventually becomes unnecessary, because as students become adept at the process, they are simultaneously developing their higher levels of thinking, abstraction, and conceptualization. They discover that they can achieve the same degree of understanding by focused re-reading.

The end result is that they learn the material they need, but not because it is processed through superficial rote memory from notes or lectures that predigest the material, but rather through their own relational and conceptual thinking utilizing their higher-level executive function skills.

What's Happening in the Brain That Mo

Perhaps what may sound like a "gimmick" this may garner the appropriate respect and attention from skeptical readers when they understand the science behind how this technique is promoting learning. Behind the colored markers, the technique works like this:

Executive functions, centered in the orbito-frontal portion of the frontal lobes, include higher reasoning, abstraction, synthesizing, critical analysis, comparison/contrast, and judgment. As brain research has found, this processing results in the learned material becoming part of long-term memory available for retrieval and subsequent critical thinking connections far beyond the classroom.

The brain is divided into lobes, each with many functions, each interconnecting to the other lobes through nerve pathways or circuits.

Areas in the frontal and temporal lobes are integral in executive attention – alerting the rest of the brain to pay attention or respond to stimuli. In learning, the stimuli are the bits of sensory information students see (through their eyes or by internal visualization after reading text), hear, feel, smell, touch, or experience through movement.

There are even more specialized brain regions that have been revealed through neuro-imaging and brain mapping while subjects are in the process of moving information from sensory data to these centers of executive function.

When new information is actively learned and stored, the first areas activated (lit up by increased metabolism seen on PET or fMRI scans) are the somatosensory cortex areas, one in each brain lobe, where input from each individual sense (hearing, touch, taste, vision, smell) is received and then classified or identified by matching it with previously stored similar data.

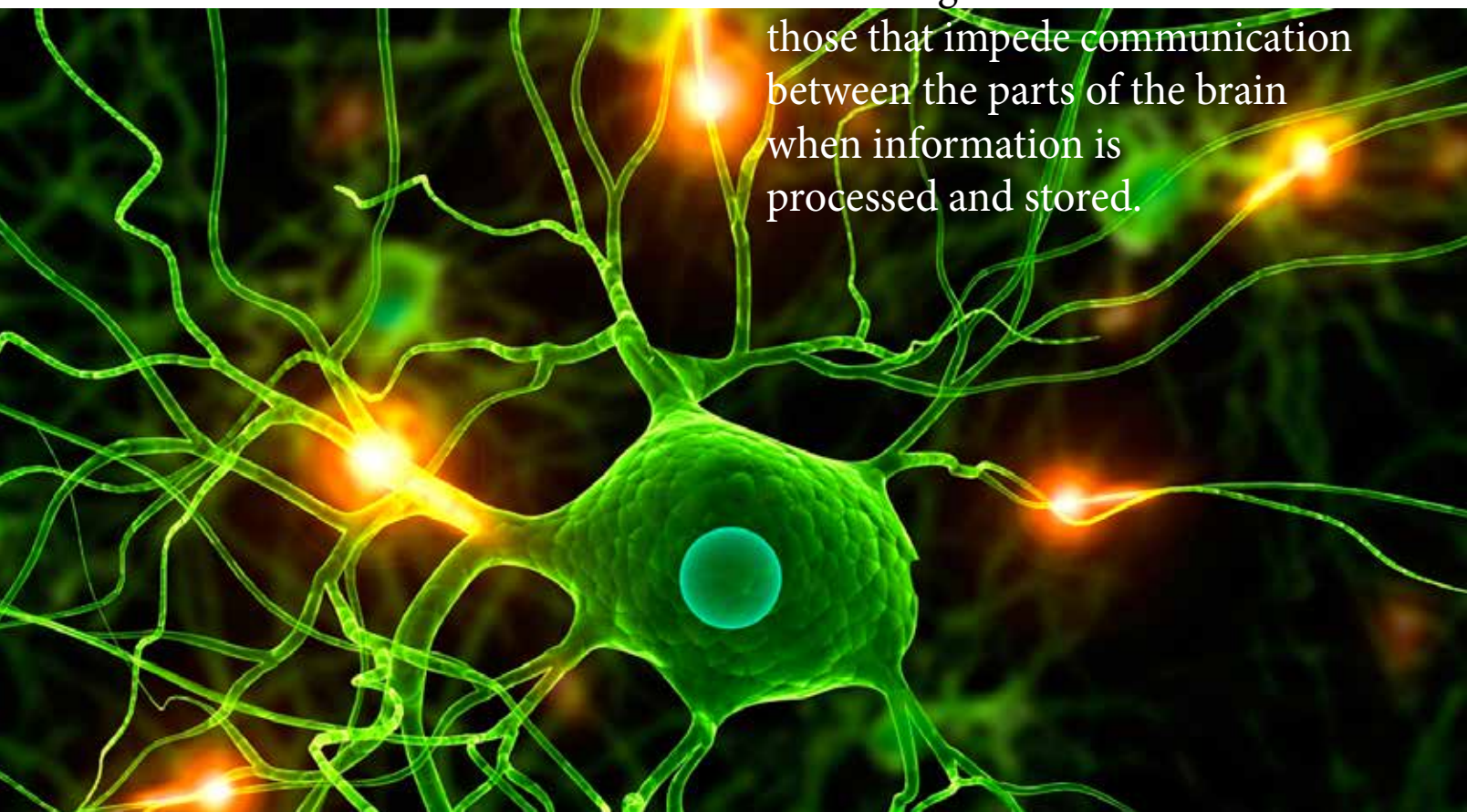
oves the Hand That Controls The Marker?

Next in the sequence of memory storage is the limbic system, comprised of parts of the temporal lobe, hippocampus, amygdala, and prefrontal cortex (front part of the frontal lobe).

Studies of the electrical activity (EEG or brain waves) and metabolic activity (from specialized brain scans) show the synchronization of brain activity as information passes from the somatosensory cortex sensory processing areas to the limbic system.

For example, bursts of brain activity from the somatosensory cortex are followed milliseconds later by bursts of electrical activity in the hippocampus and then other parts of the limbic system before being passed along to the executive function centers.

This is the one of the most exciting areas of brain-based memory research because it offers educators a view of the brain while it is processing new information. This provides empirical evidence with which to evaluate the techniques and strategies that stimulate and those that impede communication between the parts of the brain when information is processed and stored.



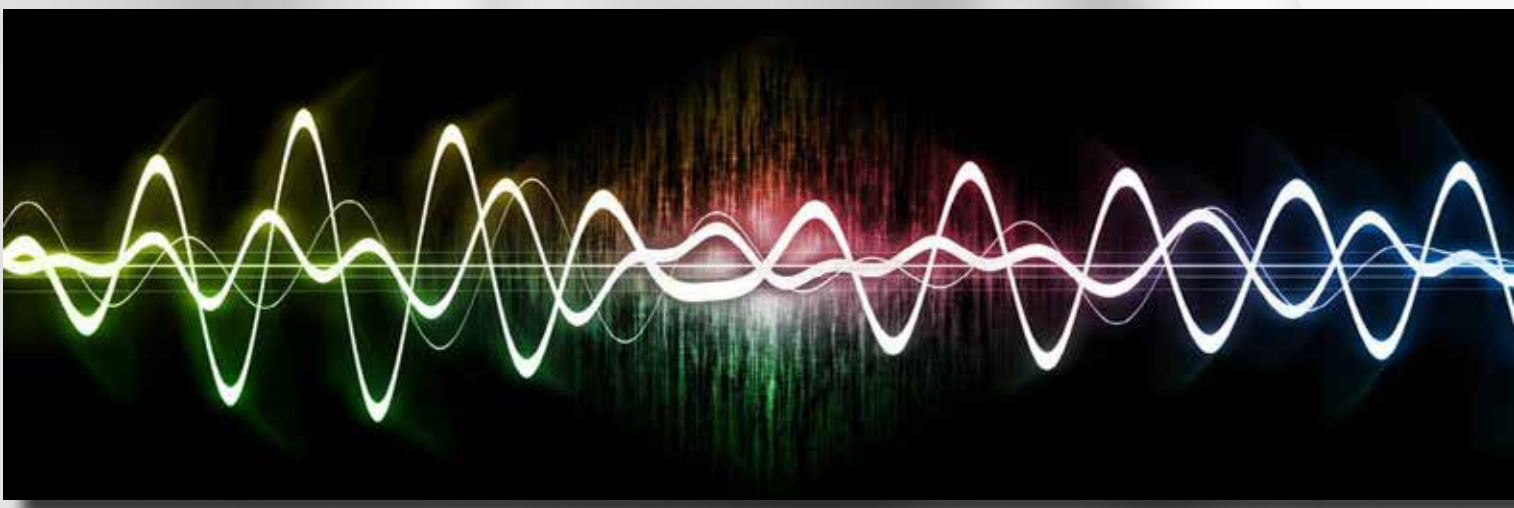
Engaging in the process of learning actually increases one's capacity to learn. Each time a student participates in an academic endeavor, a certain number of neurons are activated. When the action is repeated, such with a new color marker during each rereading, these same neurons respond again. The more times one repeats an action the more connections are made from the new memories to previous related knowledge.

