

# THE STEMEDGE

A quarterly magazine from NCSSS giving teachers and administrators the competitive advantage in professional development.

QUARTER 2 | 2019

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“Illinois Tech uniquely prepares students to succeed in professions that require technological sophistication, an innovative mindset, and an entrepreneurial spirit.”

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*(Sponsored Content)*

*"Illinois Tech uniquely prepares students to succeed in professions that require technological sophistication, an innovative mindset, and an entrepreneurial spirit."*

## FROM THE EXECUTIVE DIRECTOR

The academic year may have ended, but at NCSST we are not even halfway through. The first part of the year for us always involves implementing the work of our Board Committees. For our Membership Committee, this means an extended outreach campaign to reach non-members, an initiative that is working very productively for us. And for our

*"We have school participants from a dozen countries sharing best practices with a similar number of U.S. schools."*

Programs Committee, we have finished a Leadership Summit and a Student Research Conference, all with great success. Of course, the big one is yet to come, the Professional Conference in Seattle in early November.

I really like what I am seeing with our two-year-old Global Program. We have school participants from a dozen countries sharing best practices with a similar number of U.S. schools. It has been amazing to watch, and to see our U.S. schools benefit as much as those abroad. If you are interested in learning more, please let me know.

We have been developing partnerships with varying networks of STEM schools, many located in the mid and northwest. These partnerships are part of our ongoing work to broaden our membership base. I hope to have good news to convey to you about this at November's conference.



Speaking of the Conference, we hope to see you there. We are expecting another great crowd of attendees, and we will have some interesting excursions as well as sessions for you.

Let me close by wishing you a relaxing and battery-recharging summer. And I look forward to seeing you in the fall.

All the best,

Todd

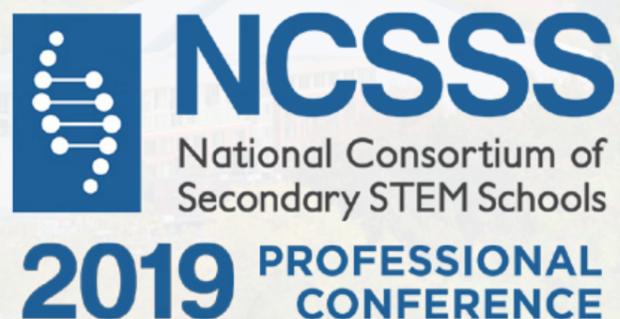
NCSST Executive Director | [todd.mann@ncsst.org](mailto:todd.mann@ncsst.org)

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## PRESIDENT'S CORNER

The end of every school year, with the celebrations around graduations and student accomplishments, as well as welcoming in the new class of students ready to participate in our challenging and engaging academic environments, gives me a chance to reflect and be grateful for many things.

It is easy to get caught up in the day-to-day, hectic life of education, without taking a step back to appreciate that we are in a remarkable time in

“An email or call to a neighboring district could start a new program or plant a seed for a new idea.”

this field and our students will wield enormous influence on the future of society with the skills and habits of mind they are developing right now in our classrooms.

Like many of us, I am grateful for the outstanding students that I get to work with every year, for the tremendous faculty that pride themselves on excellence, professionalism and innovation, for the supportive community, including research mentors, corporate partners and community service agencies that sponsor our students, our university partners that welcome and challenge our young scholars to be their best, and the families who encourage our students to leave their comfort zone and take that academic risk for the sake of personal growth.

We should feel proud of the work we do every day, and should use the network of the NCSSES to not only share these best practices with each other, but with the world. I would encourage you to reach out to colleagues and share your stories. An email or call to a neighboring district could start a new program or plant a seed for a new idea. An invitation for coffee



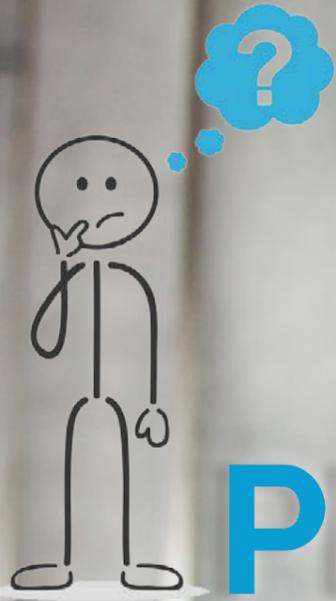
or to visit an event could help invigorate a STEM program for a school looking to get something off the ground. Our Associate member category is designed for emerging schools or programs that could benefit from mentorship or new ideas. Sometimes that call or invitation could make the world of difference for a whole group of students. Expanding NCSSES membership will have a positive influence on STEM policy and ultimately improve educational outcomes for students and secure a brighter future for our country.

Enjoy your summer, and I look forward to seeing you at our annual Professional Conference in Seattle, where I learn so much from colleagues like all of you!

A handwritten signature in black ink that reads "Michael Barney".

— MICHAEL BARNEY

President of the NCSSES Board of Directors



# THE TOP 10 PITFALLS OF SCIENCE WRITING

By Jennifer Seavey, Humanities Teacher  
& Anne Applin, Librarian

Thomas Jefferson High School for Science & Technology

“Every year, we embark on an exciting and frazzling journey with our sophomores: the crafting of a science essay.”



**“I fell in love with the Molymod kit at first sight. Its large assortment of brightly colored balls (“atoms”) and plastic white sticks (“bonds”) allowed for endless possibilities of mix-and-match. There is nothing more satisfying than the click of a white stick fitting snugly into the side of a ball.”**

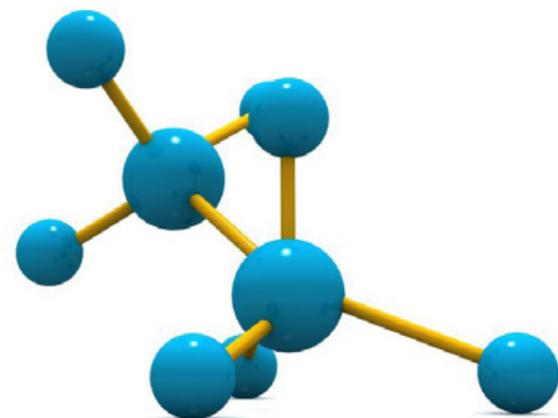
– sophomore first draft opening paragraph, science essay

Every year, we embark on an exciting and frazzling journey with our sophomores: the crafting of a science essay. In the introduction to their essay, students descriptively depict their chemistry lab experience. The example above is one of many histrionic first draft openings we encounter as our students attempt to link their topic to a specific chemistry lab they performed over the first semester.

