



SITS 2022

Summer Institute in Teaching Science 2022

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SITS Writ Large(r)

An Update on Some Exciting New Projects and Resources

by Michael Gray, Founder and Director: Summer Institute in Teaching Science

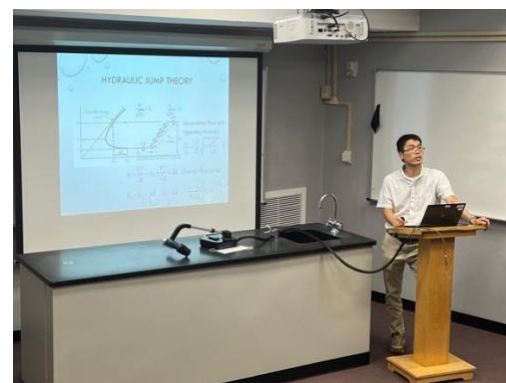
This past academic year was the first in nearly 50 years that I wasn't teaching in a university classroom. The potential void was comfortably filled as I developed resources for anyone who wants to learn how to learn or to help their children or grandchildren flourish as learners. I had a little learning laboratory applying these ideas to the preschool learning of my grandson, Joshua. What an enthusiastic learner he has been! He moved from a three-year-old who knew his colors to a four-year-old who is an emerging reader, a lover of numbers, and a lover of animals of all kinds.



Dr. Gray with his grandson, Joshua.

I've always believed that the philosophy of learning embodied in SITS is neither science specific nor university specific. The past year I've been on a quest to extend the reach of the concept- and principle-driven learning paradigm which has been honed over the 18-year history of SITS. I've had an unprecedented opportunity to drill down into what it means to know (the goal of learning) as well as to study in greater depth than ever before how the human brain learns.

The human brain is a pattern maker par excellence and (not coincidentally) the universe is full of patterns! In a sad misappropriation, most of education has historically tried to force the brain to act as a data base for disconnected factoids that regularly disappear. Deep learning is learning that systematically builds a network of patterns (concepts and principles) that answer compelling questions within the various domains of human knowledge. Deep learning is focused on achieving understanding that leads to wise action. When learning is deep, it is also durable. The brain is going to hold onto ideas that have explanatory power! *(Continued on page 2.)*



Interdisciplinary Spiritual Blindness

Exciting changes and a new format for the SITS Worldview Conference in 2022. Read about it on [page 2](#).

SITS Welcomes Four New Participants in 2022

For a bit about each new faculty member and what they were up to this summer, see [page 3](#).

Summer Research at BJU

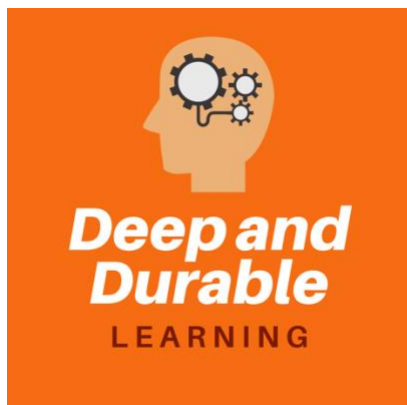
Four different Research Immersion for Undergraduates (RIU) experiences took place at BJU this summer. Read about them on [page 4](#).

XPRIZE Adventures

After a sizeable XPRIZE award, work began on developing sensors for a proposed CO₂ monitoring system. Read about it on [page 5](#).

I have created a website that houses these new resources and makes them available free of charge at

<https://www.deepanddurable.com>.



The resources include fifteen [blog posts](#) that complement and enlarge on fifteen different podcasts. Season one dealt with what it means to know and season two with how to structure learning that respects and leverages the design of the human brain. All of these resources have enriched the experience of the cohort of four new university faculty who began Track 1 this summer.

The [podcasts](#) alone have been downloaded over 2,000 times in the past ten months.

This summer I recorded a series of interviews with SITS participants as a set of four bonus episodes. The first bonus episode is an overview of SITS called "Transforming Teachers to Transform Learning." These podcasts are a powerful inside view of SITS

particularly intended for our longtime supporters. I thank all of you for your pivotal role! ♦♦♦



Michael Gray, Founder and Director, Summer Institute in Teaching Science

Interdisciplinary Spiritual Blindness

An Update on the SITS Worldview Emphasis

by Brian Vogt, SITS Faculty; and Head, Department of Chemistry and Physics

Starting with the very first SITS in the summer of 2004, we have always had sessions dedicated to worldview issues. Speakers from within and without the Division of Natural Science have addressed topics as diverse as the creation/fall/redemption model of the Bible, atheistic and theistic evolution, and personhood theory. Our discussions have at times been lively, and the science and engineering faculty have benefited profoundly from them.