If previously stored, related memories can be activated, or brought back on line, they travel back to the hippocampus and nearby regions of the temporal lobe where they are connected to the new information. The brain then makes the conscious connection between these stored memories and the new information.

When students process information through multiple sensory intake centers in their brains (visual reading, auditory reading out loud or with a partner, color stimulation of the highlighting, and the positive emotional connections to past "coloring" activities when coloring meant childhood fun, the information to be learned is connected to multiple senses and positive emotions. This excites more of the brain, increasing stimulation of executive function centers.

Part of this process is due to the brain's plasticity. When new information is input using several sensory systems, the brain's plasticity

builds additional dendrites to form more networks of information communication. For example, offering the information visually will set up a dendrite/neuron connection with the occipital lobes, the posterior lobes of the brain that processes visual input. Subsequently or simultaneously presenting the same material by



sound will build an auditory dendritic circuit with the temporal lobes. The temporal lobes process sound and play an important role in the regulation of emotion and memory processing because they are part of the limbic system. This duplication of pathways results in greater opportunity for future cues to prompt the brain to recall related stored information and make connections and higher-level interpretations.

A "*Colored*" Brain

As the highlighting lesson progresses, students feel more capable of doing higher order thinking independently. When students have the opportunity to actively think for themselves, they become self-learners, not just Blau's welfare information recipients. The person who does the work (thinks) is the one who learns.

When students are ready to respond in class discussion, open-ended questions with multiple possible responses encourage more students to be the thinkers. When some students do begin to respond with what they believe are factual answers or correct assumptions, asking them to explain their thinking and give evidence for their ideas allows others to actively listen and clarify their own interpretations.

A student must care enough about new information or consider it important, for it to go through the limbic system, form new synaptic connections, and be processed in executive function centers of the frontal lobe. Having students relate new information in the engaging process of highlighting personalizes it and increases its importance to them.

This process has the built-in

positive emotional experience

of the "play" of coloring and the success that results from feelings of accomplishment, pleasant social interactions with classmates or teacher, or specific acknowledgment and praise. This emotional connection is particularly applicable during early college years when the influences of emotions and hormones are greatest, making this a particularly significant time for teachers to use strategies that make the most of the heightened emotional state of students.

Color Me Dopamine

The chemical neurotransmitter that appears to most impact the activity state of the limbic, attention, and executive function systems is dopamine.

Dopamine has long been associated with attention and attention disorders in the frontal lobes. Dopamine carries information across synapses in the networks and circuits involved in decision-making and executive control. In the frontal lobes and the amygdala, there is an optimal stimulation state where brain stimulation and activity is enhanced with some types of reward-dependent learning. This is reflected in neuroimaging that measures dopamine levels in these brain regions.

Research evidence indicates that when reward or positive reinforcement is part of a lesson, dopamine activity increases in these brain regions to the point that there is an opening of the gates and passages through the limbic system to the executive function control centers.

Dopamine responsive brain cells in the amygdala and elsewhere in the limbic system may be where the brain "makes predictions" about possible rewards by releasing the dopamine in response to cues that rewards are possible.

The dopamine then activates the neural pathways to prompt the behavior to achieve the rewards it predicts. This research, and an even newer area of brain research related to mirror neurons (which play a part in learning language and linguistic interpretation) suggest that the pleasure and achievement-based rewards of this highlighting color process can change the way students will relate to challenging text in the future.

Thinking It Through:

Even Simple Concepts Can Become Complex in Context

Dr. Richard C. Larson, MIT

Think of math.
In gearing up for standardized math tests, we want our students to know (or memorize) so many things: sine, cosine, tangent; solutions to polynomials; matrices; trigonometric identities; etc., etc. Cram it in;

spew it out!

t Through:

And what about true understanding of what they are doing? Take averages. Simple, right? If I have ten numbers, I add them together and divide by 10, and I have the average. "Turn the crank!" Memorization done.

Well, how would a math student respond to Garrison Keeler's weekly musing about fictional Lake Wobegon, in Minnesota: "Lake Wobegon, where all the women are strong, all the men good looking and all the children are above average." How does our student respond? Well, at first glance, it is impossible for all the children to be above average. The teacher can demonstrate this by taking student volunteers to the front of the class, arranging them in order of height, and showing that the average is somewhere between the maximum and minimum heights.

But wait! Suppose the children of Lake Wobegon really are smart, smarter then most of the students in Minnesota! Then it is possible for all the children of Lake Wobegon to be above average when the average is computed across all students throughout the state. So, statements about averages must be carefully crafted to know the reference population against which the average is taken. Do we teach this?

Consider a tasty treat: chocolate chip cookies. Suppose we have a most unusual cookie baker. He bakes two kinds of cookies: cookies with only one chocolate chip and others with nine! In any large batch of cookies, we can expect 50% of each type of cookie.

To the baker and to the customer buying cookies, the average number of chips per cookie is five, up to

'industry standards'! But suppose one day you wake up and find yourself a chocolate chip inside a chocolate chip cookie! You look around. Chances are that you find 8 "sibling chips" in your cookie. In fact, there is a 90% chance that you find yourself in a cookie with 9 rather than 1 chocolate chip.

So, if you were to do this fantasy transformation of a random chip into a chocolate chip cookie every morning, 90% of the time you'd end up with 8 sibling chips and 10% of the time you'd be "an only child"! Over time you would estimate that the average number of chocolate chips in a cookie is 9*(9/10) + 1*(1/10) = 82/10 = 8.2.

You and the baker would have distinctly different averages! And both are correct!

Why do we care about chocolate chip cookies? Well, yes, they are delicious, especially those with 9 chips!

But, mathematically, aren't we doing the same probability experiment every time we go to a movie theater or to the mall, board an airplane, or commute to work?

There is a sampling bias that finds us more often in busier-than-average situations. Many of us experience movie theaters as 70 to 80% filled – because we tend to go at popular times:

Friday and Saturday nights.

Managers of movie theaters bemoan the fact that upwards of 95% of seats offered for sale over the course of a week go unsold. Both averages are correct. Or consider two airplanes: one with 180 seats occupied and the other with 20 seats occupied. Average occupancy from the airline's point of view is 100 paying passengers per flight. But you as a random passenger are 9 times more likely to be on the crowded airplane. Maybe everyone on the planes magically transforms themselves into chocolate chips!

We are speaking of averages, not a difficult concept. And we have only mentioned two of myriad complications with averages. And think of the additional complications with variances, modes and medians, not to mention entire

distributions.

How much of this do we teach? Or, maybe we need not concern ourselves with teaching each and every complication, but we should focus on preparing the student to adjust to these complications as she encounters them and then figures them out on her own. Isn't that goal better than memorization and parroting back on a test?