Students write a compelling, descriptive narrative that presents a real-world problem and describes the solutions scientists are investigating to solve these problems. Students enjoy free choice of a topic limited only by their choice of lab.

Essentially, this project requires students to research cutting-edge science. First, they must find, read, and understand primary science articles. Second, they must translate the scientific nomenclature to make it understandable to an intelligent eighth grader, the same level used by the Washington Post, according to the Gunning Fog Index.

But as any seasoned traveler knows, journeys are sometimes fraught with pitfalls. At the 2018 NCSSS conference in Houston, we presented the top 10 pitfalls we and our students face as we journey through the research and writing process.



### **PITFALL #1: FINDING PRIMARY RESEARCH**

We begin our trip in the library, fueling student knowledge by introducing our sophomores to the library resources available to them. Through our curated research guides, they explore the use of secondary sources such as EurekaAlert! They browse breaking science news. To find primary sources, they conduct guided searching in our science databases such as ScienceDirect.

In the search for science articles, students often encounter grey literature such as dissertations and theses, professional presentations, and conference papers so we help them evaluate the validity of such literature. One of our students once found a conference paper that ultimately was rejected by the governing body of that particular science association. It's important to be hands-on while students research to help them navigate and evaluate the body of science literature.

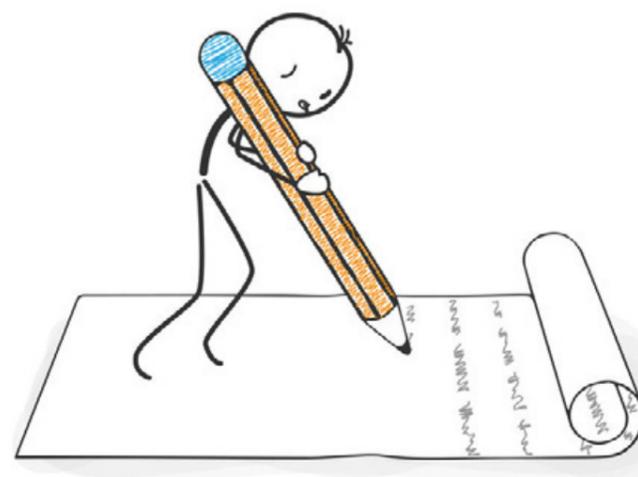
### **PITFALL #2: I CAN'T UNDERSTAND IT!**

Once the students have their primary articles, they find the language may be very technical and filled with scientific nomenclature. To help students with this pitfall, we share reading strategies, including annotating the article,

defining unfamiliar terms, and explaining an article to a classmate. We ask students to translate their article using 5 W's & 1 H: Who, What, Where, When, Why, & How. This year, we asked students to evaluate their science articles using the CARRDSS criteria: Credibility, Accuracy, Reliability, Relevance, Date, Sources, and Scope. In a survey after the project, 77 percent of students said that using CARRDSS to evaluate their sources helped them to better understand their primary source journal articles.

### **PITFALL #3: NOT REPRESENTING THE CONTENT**

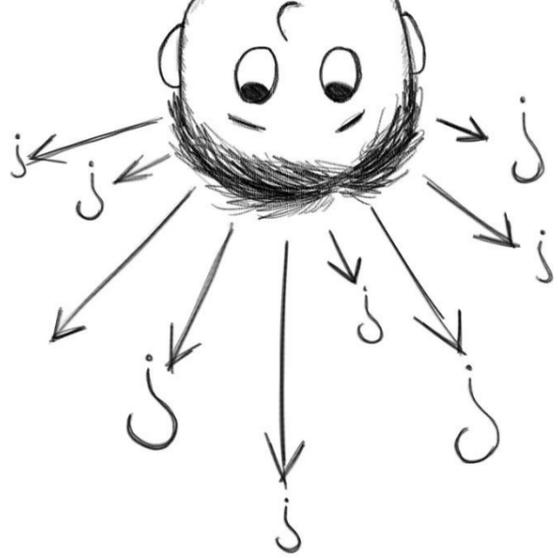
This pitfall causes the reader to choose that snazzy red sports car over the sedate family sedan. Which essay would you rather read: “Star Wars: The Fight Against Space Radiation” or “Radiation and the Environment?” Our favorite this year was, “The Itsy-Bitsy Spider Levitated Up the Water Spout.” We find that sharing student exemplars and professional sources such as The New York Times and The Washington Post science sections, help students circumvent this pitfall, not only with choosing appropriate titles but also with learning to translate the science.



### **PITFALL #4: NOT TRANSLATING THE SCIENCE**

**“Because the NETs express a high density of ss2, this makes these receptors ideal to focus on when imaging NETs. Right now, Gallium-68-DOTATOC/-TATE is used as diagnostic imaging radiotracer, but a study done in June of 2018 by Nicholas et al. found that a new radiolabeled tracer, Ga-68-OPS202, could perform better than Gallium-68-DOTATOC/-TATE in radiolabeled imaging.”** – sophomore first draft primary research paragraph

When a passage such as the one above appears in a first draft, it signals an opportune time to check for student understanding. In one-on-one conferences, we find that many times, students do understand the primary science articles and can verbally articulate the science for us in layman's terms, so all they need to do is write it. These conferences are an important way to differentiate our instruction, also. In addition, peer review groups after completion of the first draft are helpful in avoiding this pitfall.



## PITFALL #7: NONSPECIFIC EXPLANATIONS

Students write generic sentences such as “Thus, scientists have conducted more research and begun to develop more technologies in hopes of slowing down this problem.” What research? What technologies? What problem?

We find increasing repetition of nonspecific words such as it, this, these, they and them: “If it is reflected off the earth, it either exits the atmosphere again or is absorbed and reflected. It can also be absorbed by various gases.” And perhaps the writers themselves don’t know how to change direction so they start to ask rhetorical questions in their essay, a strategy without a real purpose: “Who knows what we’ll use light for in the future?”

Our first draft reviews followed by conferences help to bring these problems to the attention of our students.

## PITFALL #8: INCOHERENCE, EXAGGERATION, FACTUAL INACCURACY, FABRICATION

Long, run-on sentences, gaps in information, and weird metaphors lend an air of incoherency to the essay and disengages the reader. To be knowledgeable and engaging, sometimes students exaggerate scientific claims losing accuracy. We once had a student, when writing about the importance of blood testing for newborns to screen for potentially fatal health issues, fabricated the death of a baby to make her essay more “exciting.” First drafts and peer review groups help provide helpful feedback, and individual student conferences help students revise for clarity.

