SECTION VII: STEM EDUCATION
Paper Session
Thursday Afternoon 2:00 – 4:40 pm
Arthur J. Bond Engineering Building, Room 103
Sarah Adkins, Presiding

1. 2:00**g COGNITION AND THE 8th GRADE SCIENTIST: STRATEGIES THAT PROMOTE THINKING. *Chris Taylor,* University of Alabama at Birmingham; Tanya Hyatt, Indian Springs School.

   Here we describe methods that integrate potentially disruptive technology with a lecture format that promotes discussion, interaction, and the reinforcement of the instructor's intended narrative. The instructor was trained in previous employment to teach college students with traditional lectures. This method was perceived to inadequately engage students at the eighth grade level.PowerPoint presentations distracted students from the instructor's lecture and class pacing was disrupted. In response, we utilized pedagogical methods that promoted information retrieval, retention, and metacognitive analysis. Classes began with ten-minute warm-up quizzes. Each quiz consisted of three questions from the previous day, previous week, and the week before. This method promoted discussion and clarification of misunderstandings. The lectures also implemented retrieval methods wherein past information was used as a platform for discussion among students using a think-pair-share format. Note-taking was discouraged while the instructor was speaking, while active listening and question formulation was encouraged. The lectures were paused twice during each class to allow students to think about what they remembered from the instructor's lecture, record their thoughts, and discuss the material. Students were assigned exercises that promoted synthesis of all topics, deeper contemplation of the material, and exposed gaps in understanding. These methods allowed the instructor to still use PowerPoint presentations as a visual tool. Moreover, these methods encouraged active thought and memory retention, while discouraging the copying of material that was already available to the student.

2. 2:20**g WHY DOES OUR WORK MATTER? CONNECTING MICROBIOLOGY LABORATORY CURRICULA TO NORTH BIRMINGHAM. *Sarah Adkins,* University of Alabama at Birmingham; Brad Bennett, Samford University; Rob Akscyn, Jeff Morris, University of Alabama at Birmingham.

   A critical facet of Course-based Undergraduate Research Experiences (CUREs) is student data being relevant to stakeholders beyond the classroom. However, despite CUREs becoming a common pedagogy in the reformed laboratory class, there is little known about how students understand the importance of their data contributing to community stakeholder needs. We surveyed students' (n=113) perceptions about civic engagement across three synchronous CUREs at different Birmingham universities that are all related to the same environmental pollution issue in North Birmingham, Alabama. The curriculum also had students report their data to each other through shared two-five-minute videos. We used the Tool for Interrelated Experimental Design, Civic Engagement Survey, Civic Attitudes about the Relevance of Science, and Persistence in the Sciences as pre and post-surveys, and additionally collected qualitative data through endof semester class-wide interviews (n=53). Across survey and interview data, we

found increases in students reporting that research could, in fact, help solve a problem in the community;however, this and other gains varied between course type. Students in the introductory course were more likely to report larger gains in understanding the process of science, and students in graduate-level courses were more likely to report skills gained and a greater understanding of the needs of stakeholders, particularly through the videos. The research and curriculum modules can be used by instructors assessing or implementing CUREs in order to increase connections between laboratory students and their community needs.

3. 2:40**u BUILDING A 3-D MODEL OF THE MARS DESERT RESEARCH STATION USING ADDITIVE MANUFACTURING *Amelia Claire McCain,* Anna Abernathy, Athens Renaissance School (ARS); J Wayne McCain, Athens State University.

   This paper presents an overview of the development of a three-dimensional model of the Mars Desert Research Station (MDRS) using additive manufacturing (3D printing and CAD). The MDRS conducts high-fidelity, analog Mars mission simulations of a two-week duration as an integrated educational and research experience for space enthusiasts and students. Over 230 crews with more than 1,300 participants have been party to these mission simulations since its inception in 2001. In this research, a simple computer-aided design (CAD) software package was used to design a small-scale model of the MDRS that could be used within the Mission Operations and Communications Center (MOCC) facility for clarification of facility physical activities during simulations.

4. 3:00**u STANDUP OF A MISSION OPERATIONS &AND COMMUNICATIONS CENTER FOR THE MARS DESERT RESEARCH STATION. *Kimberly Graham,* Katherine Brewer, J Wayne McCain, Athens State University.