Dr. Richard Larson is the Mitsui Professor of Engineering Systems at MIT

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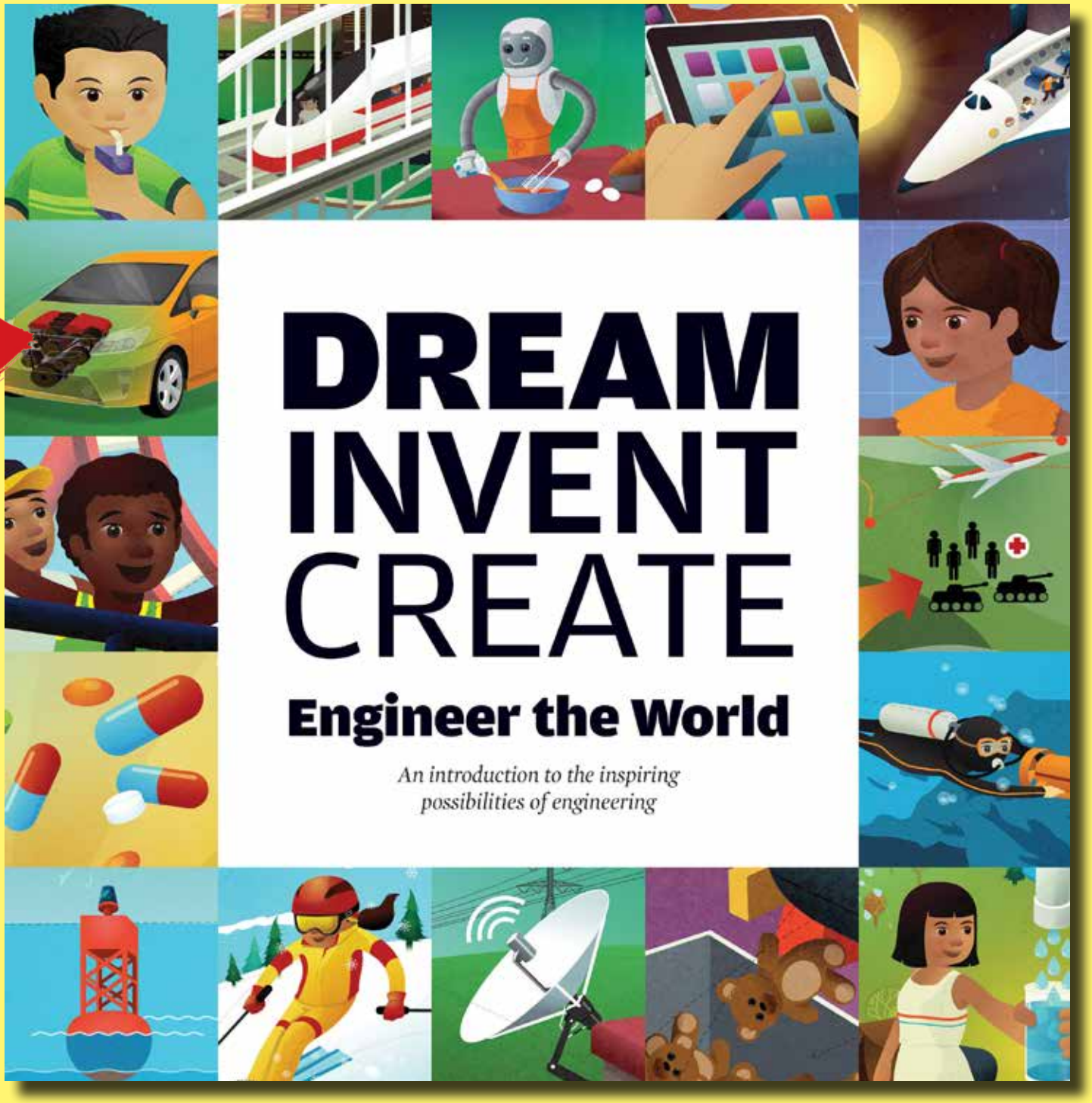

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LEVELS of STEM Careers?

When we consider STEM careers, it's common to jump immediately to rocket science, chemical engineer, aerospace engineer, nuclear physics, astronomy, oceanography or similar arenas reserved for the gifted or select few.

In reality, every career you can name uses STEM skills on a daily basis. In a recent issue of STEM Magazine we listed 6 pages of what many colleges consider STEM careers. It was vast and surprising. From secretary to scientist, STEM is and will always be deeply ingrained into ALL of our daily lives. Since this is the case, there must be a variety of levels of STEM careers, each requiring different degrees of education resulting if different amounts of financial reward.

We know that the higher the level of education reached, the greater the paycheck.....usually.

That assumption may need to change as college graduates and those with PhD's are finding it increasingly difficult to find employment. The unemployment rate of new college graduates is at its highest level in decades and they quickly find themselves "under employed" outside of their chosen degree field.

With the rising cost of college tuition, student loan fees and availability, and lack of immediate employment, more students are choosing community college, trade schools, apprenticeships and on the job training. The good news is the business community is becoming very open to hiring these students for those very reasons where until this century, if you didn't have a Bachelors degree, you were almost unemployable. The down side for students is lower salaries, which is an upside for employers.

Here is our generalization of STEM career levels for your consideration:

Level One STEM Careers usually requiring a doctorate degree.

- Aerospace engineer and many related aerospace applications
- Lawyer
- Doctor
- Dentist
- Veterinarian
- Psychiatrist
- Biochemist
- Politician (just kidding)
- Corporate software design and engineering / consulting

The list is much longer of course. These are 8-10 year college commitments. The salaries are well over $100,000 annually but are highly competitive and much harder to find…..fewer available. Keep in mind, you're in direct competition on a global scale against graduates from around the world.

Level Two STEM Careers requiring at least a Masters degree and maybe a license.

- 4 year nurse
- Architect
- Teacher
- A variety of engineering applications
- Physicians assistant
- Family therapist / Psychology
- Social worker
- MBA (Master of Business Administration
- Computer science
- Economics
- Physics
- Human Resources

These comprise much of the middle class jobs depending on the company requirements and specific applications. The jobs usually pay between $40,000 and $75,000 per year to start.

Level Three STEM Careers that require Bachelors Degree. All of the above are included of course but here is where the weather gets a bit foggy.

A Bachelors Degree has replaced the high school diploma as a necessity for most jobs paying more than $30,000 annually. It has become an expectation by most companies in all arenas with the expectation that you are well rounded, mature, motivated, teachable, and generally smart. I won't list these careers because they comprise about every other career you can name.

Level Four STEM Careers requiring a high school diploma, 2 year degree, trade school or apprenticeship.

- Auto mechanic
- Plumber
- Electrician
- Building Contractors
- Heating and Air
- Insurance agent
- Management position
- Office support staff
- Military (all branches)
- CDL truck driver

I think you get the point. But this is the level that breaks a lot of our assumptions but opens up tremendous opportunities for many young adults with drive and motivation.

Plumbers, especially master plumbers, can make far more than teachers or nurses with a fraction of the traditional education. Building contractors, many self-employed, can easily bring in $150,000 per year with only a high school education. Their skills, necessity, experience and motivation can lead them to be quite wealthy. Starting salaries may be modest, but being your own boss and owning your own company has unlimited potential.

Can you name any billionaires who dropped out of college to pursue their dreams? Ted Turner, Ralph Lauren, Mark Zuckerberg (Facebook), Michael Dell (Dell computers), Bill Gates, Steve Jobs (Apple)…and more.

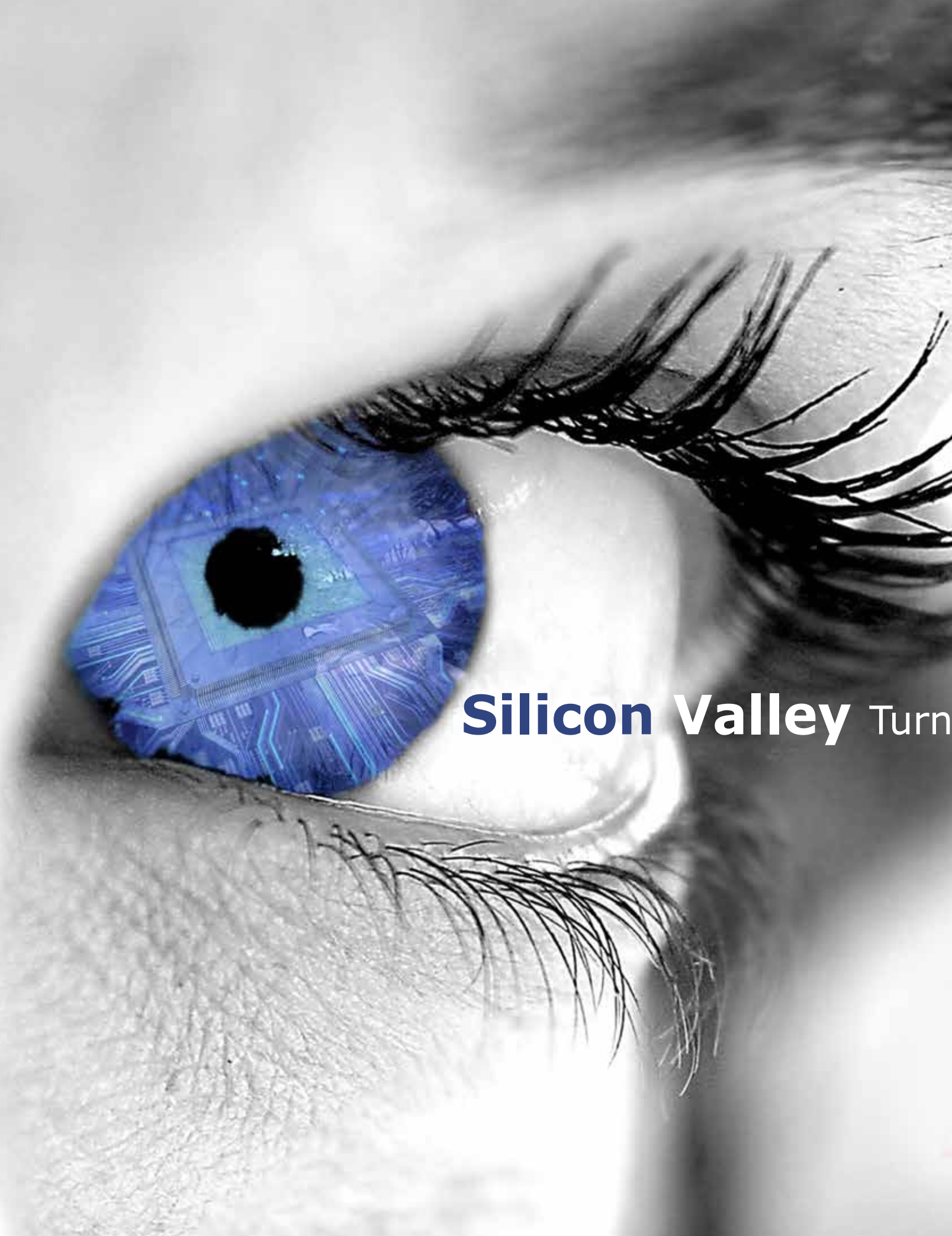
These are a rare breed and the exception to all the rules, but they