## PITFALL #9: HOW DO I CORRECTLY FORMAT AND CITE RESEARCH?

Although directions for citing sources appear to be straightforward, students tend to get detoured when weaving sources into their essay. At Thomas Jefferson, we subscribe to NoodleTools, a research platform for students to record their sources and create their bibliographies. NoodleTools has a function that will show students how to use a source in the body of their paper. We encourage our students to think chronologically and mathematically. Primary research should be discussed in the essay beginning with the oldest article and ending with the newest. Every source listed in their APA-formatted references page should be included in their narrative. We find that students understand that direct quotes from sources need to be cited in the paper, but often don’t realize that someone else’s ideas even when paraphrased need to be directly cited, too. Again, this is where student conferences are very helpful, and feedback is given prior to the final submission of the essay.

## PITFALL #10: THE END (YAWN)

For some writers, the journey comes to a screeching halt. For others, it never seems to end. Because we have a minimum word count of 1,000 words, the last two paragraphs sometimes end up as filler with no value. Their narrative is driven into the weeds with banal conclusions and repetition of information. We counsel students to discuss the implications and future applications of their research in their conclusion, and artfully link their new knowledge back to their chemistry lab experience mentioned in their introduction. After all, a superior narrative often has symmetry.

When this part of the journey is over, we hope our students can move on to junior year with a solid foundation in both writing and research, although they’re aware the pitfalls will always loom. They read “The Odyssey” as ninth graders so they’re aware passing through their research Scylla and writing Charybdis will take much work. We hope we’ve given them tools to make the journal successful. ■

## PITFALL #5: PLAGIARISM! THE DOOM OF COPY AND PASTE

“Results showed that the higher the injection rate, and the higher the temperature at which the hydrate was injected, the higher the production rate was for gas hydrates.” – sophomore first draft primary source paragraph

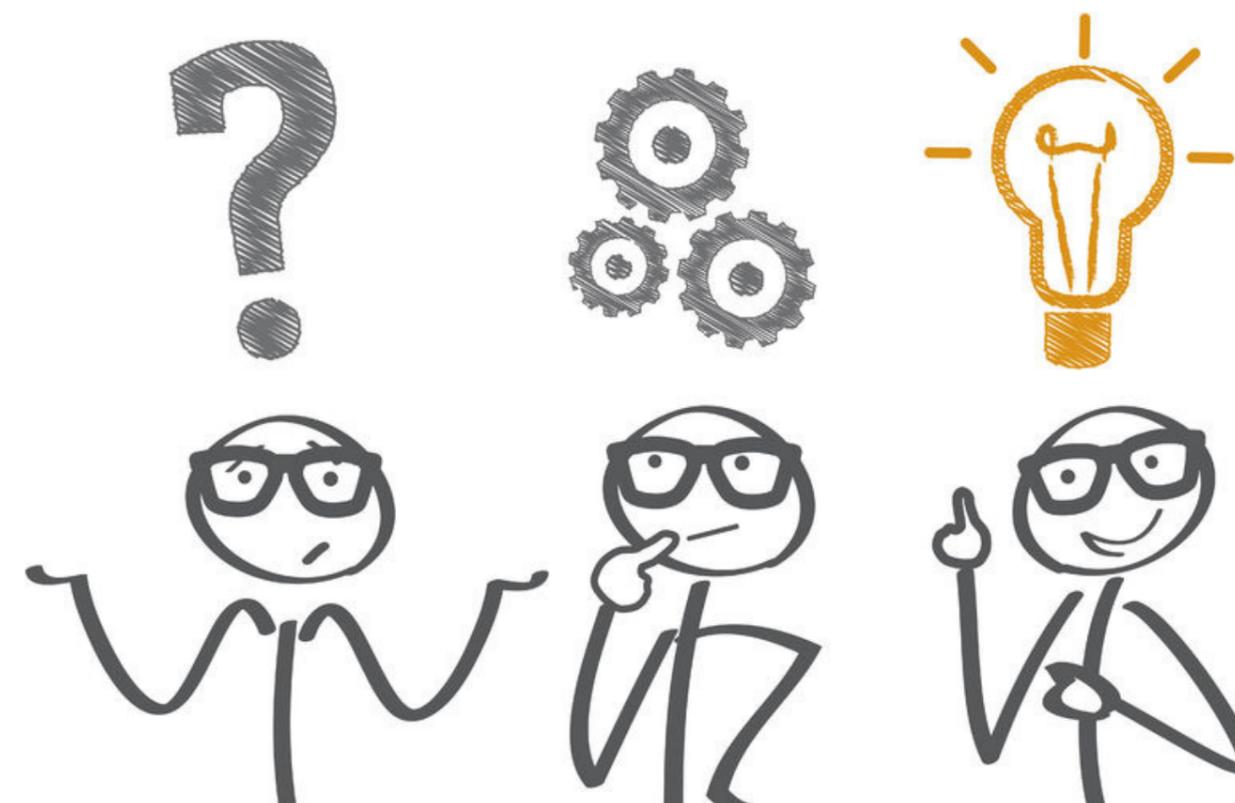
We can hear plagiarism in an essay because the student’s use of language changes. The words sound different. To avoid this academic integrity pitfall, we find that having students annotate their articles using the 5 W’s and 1 H summary and evaluating their articles using CARRDSS helps them put the information into their own words prior to even writing the first draft.

## PITFALL #6: LOSING SCIENTIFIC VOICE

Although we want students to translate the science for the general public to understand, students need to use correct, appropriate, and professional terminology and avoid “teen slang.” Student examples include statement such as:

- “While fusion may **seem like a long shot**, it really isn’t.”
- “I **stumbled** upon research conducted by...”

Ways to help students avoid this pitfall is exposure to secondary science sources such as Scientific American, peer review groups, and individual student conferences on the first draft.



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# SERVING STEM STUDENTS AFTER AP CALCULUS

**Charles R. Garner Jr, PhD, Mathematics**  
Calculus Instructor and Math Team Sponsor  
Rockdale Magnet School for Science and Technology



# A

common issue facing STEM schools is what to do with students who take AP Calculus as juniors (or earlier).

Schools and school systems have various ways to support these students. Some schools simply offer a year of AP Calculus AB followed by a year of AP Calculus BC; some offer AP Statistics after (or before) calculus; and some schools have the opportunity to be located near a college or university which offers dual enrollment. For various reasons, none of these options worked for the Rockdale Magnet School for Science and Technology, and it was left to us to determine how to serve these students.