This year we did something unique: We partnered with the BJU Center for Biblical Worldview (CBW). The CBW is directed by

Dr. Renton Rathbun, who is a professor in the Division of Biblical Studies and Theology in the School of Religion.

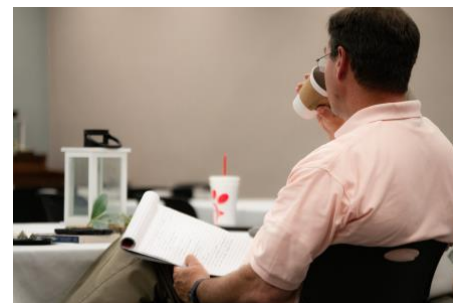
Renton holds five graduate degrees, including a PhD in apologetics from Westminster Theological Seminary. Our SITS 2022 Worldview Conference was open to all BJU personnel as well as people from off-campus.

Sessions addressed the major elements of a book entitled *How to Be Animal*, which is a treatise rejecting the exceptional nature of people and arguing that we should simply behave as animals. It's also a veritable gold mine of where your thinking goes when you reject the worldview taught by the Bible, and this is the origin of the conference theme, *Interdisciplinary Spiritual Blindness*. In order of presentation, the speakers were Dr. Brian Vogt (Chemistry and Physics), Dr. Dan Olinger (Biblical Studies and Theology), Dr. David Boyd (Biology), Dr. Brent Cook (Biblical Studies and Theology), Mr. David Lovegrove (Marketing Communications), Dr. Bill Lovegrove (Engineering), and Dr. Renton



Rathbun. We had roughly 50 people in attendance at each session, including several from off campus. Feedback was very positive.

We have already planned the SITS 2023 worldview conference, which will be entitled *The Problem of Origins*. Once again, it will be in partnership with the CBW and will be available to the public. ♦♦♦



SITS Welcomes Four New Participants in 2022

by Derrick Glasco, Associate SITS Director

A major highlight of SITS 2022 was the addition of four new participants: One biologist and three engineers. Each of them completed Track 1 which emphasizes the "Clear-Thinking Teacher." Here's a little bit about each of them:



Timothy Anglea is our newest Engineering faculty member. He first earned a B.S. in Engineering from BJU then both a M.S. and Ph.D. in Electrical Engineering from Clemson University. There, he grew in his desire to teach college-level engineering. In his own words, "I'm very appreciative of what my professors, both at BJU and Clemson, have done for me throughout my college experience, and I desire to have the same positive influence on the next generation of students."

Dr. Anglea's target course for SITS 2022 was Digital Electronics, a freshman-level course for all Engineering and Computer Science students. "My primary goal was to get all of the material for the course ready for me to teach this fall," Dr. Anglea said. "Additionally, my time during SITS was a good way to provide an on-ramp for me into being a professor here at BJU, rather than coming in two weeks before the semester starts and begin teaching. I got to meet many of the Natural Science faculty and

spend time getting to know them, as well as spending time familiarizing with the concepts and goals of my target course. I highly appreciate the Division of Natural Science's emphasis on the improvement of the faculty's ability to teach and explain their expertise clearly and effectively."



James Collins comes from South Africa to teach Mechanical Engineering courses here at BJU. After his undergraduate degree in Mechanical Engineering, he first worked for an automotive firm and then travelled the world doing missions and missions training with Youth With A Mission for 12 years. He then went back to South Africa to complete his Master's degree in Mechanical Engineering, then worked at a consulting firm for five years before accepting a lecturing position at the University of KwaZulu-Natal. While lecturing on mainly design subjects, he began additional coursework towards a PhD before joining us at BJU.

Reflecting on SITS, Mr. Collins said, "The teaching background at my previous university was mainly big classes and the usual lecturing-type style. SITS has revolutionized my thoughts on how higher education should be taught...I have been very grateful for this chance to be able to think and process about my teaching methodology and have learnt a great deal from some very good and experienced teachers."

Mr. Collins' target course for SITS 2022 was Machine Design. Regarding his target course, he remarked, "I taught a similar course in South Africa, but I find the approach here a much more interesting one and I think it will be more enjoyable for the students...It was great thinking about the core concepts of the class and what needs to be taught to help students 'think like a machine designer.'"



Rebecca Garcia is our newest Biology faculty member, having started at BJU in early 2022. She earned a Ph.D. in Healthcare Genetics from Clemson University and comes to BJU with an extensive background in industry, where she developed molecular technology used for diagnostic testing. She also owns both a local restaurant and biotechnology company!