still accomplished their goals and beyond despite society traditions and accepted norms.

We don't encourage this path of course, but as a self-employed publisher and entrepreneur, with a Bachelors Degree, all things are possible.

There is no question that a high school diploma IS A MUST as we sadly watch a frighten rate of dropouts. I know of several districts here in the south with drop-out rates as high as 50%. OMG. Try and get a job a Burger King without a high school diploma…. which is a Level 4 STEM job by the way.

To conclude my point, no matter what drives the curiosity of students to choose a career path with its financial limits or potential, they will use science, technology, the engineering method and math daily. Knowledge is power and the knowledge of education choice consequences and the resulting financial returns need to be exposed early in the life of our students and well as early exposure to STEM and its practicable applications, personal relevance and necessity.


Silicon Valley Turn

s Its  **to Education**

The education technology business is chock-full of fledgling companies whose innovative ideas have not yet proved effective — or profitable.

But that is not slowing investors, who are pouring money into ventures as diverse as free classroom-management apps for teachers and foreign language lessons for adult learners.

Venture and equity financing for ed tech companies soared to nearly $1.87 billion last year, up 55 % from the year before, according to a new report from CB Insights, a venture capital database. The figures are the highest since CB Insights began covering the industry in 2009.

Notable financing deals include Pluralsight, a company that provides online training to technology professionals, which raised $135 million; Remind, a free messaging service for teachers to communicate with students and parents, which raised $40 million from venture capital firms including Kleiner Perkins Caufield & Byers; and Edmodo, an online social network customized for classroom use that is free to individual teachers, which raised $30 million.

"Education is one of the last industries to be touched by Internet technology, and we're seeing a lot of catch-up going on," said Betsy Corcoran, the chief executive of EdSurge, an industry news service and research company. "We're starting to see more classical investors — the Kleiner Perkinses, the Andreessen Horowitzes, the Sequoias — pay more attention to the marketplace than before."

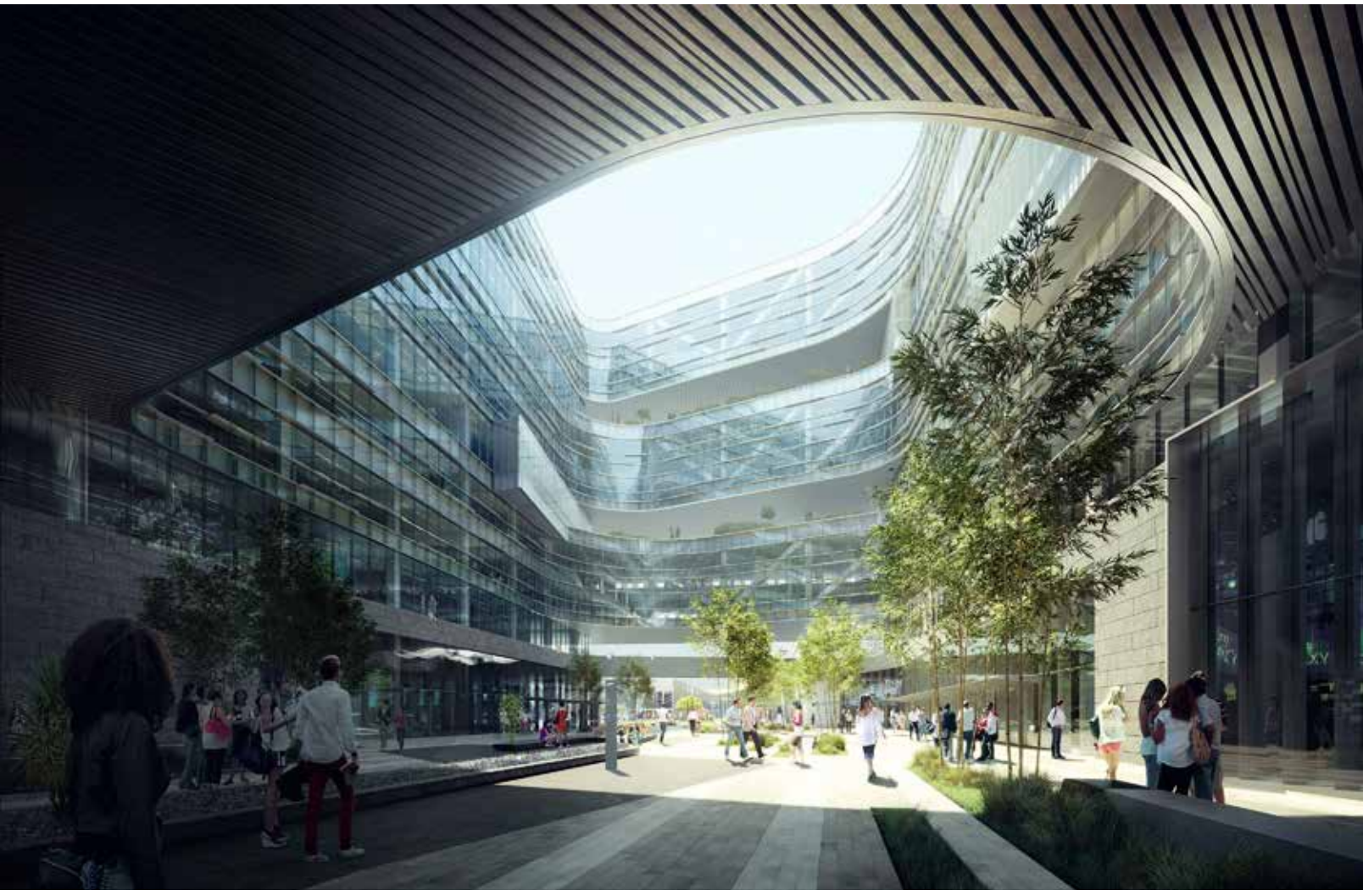
While rising sharply, the values of ed tech financing deals are chump change compared with the money flowing into consumer software.

Uber, the ride-hailing app, for instance, raised $2.7 billion last year. The smaller sums going into ed tech illustrate the challenges facing start-ups as they try to persuade public school systems to adopt their novel products. Companies often must navigate local school districts with limited budgets and slow procurement processes.

To bypass the bureaucracy, many start-ups are marketing free learning apps and websites directly to teachers in the hopes that their schools might eventually buy enhanced services.

It is too early to tell whether that direct-to-consumer **"freemium"** strategy, as it is often called, will pan out for education software.

"There are still a lot of questions around some companies' business models in the sector," said Matthew Wong, a research analyst at CB Insights. "One of the questions, because the product is free, is:



'How are you going to monetize those users?"

One example is Remind, a popular messaging app that teachers use to send homework reminders to students and share classroom news with parents. Sports team coaches also use the system to send weather updates and schedule changes to their athletes.

Word of mouth has propelled "**Remind"** from an unknown brand to a nationwide phenomenon. Started in 2009 by two brothers in Chicago, the service now has 23 million users, up from 18 million five months ago, the company said, and the service has been used to send more than a billion messages.