## A LITTLE HISTORY

To understand why these typical options did not work for us, a little background may be helpful. When RMSST was founded in 2000, the only calculus class offered was AP Calculus BC, and it was required to graduate. By the 2002-03 school year, we had juniors in BC. As seniors, they went to a local campus of a large community college to take Discrete Mathematics. We did this for only two years because the college discontinued offering Discrete Mathematics at that campus. The RMSST Advisory Board requested that

a course be offered in the school for these students. Around the same time, the school grew larger and we also decided to offer a math elective. Two senior-level, year-long courses grew out of this initiative: Multivariable Calculus as the course required of seniors who took BC as juniors, and the History of Mathematics as an elective course.

Neither of these courses existed, so it was up to me to write the curriculum and shepherd them through the State Board of Education approval process. The courses were approved and were made available to any school in Georgia as official state courses. The first course to win

**“... Neither of these courses existed, so it was up to me to write the curriculum and shepherd them through the State Board of Education approval process.”**

approval was History of Mathematics, as it was easier to gain approval for a pure elective than a “required” math class. It was first offered at our school in the 2003-04 school year, and has been offered every year since. Multivariable Calculus took a little longer to be approved

and was first offered in 2005-06.

Soon after, our administration at the time wanted to give students a little more variety in their courses selections. I recalled the Discrete Math course taken by our seniors and decided to cut History of Math down to a one-semester course, paired with a semester of Discrete Math. This proved to be a wise decision, as this pairing proved popular enough with seniors to hit maximum enrollment each year. We offered this pairing from 2006-07 until 2010-11. The reason we stopped was that the Discrete Math course, an approved state course for decades, was removed from the course list, due to the gradual introduction of the Georgia’s new standards-based curriculum, called the “Georgia Performance Standards.” (Now the standards are called “Georgia Standards of Excellence”.) This change in curriculum affected History

of Math and Multivariable Calculus as well, as they each had to be re-written to be standards-based. I rewrote and submitted them to the state Department of Education for approval again. They were happily approved again as well. (Full disclosure: at this time I served on the Department of Education’s Math Advisory Council, which approves all mathematics initiatives and courses. I recused myself when these courses came up for discussion and vote. I continue to serve on the Advisory Council.)

However, Discrete Math was simply removed, and I heard that no such course would ever be approved due to ever-decreasing rigor in non-STEM schools. Seeking a new course to pair with the semester History of Math, I learned of a new course offered by the state, called Mathematics of Industry and Government (MIG). This course was really an introduction to operations research using Microsoft Excel. This seemed like a good fit with our school’s new one-to-one device initiative. We started offering MIG with History of Math in 2011-2012, and have offered these electives every year since.

The latest change is the course called “Advanced Finite Mathematics” (AFM). This course is really a discrete mathematics course by another name. I heard from alumni who told me that the old discrete math was “the most useful math class” they took. Their justifications for this bold statement fell in two categories: that learning to write proofs helped them with all other math classes they encountered, and that it aroused their interest in other branches of mathematics besides calculus. Based on their experience, as well as wanting to offer a course for students who did not want another year of calculus, I designed and wrote the curriculum for the year-long AFM course and it was approved by the state Department of Education. We offered the course for the first time in the 2016-17 school year.

All the courses that are described are approved, state-funded courses for any high school in Georgia to make available to their students.



## MULTIVARIABLE CALCULUS

This is possibly the most traditional option for seniors who took AP Calculus as juniors. However, the curriculum for this course includes an introduction to linear algebra and to differential equations. The following is a summary of the standards.

- Students will investigate the relationship between points, lines, and planes in three-dimensions.
- Students will recognize and apply properties of matrices.
- Students will explore functions of two independent variables of the form  $z = f(x, y)$  and implicit functions of the form  $f(x, y, z) = 0$ .
- Students will explore the continuity of functions of two independent variables in terms of the limits of such functions as  $(x, y)$  approaches a given point in the plane.
- Students will explore, find, use, and apply partial differentiation of functions of two independent variables of the form  $z = f(x, y)$  and implicit functions of the form  $f(x, y, z) = 0$ .
- Students will define and apply the gradient, the divergence, and curl in terms of differential vector operations.
- Students will integrate functions of the form  $z = f(x, y)$  or  $w = f(x, y, z)$ .
- Students will apply and interpret the theorems of Green, Stokes, and Gauss.
- Students will use, apply, and solve linear first-order and second-order differential equations.

Clearly, there is much that students must learn in order to “apply and interpret the theorems of Green, Stokes, and Gauss.” Students must learn include line integrals in the plane, line integrals in space, surface integrals, vector and parametric representations of functions, and the notion of independence of path. There is a lot of knowledge packed into these few standards. For more detail into the standards, see <https://www.georgiastandards.org/Georgia-Standards/Pages/Math-9-12.aspx>. For more information as to how I teach the course, see my webpages, <http://www.drchuckgarner.com>.

## HISTORY OF MATHEMATICS

This course has been one of the more popular electives at our school. Alumni often say that it is an interesting class, and they say the class has broadened their notion of mathematics itself and its impact on our society. From the outset, I wanted the course to be more than just a history of math up to calculus, I wanted to go up to the present. That means teaching students some challenging mathematical topics – such as non-Euclidean geometry and group theory – so they may gain a better perspective on the historical impact of these topics. With only a semester to span all of human history, some things must be left out. So my perspective in teaching the course is from the student's: why do we do the math we do, and how did it get this way? This simple question guides what I teach and how. The following are the broad standard topics. For details, see <https://www.georgiastandards.org/Georgia-Standards/Pages/Math-9-12.aspx> and my webpages, <http://www.drchuckgarner.com>.

- Students will explore and use historical methods for expressing and solving equations.
- Students will explore abstract algebra and group-theoretic concepts.
- Students will use and apply number theoretic concepts.
- Students will use the algebraic techniques of Fermat, Barrow, and Newton to determine tangents to quadratic curves.
- Students will prove geometry theorems.
- Students will compute lengths, areas, and volumes according to historical formulas.
- Students will explore and prove statements in non-Euclidean geometry.
- Students will compute the ratio of winnings in an interrupted game.
- Students will identify Hindu-Arabic numerals as a prime scientific advancement.
- Students will describe factors involved in the rise and fall of ancient Greek society.

- Students will trace the centers of development of mathematical ideas from the 5th century to the 18th century.
- Students will identify the 19th and 20th centuries as the time when mathematics became more specialized and more rigorous.

## MATHEMATICS OF INDUSTRY AND GOVERNMENT

This is the one course in this article I did not write. The course is an introduction to operations research through the use of Excel. Students are given problems in linear, integer, and binary programming to solve using Excel's Solver add-in. Students are taught how manage Excel formulas and sheets to set up the problem so that Excel can solve it and so that the solutions can be read by humans! The course is actually a year-long course, but we only offer the first semester, which is optimal programming and deterministic decision making. The standards are below. The second semester is probabilistic decision making.