   This paper addresses the development and standup of a Mission Operations and Communications Center (MOCC) for the Mars Society's Mars Desert Research Station (MDRS), physically located near Hanksville, Utah. The objective of the MDRS is to conduct high-fidelity, analog Mars mission simulations of a two-week duration as an integrated educational and research experience for space enthusiasts and students. Over 230 crews with more than 1,300 participants have been party to these mission simulations since its inception in 2001. Communications with this remote facility during the simulation is done primarily asynchronously using a HughesNet satellite internet link and a custom email protocol. Capsule Communicators (CapComs) are voluntary positions consisting of trained personnel scattered throughout the world. The goal of establishing the MOCC is to provide a central communication and support hub that can be online from the Central Time Zone and increase communication capabilities, while reducing the effects of world-wide time zone scattering of current volunteers. In addition, it will be the long-term goal to increase MDRS's communication capabilities to include synchronous voice, video, and data. The proposed architecture of the MOCC is presented herein.

5. 3:20 CAN PRESCHOOLERS DO FRACTIONS? YES, AND FINE MOTOR SKILLS PREDICT THEIR ABILITY. *John Shelley-Tremblay*, Lindsey Clark, University of South Alabama; Julie Cwikla, University of Southern Mississippi.

   We investigated how preschool-aged children understand and solve fractional problems involving whole numbers and fractions using "equal sharing." Mathematical tasks were presented in two formats : paper and pencil format and in context as E-stories displayed

on a touchscreen. We also measured how fractional reasoning ability correlated with both fine motor skills by using a pegboard and usage of gestures during a counting task. Participants included fifty preschoolers ages four-to-five-years-old in two public schools from the United States. Children were tested individually inside the school. Mathematical tasks were developed to evaluate subjects' fractional reasoning ability. The mathematical questions were presented in either a paper and pencil format or as E-stories displayed on a touchscreen laptop. Children who received the paper and pencil version were presented with items, such as pictures on a sheet of paper, and were asked to split-up or share the items "evenly" and "fairly" amongst people or other objects. The E-stories included the same mathematical stories and directions as the paper and pencil version. Accuracy for the paper and pencil version was computed by dividing the total points possible by the total points achieved. For the E-stories, the child's number of attempts and the amount of time taken to complete each question determined accuracy. After the mathematical task, children completed a counting task where they were instructed to use their fingers and count the number of dots in a box on paper out loud. A behavioral analysis of gestures recorded their accuracy, synchrony, hand morphology, and whether or not subitizing occurred during the task. Lastly, children completed the Grooved Pegboard test to assess fine motor ability. This included two trials, once with their dominant hand and once with their non-dominant hand. We found that the performance on our mathematical measure significantly predicts fine motor ability as assessed by the Grooved Pegboard test. A stepwise linear regression positioned total score on the mathematical stories as the outcome variable and the independent variables were peg-board dominant hand time, non-dominant hand time, dominant hand drops, and non-dominant hand drops. The model shows that the number of non-dominant hand drops explains 25.8% of the variance of the outcome variable. The paper and pencil mathematical stories had a maximum score of seventy-six and a minimum score of eight with an average score of 40.36. Mean accuracies for the paper and pencil stories and the E-stories were compared with an independent samples T-test. E-stories yielded significantly more accuracy than the paper and pencil version. Preliminary analysis of gestures during a dot counting task indicates that gestural accuracy is associated with improved mathematical ability. Preliminary analyses suggest that embedding fractional concepts within a social context may be more beneficial to mathematical learning during the preschool years. These results also provide insight into the strength of the relationship between fine motor and cognitive development and are relevant in their support and extension of previous research, suggesting that these two functions display similar protracted-time courses during development.

6. 3:40 LEGACY SIMULATION OF HUMANS-TO-MARS, PROJECT ARES. *J Wayne McCain*, James Garrett Athens State University; Wallace Price, University of Alabama; Sally McClelland, Samual R. Martin Auburn University; James E Young, Jacksonville State University.

While present-day simulations of human missions to Mars are high-fidelity and quite impressive (e.g., MDRS and HI-SEAS), a notable, sixteen-day simulated flight to Mars was conducted in the spring of 1969 by a group of more than thirty high school students from Anniston High School in Alabama! Acclaimed by then Director of the Marshall Space Flight Center, Dr. Weiner Von Braun, in a congratulatory letter to the I crew, this activity took place between the first manned orbital mission to the moon, Apollo 8 in December of '68, and the Apollo 11 moon landing in July of '69. This paper

summarizes the project which was embraced by the high school administration and the community as a point-of- light in an otherwise time of darkness as nation-wide campus demonstrations against the Vietnam War and civil-rights unrest were commonplace. The Ares I mission, a coordinated, group science project might serve to inspire today's students to conduct similar, but updated research. Ares I is summarized in a recent Amazon paperback entitled, “Eight Days To Mars: A 16-Day Simulated Mission Barsoom- Ares 1” or in a Kindle edition that's free for Kindle Unlimited members. This little booklet is also being used in our “How to Create a Science Project” campaign.