“Today, you can order a pizza, or a ride with Uber or Lyft, in an instant,” said Brett Kopf, 27, a co-founder and chief executive of Remind. “But if a student is struggling at school, oftentimes the parents don’t know. We want to make that communication more real-time.”

Where some other ed tech start-ups have been slow to capitalize on the ubiquity of mobile phones, Remind has grown quickly partly because its system enables teachers to send messages through multiple channels — via the company’s website or mobile app, by text or by voice message.

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Remind recently hired growth strategists and engineers with experience at consumer companies like Skype and Facebook. Mr. Kopf

Technology changes half of what they

said Remind planned eventually to earn money by charging subscription fees for additional services—such as emergency notification systems for schools. Right now, however, the company is devoting the $40 million in financing it raised last year to improving its product and expanding its market internationally, he said.

Ed tech start-ups that manage both to engage teachers and to achieve significant scale may eventually be able to profit from the freemium model used successfully by consumer brands like **Spotify**, the music service.

"I think there are businesses that won't be able to cross that bridge," said Michael Moe, chief executive of GSV Capital, a venture capital firm. *"But if you monetize 2 to 20 percent of the network, there's no reason it can't work in education."*

GSV Capital has investments in consumer tech companies like Dropbox and Spotify as well as in ed tech companies like Coursera, a provider of free online courses.

Coursera earns revenue by selling verified certificates to students who complete its courses. But some investors are more enthusiastic about ed tech companies that charge directly for their products, like those that sell software-as-a-service to schools or practical training to adult learners. Pluralsight, a company in Farmington, Utah, for instance, provides online training to technology professionals seeking to stay current with programming languages or the latest game design tools.

The company charges monthly subscription fees of $29 to individual users and has enterprise clients that pay larger annual fees to make

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y know in a **two-year** period of time.

courses available to their employees.

"Because technology changes so quickly, software professionals lose half of what they know in a two-year period of time," says Aaron Skonnard, the chief executive of Pluralsight. "They can use us as their go-to resource to stay current."

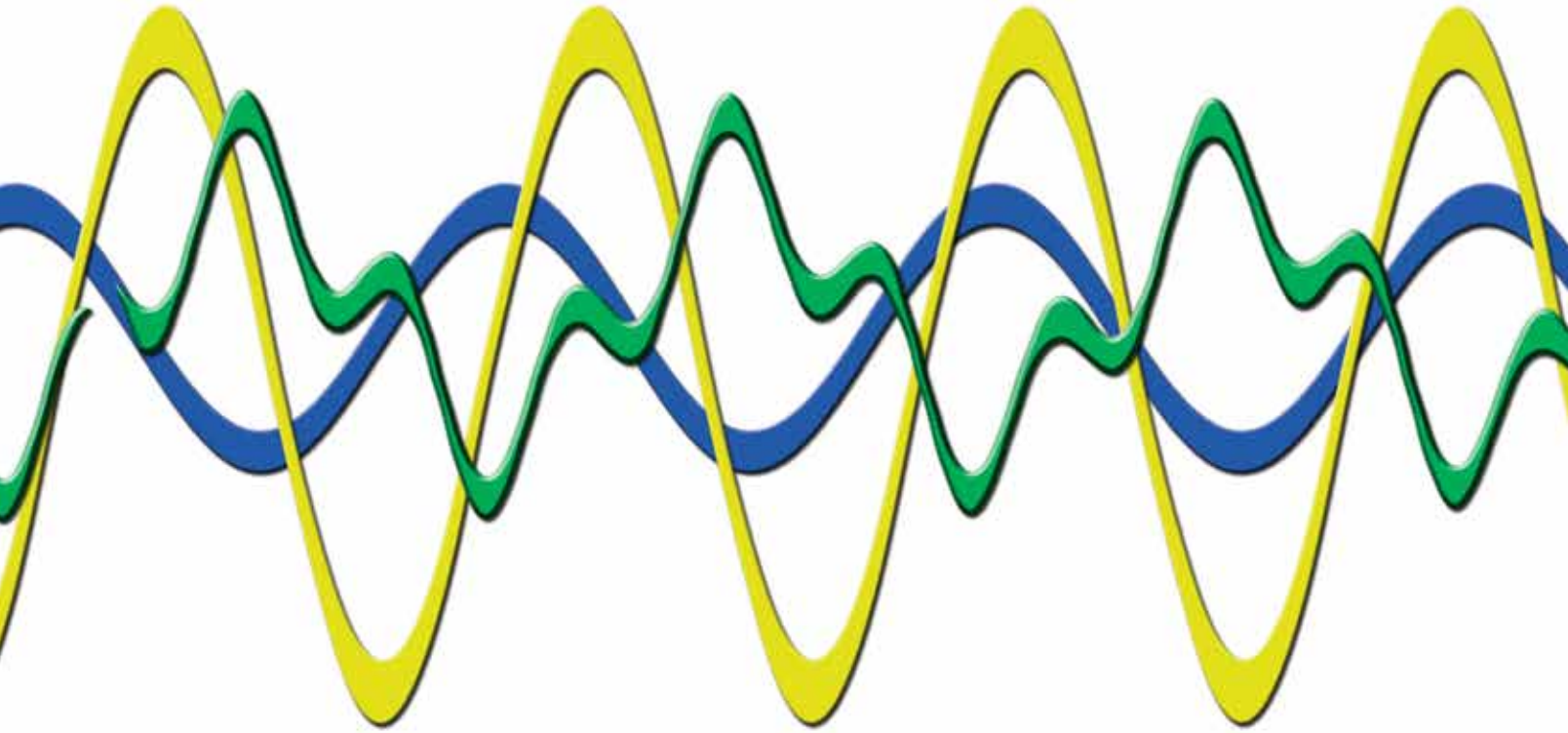
That is the kind of recurring revenue stream that appeals to ed tech investors.

"We are looking for things with returning revenue," said Matthew Greenfield, a managing partner at Rethink Education, a venture capital firm in Manhattan. Of Pluralsight, he said: *"Because it plays a central role in people's careers, they keep the subscriptions."*

Mr. Greenfield's firm is not invested in Pluralsight. But one of its portfolio companies — Smarterer, a skills-assessment and scoring system — was acquired by Pluralsight last year for $75 million. Given the infancy of the ed tech industry, however, investors said they were being selective.

"If you get share, users and engagement, you can find a way to build a viable business," said John Doerr, a partner at Kleiner Perkins, which is an investor in Remind. *"But none of it is easy."*

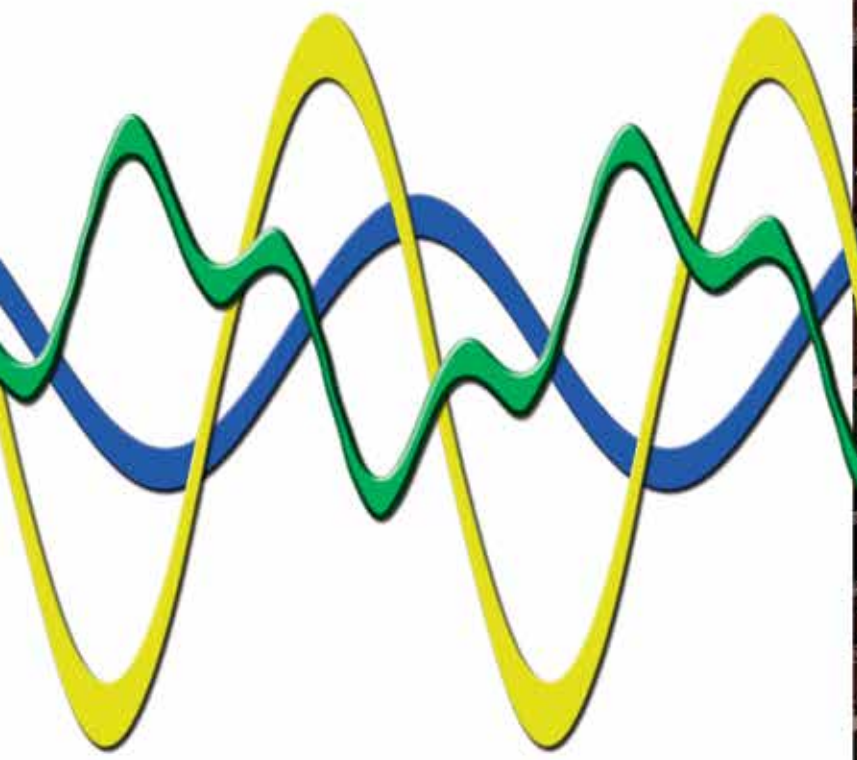
The ***Sound Barrier*** does



There is not actually a “physical barrier” in the sky that prevents sound or aircraft from going faster, and thus cannot be “broken”. There is nothing to break through.