- Students will use advanced linear programming to make decisions.
- Students will determine optimal locations and use them to make appropriate decisions.
- Students will determine optimal paths and use them to make appropriate decisions.

More information can be found at <https://www.georgiastandards.org/Georgia-Standards/Pages/Math-9-12.aspx>.

## ADVANCED FINITE MATHEMATICS

This course introduces a variety of discrete mathematical structures, and interweaves proofs throughout. Students initially took this course instead of Multivariable Calculus, because they thought it would be easier, but writing good proofs presents its own unique

challenges. This course includes so much that to list it all would take pages. Listed below are not the standards, but the overall group heading of the standards, so you have some idea of the breadth of the course.

- Represent and interpret statements using logical symbolism
- Use set theoretic operations
- Use and interpret Boolean algebra
- Use number theoretic operations
- Prove statements in number theory
- Apply number theory
- Calculate the probability of events
- Use methods of counting
- Prove statements involving combinatorics
- Use and recognize graph properties
- Prove statements in graph theory
- Apply graph theory
- Use certain proof techniques

For example, under “proof techniques” one finds explicit standards for teaching mathematical induction (both regular and strong induction), proof by contradiction, and proof by contrapositive. There is quite a lot involved in AFM. Of course, for details, see <https://www.georgiastandards.org/Georgia-Standards/Pages/Math-9-12.aspx> and my webpages, <http://www.drchuckgarner.com>.

## CONCLUSION

We have mathematics courses at our school which make us unique. The high standards of rigor, while difficult to maintain consistently, give our students a unique advantage: some alumni have successfully argued that they should be exempt from certain college courses (one successfully argued for credit). The obvious benefit to creating courses yourself is that you know your student populations and you can design a course to serve that population well. But there is another benefit: professional development. To write a course, you really have to know the material, know the most important parts and themes, and communicate that to students and colleagues. One must interact with other teachers and educators, to get feedback and advice. In doing so, I made contacts at the Department of Education which led to opportunities to present at state and national conferences, and to sit on state and national Boards. This is a rewarding experience which I would suggest anyone do if given the opportunity. ■



**CHARLES R. GARNER JR, PHD, Mathematics**  
*Calculus Instructor and Math Team Sponsor*  
**Rockdale Magnet School for Science and Technology**



# GSSM AND FIZMAT COLLABORATE TO BUILD GLOBAL OPPORTUNITIES FOR STUDENTS

By Randy La Cross  
Vice President for Outreach & Global Initiatives

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NCSSSS is now the go-to for Congress: The definition in ESSA of a STEM school was drafted by NCSSSS's Board.



Contact Todd Mann to engage with NCSSSS

[todd.mann@ncsss.org](mailto:todd.mann@ncsss.org)





Four students from the South Carolina Governor's School for Science and Mathematics (GSSM) recently traveled to Almaty, Kazakhstan, to participate in the 15th International Zhautykov Olympiad, a prestigious competition that brings together student scholars from across the world to complete team challenges in math, physics and computer science. The students' participation in the Olympiad sprang from an NCSST-sponsored collaboration between GSSM and Kazakhstan's National School of Physics and Math (FIZMAT).

Origins of the Collaboration  
During summer 2018, GSSM agreed to become an active participant in the NCSST Global Pilot Project and to assume a leadership role in one of the projects' three work stream groups. Representing GSSM in the Global Initiative professional development group was Randy La Cross, the school's Vice President for Outreach & Global Initiatives. In a series of regularly

scheduled video conferences, La Cross formed relationships with NCSST global member schools and began, in coordination with those schools' representatives, to brainstorm collaborative strategies that would address each member school's needs.

It was through these interactions that La Cross made the acquaintance of Yerlan Uteulin, FIZMAT's Chief Business Development Officer, and Bakyt Ospanov, FIZMAT's Board of Directors When La Cross, Uteulin, and Ospanov later learned that they would all be attending the 2018 NCSST Professional Conference in Houston, they decided to meet up to develop an international partnership.

While in Houston, Uteulin and Ospanov informed La Cross about the International Zhautykov Olympiad (IZHO), which their school had been hosting for many years. Mentioning that the 15th IZHO was slated to occur in January 2019, Uteulin and Ospanov suggested that La Cross attend the event to learn more about FIZMAT, to meet key staff at the school, and to determine whether GSSM might one day send a team of its own to compete at the Olympiad.

**To get to the school, La Cross and the students had to take a 30-minute walk through Almaty, and all were astounded by the beauty of the city, which is surrounded by breathtaking snow-topped mountains.**

Although the three representatives agreed to stay in touch after the Houston conference, La Cross was happily surprised in December 2018 to receive an earlier-than-expected call from Uteulin and then an official invitation from Gabit Bekakhmetov, CEO of FIZMAT, to visit FIZMAT during the 15th Olympiad. Perhaps most extraordinary about the invitation was the stipulation that accompanied it: GSSM should bring a team of students to compete. Overjoyed at this unforeseen development, La Cross spoke with GSSM's president and administration and received their blessing to take a student team to the IZHO in January. La Cross then set about assembling the team and planning their 13,600-mile, 8-day adventure to Almaty, Kazakhstan.

## THE TRIP BEGINS

On January 7, 2019, La Cross met a team of four students in Charlotte, North Carolina, to begin their trip to Almaty. The team members were 10th and 12th graders who participate in GSSM's three-year virtual engineering program, which is known as Accelerate. Somewhat anxious but also highly excited at the prospect of traveling to a new country, La Cross and the students resolved to think of themselves as "pioneers on a journey to a new culture," a journey that would lay the foundation for a lasting, mutually beneficial GSSM-FIZMAT partnership.

After nearly 23 hours in the air and a layover in Frankfurt, Germany, the GSSM team arrived in Almaty on January 9th. They were received by FIZMAT officials who escorted them to the Astana International Hotel, which would be their home away from home for the next 8 days.



On the following morning, after only a few hours of sleep, Team GSSM met in the hotel's dining room for their first taste of Kazakh cuisine and



were soon thereafter greeted by a group of FIZMAT student ambassadors, who guided them over the ensuing days through the Olympiad's activities. The first stop that winter morning was FIZMAT itself, where the team needed to register for the competition. To get to the school, La Cross and the students had to take a 30-minute walk through Almaty, and all were astounded by the beauty of the city, which is surrounded by breathtaking snow-topped mountains. The team was also awed by the Kazakh weather. Coming from South Carolina, where less than an inch of snow causes much trouble and many school cancellations, the students quickly understood that sub-zero temperatures and falling snow do not bring life to a halt in Kazakhstan!