For SITS 2022, Dr. Garcia developed her Introduction to Biotechnology course. She redesigned the course to teach students how to think like a biotechnologist and introduce them to the design process from identifying problems through brainstorming solutions. She also lined up four external experts to share their research with the class. As Dr. Garcia puts it, "I hope to inspire the next generation of biotech scientists, allowing them the opportunity to realize how they can advance biotechnology."



Jeff King comes to BJU after serving 28 years in the Navy and most recently serving as the Chair of the Aerospace Engineering Department at the U.S. Naval Academy (USNA). His background includes experience as a Navy helicopter pilot, a satellite program manager and systems engineer, and a professor of Aerospace Engineering at USNA. He earned his Ph.D. in Astronautical Engineering from the Naval Postgraduate School while on Active Duty. He is married

with four children (two BJU alumni, one current BJU student, and one U.S. Marine).

Dr. King is launching our new Aerospace Engineering concentration within the Engineering degree program with several new courses over the next two years. This summer he was able to take his experience in both working and teaching aerospace engineering and formulate some fundamental concepts and principles that make aerospace unique from other engineering branches. He also appreciated the time in SITS devoted to incorporating the Biblical Worldview into all of his courses. ♦♦♦



Summer Research at BJU

An Update on RIU Programs

Several Research Immersion for Undergraduates (RIU) programs take place at BJU each summer which are supported by the Science & Engineering Endowment Fund. Here are some quick updates from each of the RIU directors:

Biology RIU – Cancer Research Lab (Dr. Steve Figard)

This summer we focused on learning to use our new instrument, a BD Accuri C6 Plus flow cytometer. This is an instrument that allows us to evaluate multiple markers simultaneously in an entire population of cells, one cell at a time. We have once again obtained evidence suggesting the presence in almonds of something that will kill certain cancer cell lines in tissue culture. The trials and tribulations of learning the practical “tricks of the trade” render our conclusions tentative at present, but progress was made.

(See photos on next page.)

Chemistry RIU (Dr. Robert E. Lee)

This summer, three Biochemistry & Molecular Biology students participated in the synthesis of TG4-155, an antagonist of the prostaglandin EP₂ receptor with functions in the brain and prostate. TG4-155 is being investigated as a potential treatment for both epilepsy and cancer. Their project was successful, and they were able to produce 5 – 10 grams of final product. Paige Heiple, a BJU graduate and now Senior Scientist with Cambrex, also served as a consultant for the project.

Robotics RIU (Dr. Bill Lovegrove)

Three engineering faculty and six students attended the Intelligent Ground Vehicle Competition (IGVC) at Oakland University in Michigan on June 3-6. They took two robotic vehicles and competed in two competitions, the large “Self-Drive” competition for self-driving cars, and the smaller “Auto-Nav”

competition for robotic vehicles. The teams placed third in Self-Drive and fifth in Auto-Nav in the design competitions.

In preparation for the competition, the students worked for three weeks in our summer Robotics RIU program, developing the vehicles. They gained significant experience with the ROS robotic operating system and learned a lot about robotic vehicles and control software. Bill Lovegrove, the department head and robot team coach, led the effort. Two new engineering faculty, Jeff King and James Collins, were able to participate and learn about the competition. James Collins will take over as robot team coach beginning in September. We hope to participate in the competition again in 2023.

Physics RIU (Dr. Nick Gothard)

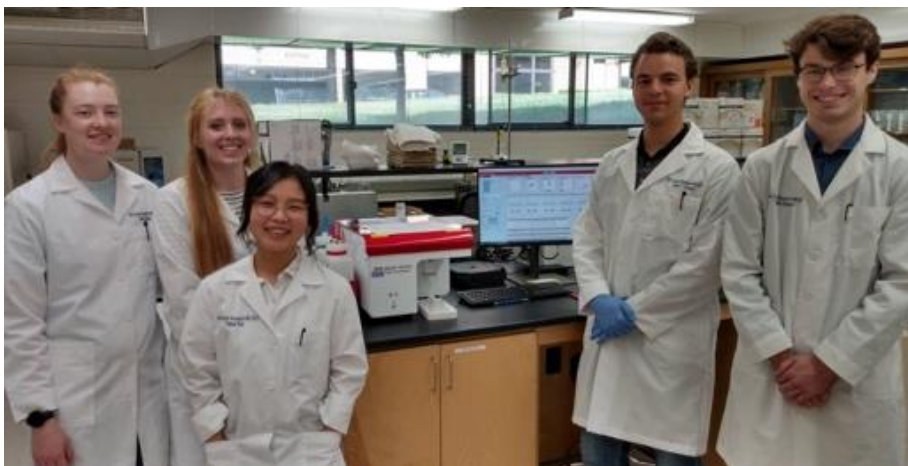
The Physics RIU hosted one student for four weeks to study the effects of secondary phases on the microstructural development of materials for solid state batteries. Materials were mixed from powders and densified by thermal and microwave processes. Microstructures and elemental compositions of the resulting materials were characterized by scanning electron microscopy and energy dispersive spectroscopy. ♦♦♦