Let’s explore how sound and objects travel to better understand the actual science behind this ***misnomer.***

not exist



Misnomer [mis-noh-mer]

noun

1. a misapplied or inappropriate name or designation.

2. an error in naming a person or thing.

How do sound waves *(vibrations)* and solid objects travel through the air, water and earth?

Sound is made when something moves or vibrates. The movement sets up a sound ***wave*** in the surrounding air. A sound wave bounces off of air molecules to produce motion or travel outward in many directions.

The original *FORCE* or energy of the sound produced usually determine how far it will travel. As the vibrations continue to bounce off of the air molecules, they begin to slow down until they stop traveling or an object gets in the way blocking continued travel.

In simple terms, the thickness or density of the air (how many air molecules per square inch) determine how far the sound waves can travel.

Sound waves travel through the space "between" the air molecules.

The more space there is, or the thinner the air is, the less molecules there are to bounce off of and the sound does not travel as far or as long. The thicker the air, or the more densely packed the air molecules are, the more molecules there

are to bounce off of so the sound travels faster and further for longer.

Now that we have a basic understanding of how sound travels, we realize there is no invisible wall in the sky or "barrier" that has to be broken through to go faster.

Molecules in the air we breathe include primarily nitrogen and oxygen as well as water, carbon dioxide, ozone, and many other compounds in small amounts, some created naturally, others the result of human activity like pollution and dust. These are what sound waves have to bounce off of to move outward from their source. If you whisper, those sound waves do not travel very far because there is not very much verbal energy put into it. But if we YELL with a lot of energy, sound waves travel further before running out of energy.

The Speed of Sound

The atmospheric pressure or the pressure exerted by the weight of

the atmosphere at sea level is 14.7 pounds per square inch. Since our atmosphere is primarily air molecules, we can say that the weight of the air and its thickness is 14.7 pounds per square inch (PSI) of force on our bodies and everything around us.

Based on this pressure or thickness of air at sea level, sound waves travel at about 760 miles per hour through this level of atmospheric pressure. That is as fast as sound waves can go based on the spacing of the air molecules. When your teacher talks to you in class, his or her voice is traveling at 760 miles per hour (mph) from their mouth to your ears. Pretty cool....and fast.

Now it gets really interesting. If you go up in the atmosphere to about 35,000 feet, the air is thinner and the molecules a spaced further apart causing sound waves to actually slow down because there are fewer molecules to bounce off of.

The speed of sound at 35,000 feet is about 670 miles per hour. As you go higher and the air gets thinner, the speed of sound slows down even more. This brings us to a broader discussion about the speed of sound.

The speed of sound at sea level is about 760 miles per hour.

The speed of sound at 35,000 is about 670 miles per hour.

This is what the math equation looks like:

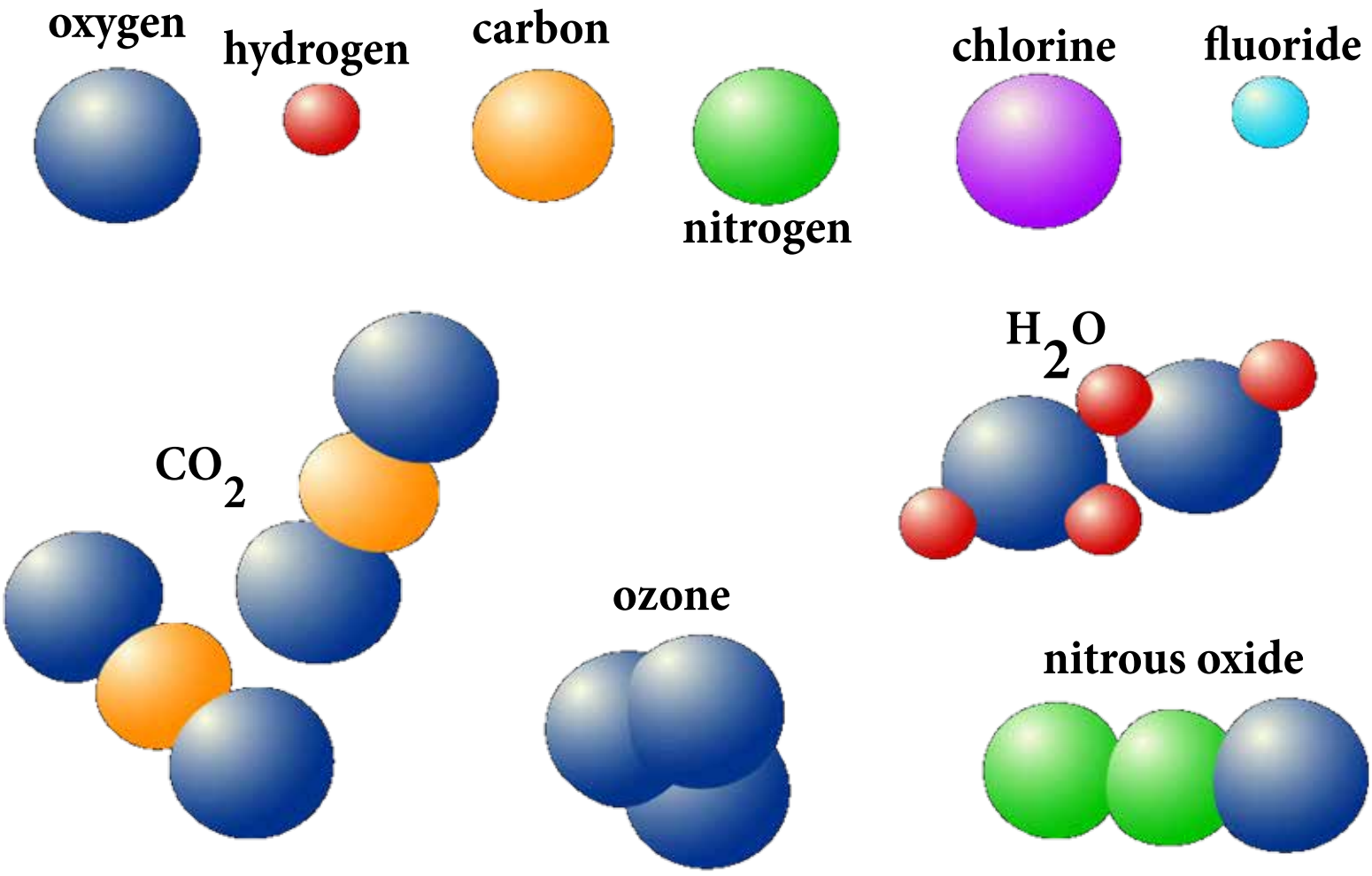
$$V = 331.4 + 0.6Tc$$

V = velocity (m/s),
Tc = temperature in Celsius.

This is pretty much what we breath.

Our air is composed of many molecules, so when we talk about sound waves traveling through the atmosphere and bouncing off air molecules, this is what they are.

The speed of sound in space is.....
.....what is your best guess based on our discussion so far?



Molecules in the air we breath

So what is the speed of sound in space? Zero miles per hour.

There IS sound in space coming from the International Space Station, satellites, rockets and more, but it has no "medium" or atmosphere to travel *through*.

This is amazing.....
The speed of sound under water is just over 3,000 miles per hour. Tell me why.....

The density of water molecules is much greater than air, so sound waves under water travel **much** faster and further. This is why sonar (under water radar) is so effective over long distances. This is also why whales can communicate half way around the world, using their sound wave language.

What is the speed of sound through rock? Well that varies with the type of rock, but the speed of sound through Granite is about 4,000 miles per hour.