Once on the FIZMAT campus, Team GSSM was warmly welcomed by the FIZMAT faculty and staff who were responsible for organizing and running the Olympiad. The GSSM students were also introduced to members of other student teams, whose home countries included Kazakhstan, Denmark, Bulgaria, Turkey, and Georgia. Growing more and more adept at communicating with students and teachers who spoke languages other than English, Team GSSM registered for the IZHO, took a tour of FIZMAT, and had lunch in the school's dining room. The FIZMAT student ambassadors then took the team to a store where they could buy souvenirs and snacks, including several bars of delicious Kazakh chocolate and a bottle of



camel milk that team members shared. All these activities provided the team with opportunities to learn about the culture of Kazakhstan and to recognize the similarities and differences between the US and Kazakh educational systems.

### THE COMPETITION

The 15th IZHO officially began on the morning of January 11, 2019, with an opening ceremony in FIZMAT's O. Zholdasbekov Student Palace. Arriving at the Palace, Team GSSM stood among 500 students from 25 countries, all of whom had come to compete in the Olympiad. Although the GSSM students might rightly have felt daunted at being the only American team in the competition, they instead felt honored to represent their country and were eager to begin the challenges of the day.

Prior to the beginning of the opening ceremony, La Cross met back up with Gabit Bekakhmetov and Bakyt Ospanov, who kindly led the team members to their seats. The ceremony itself

proved to be an amazing spectacle that featured musical performances by FIZMAT students, a parade and introduction of all competing teams, guest speakers, and a live performance by a popular Kazakh hip-hop group. Greatly impressed with the ceremony, La Cross subsequently invoked a southern expression of high praise when he told one of his new FIZMAT colleagues, "You all know how to do things right!"

With the conclusion of the ceremony, the stage was set for the two rounds of rigorous competition that would take place during the following two days. Over the course of the Olympiad, the 500 student participants spent many hours solving difficult mathematics, physics, and computer science problems, and Team GSSM accepted the challenge of the competition with gusto. Aside from appreciating the complexity of the academic problems, the students also took pride in competing against schools with long-standing traditions of participating in international Olympiads, including the IZHO itself.





## AFTER THE COMPETITION

Once the Olympiad had come to an end, many teams joined together in friendly sports competitions or took trips around Almaty. Team GSSM, for instance, participated in a snowball battle with Danish students in the courtyard of FIZMAT and also visited the Kazakh State Circus and the Medeu Skating Rink, which is the highest-altitude skating rink in the world. While on the Medeu trip, students enjoyed the spectacular views and also strengthened friendships with students from across the world.

Since the conclusion of the Kazakhstan journey, La Cross has often reflected in amazement on how significant the experience was. As he explained, “Little did Yerlan, Bakhyt, and I know at the time of our first face-to-face meeting in Houston that a small group of students from the top STEM high school in South Carolina would travel thousands of miles from home to participate in the Olympiad and pave the way for our schools’ future global opportunities and experiences.”

These opportunities and experiences are certain to become a centerpiece of GSSM and FIZMAT’s ongoing collaboration, and representatives from both schools have already begun exploring additional partnership possibilities. According to La Cross, these possibilities include FIZMAT students participating in GSSM’s summer residential STEM program and its international Research Experience Scholars Program. Also under discussion are plans to develop student research experiences in Kazakhstan for both GSSM and FIZMAT students. “We look forward to our continued partnership with FIZMAT,” La Cross said. “The Kazakhstan trip was a phenomenal experience, one that we certainly hope to build upon in the coming years.” ■



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## Top 10 Lessons I Have Learned Through Leadership at a STEM School

By Natalie Arias

In December of 2015, I took on the challenge of attending a school designed for excellence in the fields of science, technology, engineering, or mathematics—STEM, for short. Merely thirteen years old, I had no idea what I wanted to pursue, and I still believed that I could only pursue *one* interest of mine. But acceptance into the Rockdale Magnet School for Science and Technology (simply known as “Magnet” or “RMSST”) widened my imagination to all the doors that could open: research in Biosafety Level 1 laboratories, Advanced Placement (AP) classes and teachers available as early as the ninth grade, and involvement in Student Council, something that many other schools take for granted.

With each of these fields of interest that I am involved in, new challenges arise almost every single day. It is definitely a struggle to combat most of them without some guidance from those who have done it before, but I am thankful that I am here to reveal ten of these lessons.

### 1. Leadership isn't always being the smartest.

No leader or person in charge who I have ever met has been omnipotent or all knowing—it just doesn't happen! It's a misconception that only the people who are in charge can unlock all the secrets of the universe. I am proud to disclaim that I don't know everything. I like to hold myself to a higher standard, but truth be told, I can't have all of the answers. If that were the case, why would I lead others when I could just dictate?

This principle is especially present in not just student council, but also lab groups. AP Chemistry hosts loads of new labs to correspond to the lectures and the readings, and work with

three intelligent students who help each other to use deduction and analysis of the data to find out the answers. We uplift each other in many ways, and I love having people who I can count on to steer me in the right direction, and vice versa.

### 2. Being the leader doesn't mean you have to change.

Well, sometimes. Of course, there are certain occasions where it is necessary to uphold yourself to a high standard, such as during a presentation or a meeting. But to abandon all your ideals and morals and values just to fit in is not the point of being a leader who stands out. An outstanding leader has character, and his or her actions show in many things that he or she does. Maybe the leader is passionate about serving the local community and wants to increase participation in such organizations. Or maybe the leader is keen on making a change within his or her current facility, so he or she strives to create an event with the mission of delivering said impact to the target audience. Whatever the case may be, it is the leader's obligation to never forget his or her roots; they are the foundation to leaving a footprint and documenting the stories of success.

### 3. Don't be afraid of mistakes.

However confident I am in my actions and thoughts, I am still subject to error. I may forget an important deadline, or I have no sense of direction, or I don't follow through with the intended agenda. The workload between student council, AP classes, and extracurricular activities can impede on my stability at times. This is all a part of the process. And it's a way to grow as a person. According to Dr. Carol Dweck's growth mindset theory, looking at mistakes as opportunities to learn and to be better is serum to triumph in the future. However brutal the mistake may be, it's understandable, it will be forgiven and forgotten, and it will prepare for the future—just as long as you make the conscious effort to learn from it.