7. 4:00**u DEVELOPMENT OF THE “HOW TO CREATE A SCIENCE PROJECT” PODCAST FOR STEM ENHANCEMENT. *Katherine Brewer*, Kimberly Graham, Collin Rogers McCain, J Wayne McCain, Athens State University; Tracy Chastain, Athens City/County Schools.

   During the 2019 Alabama Academy of Science (AAS) annual meeting, members of the section “VII STEM Education” accepted the task of developing a series of podcasts to encourage students to further pursue submission of science research projects and/or posters to the Academy. This paper presents a summary of the efforts to develop and produce the first podcast in this series entitled "Steps In Creating a Science Project.” Along with Mrs.Tracy Chastain, a highly qualified fourth-eighth grade science teacher, Dr. Wayne McCain produced and directed the podcast which is being aired on the Athens State University radio station kasuradio.net. In addition, the podcast is available on the AAS STEM Education Facebook Group page (https://www.facebook.com/groups/1235671676444524)(https://anchor.fm/dr-j-wayne-mccain/episodes/Alabama-Academy-of-Science---Steps-In-Creating-A-Science-Project---1-e941vv/a-a12ceiq.) It is expected that this first podcast on this specific topic will lead to additional podcasts that may be distributed to K-12 science students within the State. The actual podcast will be presented as well.

8. 4:20 LATE COLLEGE CAREER INTERVENTIONS: ENCOURAGING WOMEN TO ENTER COMPUTER SCIENCE THROUGH CROSS-DISCIPLINE PROGRAMS (A CASE STUDY). *Sara Cline*, Athens State University.

   This paper presents a description of the motivations of a woman in her junior year at Athens State University to change her degree plan from biology to biology with bioinformatics option. Her experiences are presented as a case study that provides a potential pathway for moving women into the field of computer science late in their undergraduate careers. The implications of her motivations for switching fields are discussed, including the impact her experiences may have on informing future research and program design.

**u or **g* Denotes presentation entered in student competition as an undergraduate or graduate student, respectively.

SECTION VII: STEM EDUCATION
Poster Session
Thursday
***Arthur J. Bond Engineering Building*, Auditorium**
Authors Set-up: Begins at 7:30 am
Authors Present. 1:00 – 2:00 pm,Viewing and Judging
Sarah Adkins, Presiding

9. **g ASSESSMENT OF TEAMWORK SKILLS IN UNDERGRADUATE EDUCATION. *Elizabeth Huckaby*, Monica Mason, Norman Estes, Samantha Giordano-Mooga, University of Alabama at Birmingham.

   Teamwork is an essential aspect of all careers and in no sector is this more pertinent than in healthcare. This study looks at a team-based learning (TBL) curriculum present in an undergraduate program geared towards pre-health students. TBL utilizes skills that should be practiced over time and built upon; thus, it is crucial to start these programs early in an undergrad's collegiate study. In this study, we hypothesized that students struggle to accurately rate team effectiveness using two previously validated tools: CATME and Team Value Rubric (TVR). A semi-structured interview was used to obtain qualitative data for comparison to the quantitative data provided by CATME, which was used to assign a grade, and TVR, which was not. During the interview process, students were asked targeted questions and were asked to provide a ranking for each member of the team. This pilot study shows that the results of CATME and TVR align, suggesting that grading incentives do not affect accuracy. Interviews addressed key insights into specific themes, such as communication, conflict, and relationships, that will be used to frame future project interviews. Our future goal is to conduct this study in a larger sample size of students. Understanding accurate representation of team rankings, as well as student ability to rate team effectiveness, will help educators target specific teamwork skills for improvement for undergraduate students and will prepare themfor entrance into the healthcare workforce.

10. **u UNDERGRADUATE RESEARCH AND TRANSFERABLE SKILLS: A SCOPING REVIEW. *Marissa Brasher*, Cameron Pittenger, Jenna Bae, Samantha Giordano-Mooga, Christine Loyd, University of Alabama at Birmingham.