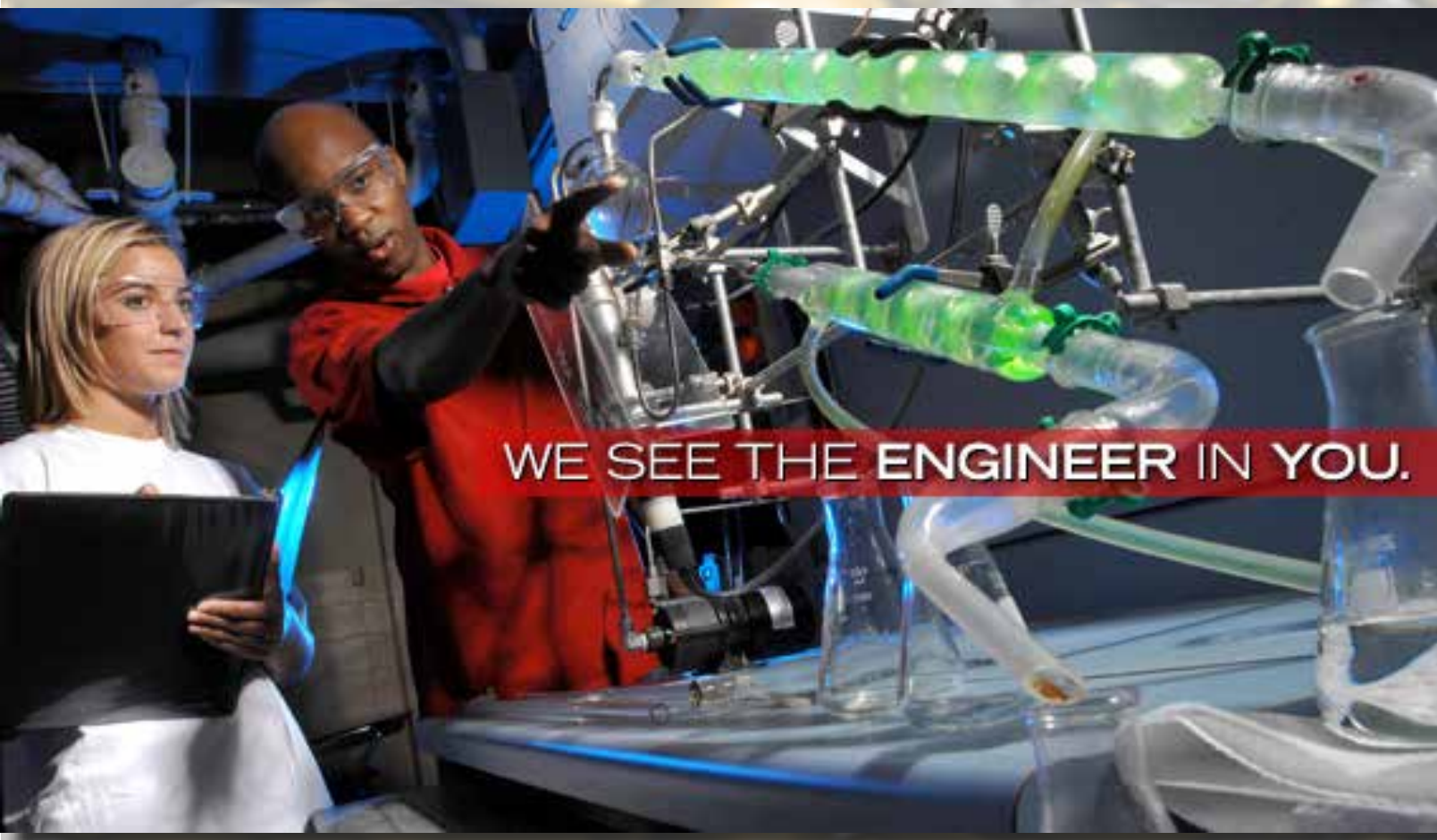
***Next issue*.....we'll discuss the speed of "objects" through our atmosphere.**

In conclusion, we know there is not really a barrier in the sky, but we understand the science, physics and molecular interaction as it relates to the speed of sound.

It's a misnomer.

A few STEM careers that deal with the study and use of sound include:

- Seismology (earthquakes)
- Music / sound engineers
- Acoustics
- Sound based non-lethal weapons
- Astrophysics
- Radio astronomy
- What can you think of?



What do ***Chemical Engineers*** do?

Chemical engineers use math, physics, and economics to solve practical problems. The difference between chemical engineers and other types of engineers is that they apply a knowledge of chemistry in addition to other engineering disciplines. Chemical engineers may be called ***'universal engineers'*** because their scientific and technical mastery is so extensive.

They design processes and equipment for large-scale safe and sustainable manufacturing, plan and test methods of manufacturing products and treating byproducts, and supervise production.

Manufacturing

Chemical engineers often work in manufacturing to help design and coordinate any chemical processes used in making goods. They help to manufacture goods such as pharmaceuticals, organic products, textiles, industrial chemicals such as paint and fertilizer, composite materials, food and electronics. They make sure that these goods have the best quality and the cheapest manufacturing costs possible.

Environment

Chemical engineers also use their knowledge of chemical processes to help counteract the effects of chemicals on the environment. They help companies and organizations to reduce pollution in the air, soil and water as well as assist

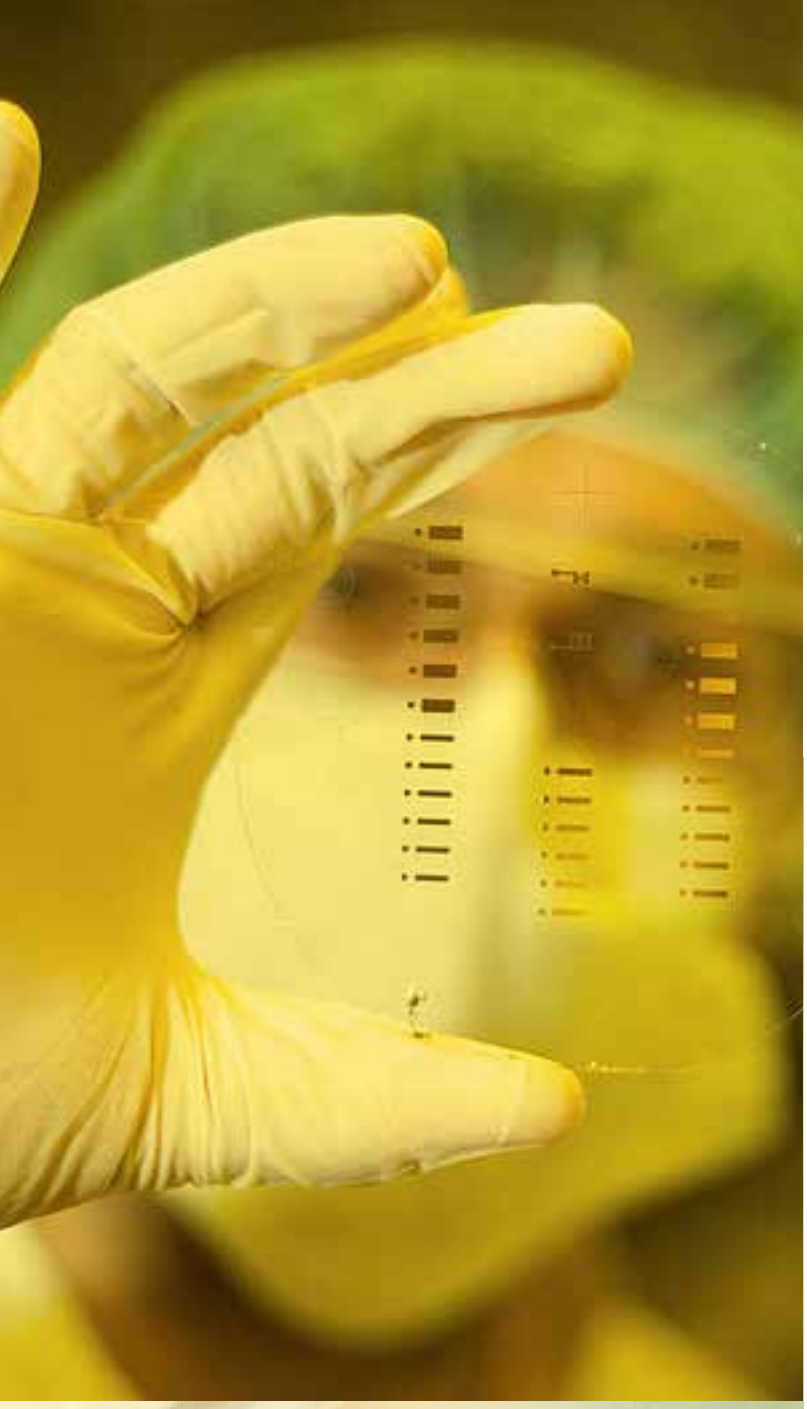
manufacturers in creating a manufacturing process that causes less pollution.

Chemical Production

Other chemical engineers work directly with chemicals to see how they work in mass quantities. In order to manufacture large quantities of chemicals or use a significant amount of chemicals in a manufacturing process, chemical engineers have to study the properties of each chemical, such as the polymerization or oxidation qualities for that specific type of chemical.