### 4. Everyone should have a purpose!

One of the most aggravating things about working in a group is partial involvement. Similar to ionic compounds and having positive and negative charges between the atoms (sorry—I just had to include a chemistry reference), one side of the group is positive in working efficiently, meeting deadlines, and being on track toward a good grade, and the other side is negative. Leaders should not let this happen if they want everyone to have an equal chance and an equal voice! Tasks should be divided equally so that no one person gets by without a scratch and no one person is stressed to the core. It only impedes trust calm-headedness.

### 5. Give credit where it's due.

Just as I would not want to be recognized for my hard work, I do my best to shine the spotlight on my fellow teammates. Whether it be as simple as letting me borrow a pen or a computer charger or as grandiose as teaching me a concept that I missed in class or sharing the notes with me from the last meeting, the lender is in many ways an important part in the process of reaching your goal, so it is vital to share his or her importance with the world just as you would your own.

### 6. Say thank you all the time!

Similar to the last lesson, recognition is key to maintaining healthy relationships among the members of an organization. People want to know that their efforts are appreciated because it means that they are no longer just an inconceivable speck in the universe. At my school, Student Council has an award that is given every year to a new faculty member called the UMPH Award. This was named in honor of a past Student Council president, with the quote on the plaque being “the difference between **try** and **triumph** is a little **UMPH!**” So to a teacher, an administrator, or a staff member, the award goes to someone who goes above and behind in

## NATALIE ARIAS

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everything and makes sure that the little things about people are remembered just as the big things are. Each year that we have hosted this, the selected candidate has cried or screamed or smiled in glee, knowing that all that they do has been recognized by the public. Saying thank you can be just as powerful as saying you're welcome.

## 7. Tell people when you'll be away or offline.

This is one of the most courteous things you can do as a leader. Letting people know where you will be (or where you won't be) at certain times that are most active will save time and

toil in the future. It will also prepare people to make a running list of questions and concerns for the time that the leader returns to the face of the earth. Being on vacation for two weeks in Honolulu is nice, but while members of the team are slaving away to finish work you've left behind, they are also worried about the potential of the event or goal. So why not share some of that information with the rest of us? It takes but two seconds to do and the allotted time of the vacation to be in effect.

## 8. Concentrate.

It is always a struggle for me to find motivation to do homework or make school-related phone calls on a Saturday or Sunday morning. The key phrase that plagues me every time I sit at my desk: why do something now when I could do it later? This is where the eighth lesson kicks in. I know that I am wrong, but I have only recently found a method to steer me in the right direction: an Excel spreadsheet and a timer. I type all of the assignments that I want to accomplish in the work session. I assign a reasonable amount of time to each assignment. I pick up my writing utensil. I start the timer.

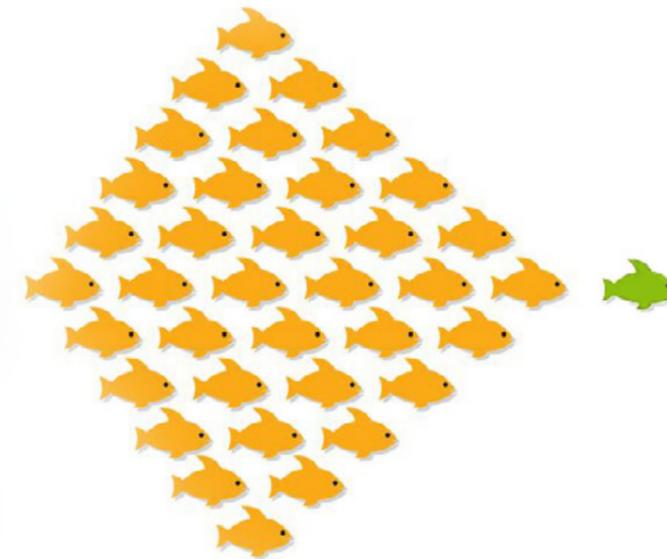
Simple enough, right? The most important part of that whole process is to envision being done with the assignment and getting what was required out of it: a completed goal, knowledge, reviewed information. It all depends on the subject, but nevertheless it is worthy of trying (or trying a variation) so that laziness and haziness doesn't get to the best of us.

## 9. Get a head start.

All my teachers as well as my student council advisor has pushed this narrative onto me, that I ought to use what resources are available to me at present to begin a project early. Whether it's brainstorming with a couple of friends or making an outline of a checklist, any effort to get to thinking about a grand event or project is one that can be respected and pursued. As long as thinking doesn't get to the point that the daydreams are all in one's head and uncommunicated with anyone else, there is a healthy point in the process that can be drawn.

## 10. You have all that you need; conquer your fears!

The time is here. It's the Big Test; it's the School-Wide Performance; it's the Important Presentation. You've done countless hours of preparation, practicing, and pinning down the errors. But what holds you back? Just yourself. Going back to the growth mindset, the only way to get better at something is to try. And the only way to try is push aside all the fear-mongering that has been building up. Nothing is more important than this next moment, but it is something that a leader should never let psych him or her out. And it is only something that will be used as a learning experience if you let it. Be in the moment, present with every emotion that you let push yourself forward, and go for it. All that's left to lose is nothing, just as long as you create that landscape for you to unleash your inner artist, persona, and leader. ■



## HOME-GROWN MEANS MORE THAN JUST GREAT-TASTING TOMATOES

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# BUILD IT AND THEY WILL COME— TO INNOVATE

**Edited by Marcia Faye**  
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## DESIGN FEATURES THAT COMPLEMENT THE CURRICULUM

With its bold façade of glossy, white ETFE (ethylene tetrafluoroethylene) panels, the two-story, 70,000-square-foot Kaplan Institute is impossible to miss against the backdrop of blonde brick, steel, and glass of Illinois Tech’s Mies Campus. Designed by award-winning architect John Ronan, Illinois Tech John and Jeanne Rowe Endowed Chair in the College of Architecture, the Kaplan Institute is a “hybrid of campus space and building.” Ronan lists some of the building’s one-of-a-kind details:

- “Room colors correspond to Post-it® Note colors, which are instrumental in the Interprofessional Projects (IPRO) Program and Institute of Design teaching methods.”
- “The two-story glazed courtyards bring natural light deep into the floor plate, creating a spacious, airy, and light-filled interior and a continuous connection with nature.”

- “Assigned project spaces and meeting spaces that require sound isolation are enclosed with demountable partitions that can be reconfigured over time, preserving the building’s future flexibility.”