    The purpose of college is to prepare individuals for entry into the workforce. These types of positions require extensive ability to assess situations, think critically, solve problems, work and lead teams, and communicate effectively, all while maintaining motivation and self-efficacy. Often there is limited time or lack of opportunity in classroom settings to build and retain these transferrable skills; thus, necessitating other outlets, such as research experiences. We have conducted a systematic review of the literature in order to assess the ability of undergraduate research experiences to facilitate the development of transferrable skills. Using relevant keywords, our librarian-collaborator conducted a systematic search in five literary databases amassing 20,834 abstract hits, our team currently has reviewed 12,893 abstracts with an ~8.7% acceptance rate. For sake of review efficiency, the research team is organized into a hierarchical structure consisting of faculty, graduate students, and undergraduate students from multiple institutions. The initial screening of the abstracts showed trends within the data relating to transferrable skill development through undergraduate research experiences. The most prevalent transferrable skills observed in the

data are communication, critical thinking/problem solving, and teamwork. Interestingly, the data also indicates that a majority of undergraduate research experiences are conducted via some form of course-based setting. Furthermore, while conducting this study, our research team identified a gap in the literature regarding what constitutes an undergraduate research experience. Lastly, an analysis of the selected literature will be conducted to further qualify and quantify the effects of undergraduate research experiences on the development of transferrable skills.

11. FERMENTATION FUN: A STRAIGHTFORWARD ACTIVE LEARNING EXERCISE THAT BLENDS FOOD SCIENCE, MICROBIOLOGY, MOLECULAR BIOLOGY, AND BIOINFORMATICS. *Brad Bennett*, Silvia Kinnebrew, Samford University; Shannon Carden, Magic City Ferments.

    Kimchi is a traditional Korean condiment made of spicy fermented cabbage, and its origin dates back at least 2,000 years. Fermentation is the microbial anaerobic breakdown of primary metabolites, such as simple sugars, providing energy to the bacteria. For kimchi, fermentation is typically accomplished by lactic acid bacteria (LABs), with the process taking weeks to generate the secondary metabolites (by-products of fermentation) that enhance the flavors of this dish. The goal of this project was to isolate and identify LABs present in a locally made kimchi. Separate small batches of kimchi were allowed to ferment over the course of two weeks at two different temperatures: room temperatureand 4ºC. On days two, eight, and fourteen, ~15 g of kimchi was removed and processed into a homogenous mixture. The kimchi brine was filtered from the vegetable solids, brine dilutions were plated onto Lactobacilli MRS Agar plates that included a Bromophenol Blue (BPB) indicator dye, and the plates were incubated at 30ºC for two days. At each time point and temperature, multiple colonies grew on the plates, some with differing shades of blue. We isolated genomic DNA from ten representative colonies and performed PCR using sixteen rRNA primers. Amplified PCR products were purified and sent for DNA sequencing. According to BLAST and the Ribosomal Database Project (RDP), most sequences returned matches to probiotic LAB genera commonly found in kimchi, such as Leuconostoc, Lactobacillus, and Weissella. This could be incorporated as a modest cost active learning module in an undergraduate biology course.

12. CAREER DEVELOPMENT ENHANCES TRANSFER STUDENT SUCCESS. *Betsy Dobbins*, Rita Malia Fincher, Samford University.

    The transition from a two-year community college to a private four-year university can be especially challenging in STEM disciplines and requires intensive mentoring. We describe a low-cost, student-centered support system that we developed at Samford University to facilitate first-year transfer student success. Samford offers a one-credit Foundations class to freshmen and transfer students, with the aim of acclimating students to the campus and city, providing access to campus support and resources (e.g., writing center, career services), and building cohorts within incoming students. This freshman-oriented program lacked appeal and utility for transfer students. We created a custom Foundations course for first semester STEM transfer students, designed to enhance retention and student academic success by mentoring students through career skill-building. Within this goal-oriented approach, each student was encouraged to develop and articulate individual career and academic objectives, both immediate and long-term. We then scaffolded skill development and meetings with campus mentors thattargeted off-campus interactions with career mentors that prepared students to apply for internships or research experiences the

following summer. During this career-development process, students built strong relationships with mentors and peers, established mentoring constellations across campus, cultivated local career networks, interacted with student support organizations on campus, created strong resumes, practiced application and interview skills, and received guided, active mentoring by program faculty. This program increased student retention and helped students secure paid summer placements that will contribute to their career development. This one-credit course is applicable to all four-year institutions that receive transfer students.

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