Salary

In 2006, the US Department of Labor estimated there were 30,000 chemical engineers in the United States. At the time of the survey, the

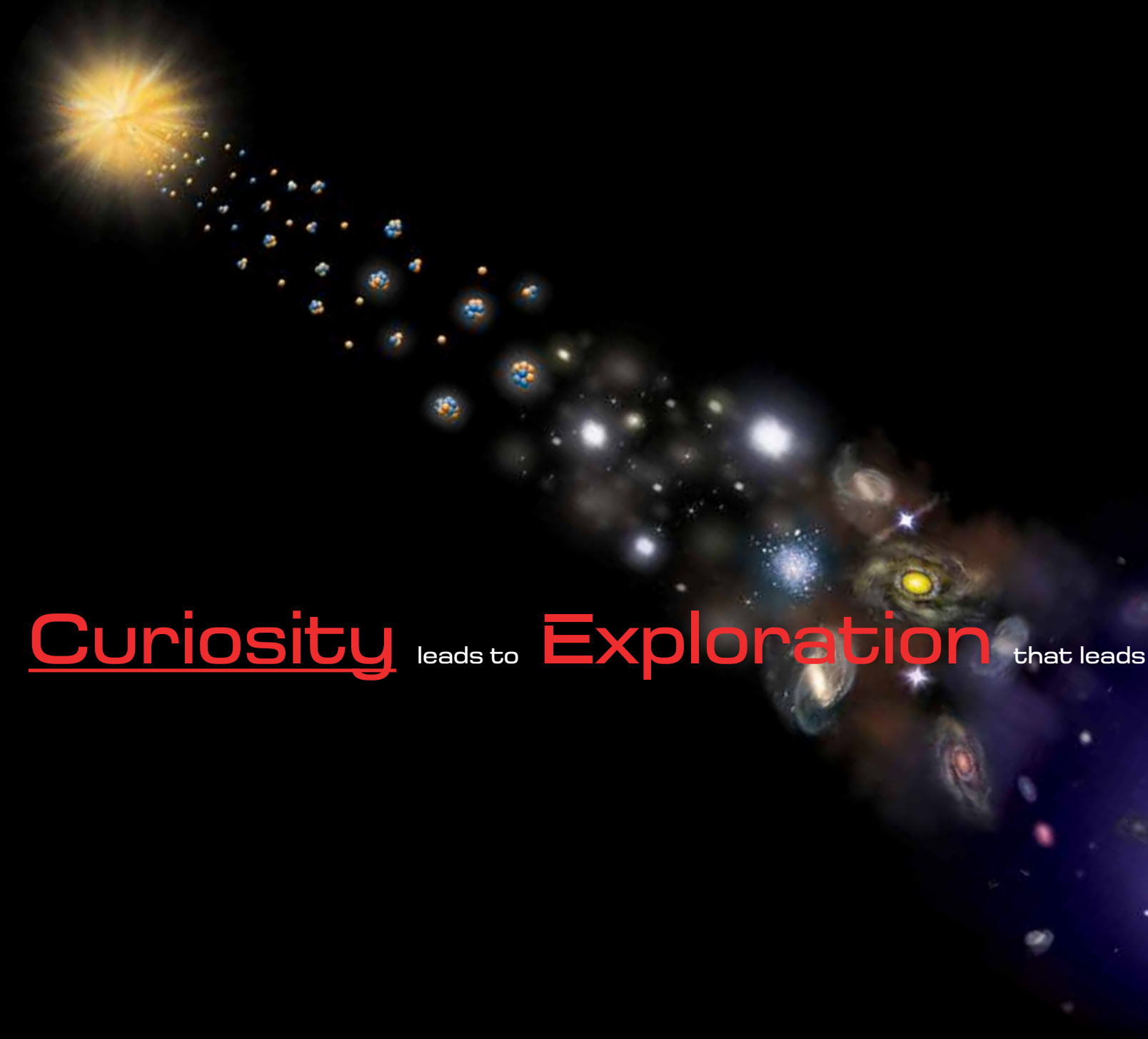


average hourly wage for a chemical engineer was $39.23 per hour, ranging from $24.07 to $57.05 per hour. The median annual salary for a chemical engineer was $78,860. The middle 80 percent of chemical engineers made $50,060 to 118,670 annually.

Employment of chemical engineers (as well other types of engineers and chemists) is expected to grow at the average growth rate for all occupations through 2016. The related field of environmental engineering is expected to grow at a much faster rate.

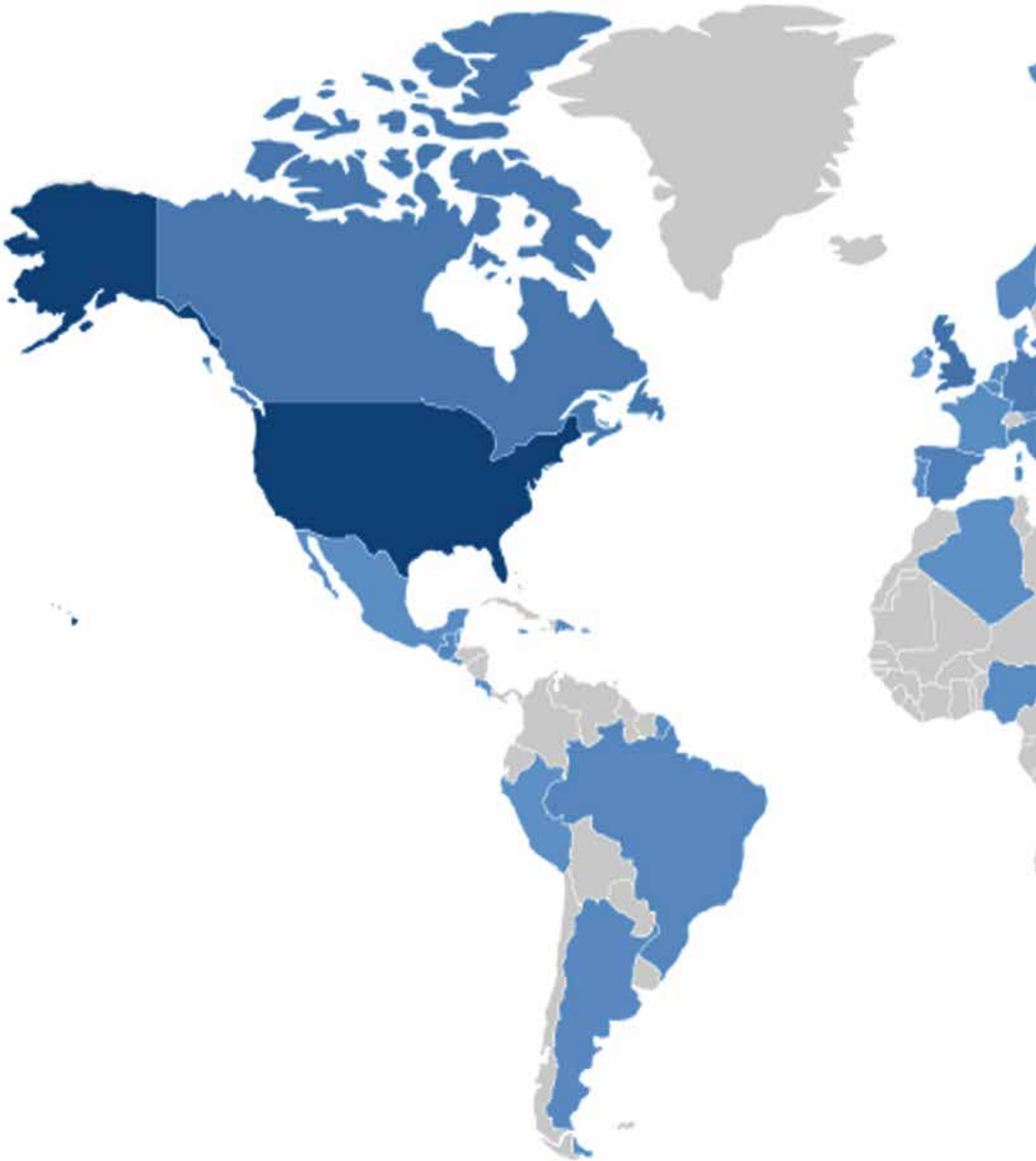
Entry level chemical engineers advance as they assume more independence and responsibility. As they gain experience, solve problems, and develop designs they may move into supervisory positions or may become technical specialists. Some engineers start their own companies. Some move into sales. Others become team leaders and managers.

We see the Chemical Engineer in you


Curiosity leads to Exploration that leads

to Imagination that leads to Creativity

Global Readership as of January, 2015



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