### “I” Stands for Innovation and . . .

From its whiteboard walls to its maker spaces, the Kaplan Institute is focused on student, faculty, and industry initiatives aimed at moving ideas from rough concepts to early-stage ventures as well as other programming and resources that support more traditional coursework in more interactive settings. It is also the new campus home of the Institute of Design. The most prominent entities within the Kaplan Institute are:

- **Institute of Design**—Considered one of the world’s leading graduate institutions for human-centered design and systems thinking, the Institute of Design joined Illinois Institute of Technology in 1949 and is now housed in a building that truly complements its teaching methodology.

**A**s Chicago’s only tech-focused university, Illinois Institute of Technology is now offering students even more opportunities to discover, create, and prepare for careers in areas of significant innovation in 2019 with the opening of the Ed Kaplan Family Institute for Innovation and Tech Entrepreneurship. One of 21 institutions that comprise the Association of Independent Technological Universities, Illinois Tech provides an exceptional education centered on active learning, and its graduates lead the state and much of the nation in economic prosperity. Illinois Tech uniquely prepares students to succeed in professions that require technological sophistication,

an innovative mindset, and an entrepreneurial spirit.

Learn more about the Kaplan Institute, which houses the Institute of Design, the Janet & Craig Duchossois Idea Shop, the university’s signature Interprofessional Projects (IPRO) Program, and other creative spaces.

## MULTI-LEVEL MISSION

Illinois Tech is dedicated to providing smart, forward-thinking students with an education that inspires technology-based innovation and entrepreneurship that is relevant in the twenty-first century. The mission of the Kaplan Institute is to nurture the advancement of critical and creative ideas, to foster interdisciplinary and external collaboration, and to create a culture that enables innovation and tech entrepreneurship to flourish.



• **Janet & Craig Duchossois Idea Shop**—Along with the Grainger Maker Space and assorted studios, students can work independently, in collaboration with others, and even participate in hackathons in expansive rooms surrounded by whiteboards and filled with equipment ranging from 3-D printers and CNC milling machines to laser cutters and computer stations.

*“It’s really been designed around how we’ve observed students working,”* says Idea Shop Director Jeremy Alexis (ARCH ’97, M.Des. ’99), noting that based on student input, a large section of the Idea Shop is specifically for accessing mock-ups and performing light prototyping.

• **Interprofessional Projects (IPRO) Program**—Popularly known as IPRO, Illinois Tech’s signature Interprofessional Projects Program, established in 1995, gives undergraduates the chance to team up with fellow students across academic disciplines to tackle real-world problems.

In a current IPRO, teams of students are working to improve preparedness and responsiveness to fire emergencies in Chicago through a collaboration with the American Red Cross that

provides access to its rich array of data through a grant from the Motorola Solutions Foundation. In one project, students are developing low-cost, high-effectiveness solutions to educate individuals in hot-zone neighborhoods where fire incidence is especially noted.

*“I love working on real-life problems. You don’t get the chance too often in a classroom setting to help a nonprofit organization develop tools to reduce real fires affecting real people,”* says Tayseer Mozaffar (EMGT 4th year). *“In my opinion, there’s no more valuable a class than an IPRO.”*

## LEADER WITH A TRACK RECORD OF SUCCESS

Howard A. Tullman, a veteran entrepreneur, investor, and academic administrator who spent the last five years leading Chicago tech hub 1871, is executive director of the Kaplan Institute. Also the general managing partner of Chicago High Tech Investment Partners and G2T3V, LLC, both Chicago-based early-stage venture capital funds, Tullman has successfully founded more than a dozen high-tech companies. He was the chairman and chief executive officer of Tribeca Flashpoint

College, which he co-founded in 2007, the former president of Kendall College, and the former chairman and CEO of Experiencia, Inc.

Tullman believes that the potential for future employability is critical in educating students today.

*“From day one, I said that the Kaplan Institute can’t just be the student union for techies. There are plenty of those. And I think that’s a risk; most universities that have incubators are not sufficiently focused on turning out talented and qualified students who can hit the ground running and immediately help their employers,”* says Tullman. *“We don’t do [our students] much long-term good if we give them this wonderful education in a vacuum. If I can’t give you the skills you need for tomorrow and if I can’t get you a serious job upon graduation so that you can support yourself and repay your student debt, then we haven’t prepared you and fully equipped you with the skills you’re going to require not simply for graduation but to go on and build a successful future.”*

## CORPORATE PIONEER AND VISIONARY

Chicagoan and Illinois Tech mechanical engineering alumnus Ed Kaplan (ME ’65), co-founder of barcode technology global leader Zebra Technologies Corporation, had a strong desire to teach students how to build a business. He and his wife, Carol, donated \$10 million in the form of a challenge grant to help encourage and support the development and construction of the new building. To date, 14 other donors have

contributed at least \$1 million to the institute, which had its grand opening on October 25, 2018. It is also funded by the generous philanthropy of hundreds of faculty, staff, and alumni donors.

## EXPERIENCE AND SKILLS TO LAST A LIFETIME

Part of the purpose of the Kaplan Institute is to supplement the technical education of the students with critical and future-proof skills, including intellectual curiosity, a commitment to change, team-building ability, an entrepreneurial mindset, a willingness to accept challenges, and a bias toward action. Special leadership programs are being developed and offered to identified cohorts of undergraduates as well as graduate students, focusing on the development of critical-thinking skills, resilience and perseverance, adaptability and agility, and strategic design and planning.

*“At the Kaplan Institute, we will provide pathways, giving students a menu of practical, useful, targeted courses that will help them pursue their entrepreneurial interests. We will give our students opportunities to learn from the experiences of others as well as through hands-on learning. We will teach our students how to convert an idea into an innovation and then commercialize that innovation or use that innovation to save lives,”* explains Ed Kaplan.

*“No single university in the United States has a program that will be as robust as ours.”* ■



### MARCIA FAYE

**Associate Director of Editorial Services  
Illinois Tech**

Marcia Faye is associate director of editorial services at Illinois Tech and managing editor of Illinois Tech Magazine.





The National Consortium of Secondary STEM Schools (NCSSSS) was established in 1988 to provide a forum for specialized secondary schools focused on science, technology, engineering, and mathematics (STEM) disciplines to exchange information and program ideas.

## NCSSSS Mission

Our mission is to advance STEM education by providing professional development and networking opportunities for educators and learning experiences for students; to serve as a national resource for STEM schools and programs in partnership with educational, corporate, and international organizations; and to inform policymakers on STEM education.

## NCSSSS Vision

Our vision is to serve as the resource for secondary STEM schools by supporting collaboration and knowledge sharing and providing professional development for teachers and administrators to positively impact student achievement in authentic STEM educational environments.