Chemistry RIU students discuss their research with Health & Safety EduCamp participants

Top row: Chemistry RIU

Summer RIU Programs



Bottom left: Biology (Cancer Research) RIU



Bottom right: Robotics RIU

XPRIZE Adventures

by David McKinney

This past school year, Elon Musk's XPRIZE competition involving carbon capture awarded Bob Jones University \$100,000 to develop and test a proposed CO₂ monitoring system. This summer, under the supervision of faculty members Bill Lovegrove (engineering), David McKinney (biology), and Brian Vogt (chemistry), the development and testing of the system's sensors commenced, with two engineering students developing the software and hardware, two science students handling the testing and validation of the prototype sensors, and two business students keeping the books

and actively promoting the business platform designed to make the sensor available broadly: Soil Economy.

The engineering students, Benjamin Withrow and Steven Platt, spent the summer building the sensors and the accompanying software to collect CO₂ data and report it back to a hub. The hub, connected to a computer, allows for the mapping of CO₂ released from the soil across a wide area. In theory, this would allow agriculturalists to monitor soil health and validate carbon retention in the soil.

The science students, Lydia Flynn and Tricy Yue, validated the prototype sensors' laboratory conditions before deploying them to a test field site. After some initial uncertainty about the best configuration for the sensors' design based on comparisons with commercial CO₂ sensors, the prototypes were deployed to

the test field. Data collected simultaneously from eighteen test sites, which were divided into treatments of both positive and negative control groups distributed across the field, validated the capacity of the sensors to monitor and distinguish between sequestered CO₂ and emitted CO₂.

The future of the student owned and operated company, Soil Economy, will involve pursuing funding and further refining the prototype sensor prior to manufacturing and marketing the product. The company has already formed relationships with local South Carolina research groups, and the business students have, at the time this is published, marketed their idea to capital funding entities in a study abroad experience in Portugal. ♦♦♦

Feedback from 2022 SITS Participants

"[SITS] has fundamentally changed how I approach my target course. I was originally planning on a series of lectures with complementary labs, but now am leaning more toward project-based learning as a whole and using the labs to drive the learning."

"Actually getting to interact with other faculty members is always my favorite thing about SITS. There's also a great satisfaction in helping other faculty (in whatever way possible) to improve their thinking so that they can be better teachers. I also greatly appreciate the time just to work alone, so it's a nice balance."

"I really enjoyed the comradery, and the opportunity to sit and talk about important ideas with individuals in my division. It was also a great time to connect personally with the new faculty."

"As always, I greatly appreciate the time to work on my courses when not under pressure to be teaching at the same time!"

"I thought that Dr. Gray's book was great ('unforgettable', even 😊). I've had some training in the scholarship of teaching and learning, and I found Dr. Gray's approach and ideas in agreement with my previous training but presented in such a way that explains why the various teaching and learning strategies that have been proposed over the last several decades are actually aligned with how humans learn and retain information and knowledge."

"As always, I greatly appreciate the opportunity to work on a target course when

classes are not in session or during the brief Christmas vacation and still get financial support during that time. I cannot adequately express my gratitude to the generous donors who have made this possible by contributing to the Science & Engineering Endowment Fund."

"SITS has really helped me think about a better way to teach. I come from a background of 'traditional lectures' with big classes so going through this methodology is

lesson planning and test writing on the fly, I will be able to put most of my effort into focusing on the day-to-day delivery and student engagement."

"...thank you [to the donors] for this opportunity. It is very beneficial, and I feel privileged that we get to have this processing and development time."

"The sessions for the Lab Track have been invaluable. I've been able to think about the strengths, weaknesses, and improvements



very helpful. I think that especially with the smaller classes we have at Bob Jones we can be more interactive, and SITS has given me the tools to hopefully make that happen. Not only will it be more enjoyable for my students, but a more interactive style will be more enjoyable for me."

"I would be in big trouble next year without the valuable time spent in SITS thinking through and planning this course! Instead of

that are needed within the labs that I offer. As a result, I've been able to create a lab that helps remedy some of them and improve the overall lab experience. I was also able to test the lab and have a practice run with another faculty member. The feedback from that was also helpful in pointing out ways I can make the lab a better learning experience for the students." ♦♦♦