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EDUCATION

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MATH MATTERS

CENTER FOR MATHEMATICS EDUCATION (MathEd)

CfME and Local School Connections

by Janet Walkoe, Daniel Chazan, and Beatriz Quintos

Collaborating with local school districts is essential to the mission and work of the Center for Mathematics Education. Our mission is grounded in work with local schools. We work alongside our school partners, learning from their expertise and experiencing their challenges. We have built a number of relationships through our multiple projects in surrounding districts

There are two primary ways we have engaged in meaningful work with surrounding districts. One way involves the work of practicing teachers. For instance, the Sphero project integrates computational thinking into the mathematics classroom, with the goal of exploring ways computational thinking and mathematical thinking can be mutually supportive. Part of this work involves designing lessons, with an eye toward grade-level mathematics objectives, that involve programming a Sphero robot (sphero.com). CfME faculty and students work alongside inservice teachers to design lessons for 4th and 5th grade students. This creates a nice learning experience for both teachers and CfME faculty and students. This is a professional development opportunity for teachers, while CfME faculty and students can see how teachers integrate certain tools into their classrooms. Another example is the collaboration at Paint Branch HS, between Kayla White, Willy Viviani, and Daniel Chazan, around creating formative assessments that help pre-Calculus and Calculus teachers identify the concept images and concept definitions students hold for key curricular concepts. This collaboration is supported by Kayla's position as a Terrapin Teachers Master Teacher and provided Dan and Willy as members of CfME an opportunity to engage with Kayla on instruction for her students.

A second way involves the work with prospective teachers. In Terrapin Teachers, for example, prospective teachers gain early fieldwork experience. This year involved virtual experiences to allow undergraduate students to better understand learning in schools. In the middle school program prospective teachers also have internships that are an immersion experience. In this newsletter, we highlight the work of Angela Stoltz, who is the Coordinator for the Professional Development Schools in the middle grades program. Another illustration of our partnerships is the field work experience at Buck Lodge Middle School in which math and science middle school prospective teachers get to work with students in an after-school program. Prospective teachers gain insight into students' interest and learning, while students get rich experiences focused on positive rich mathematics experiences. Collaborations between schools and universities are a fertile ground for creating the sorts of innovative and transformative work that is desperately needed in mathematics education.

As a Center we also have multiple celebrations. Congratulations to **Dr. Janet Walkoe** for having received tenure and promotion to the rank of associate professor, as well as the launch of her NSF CAREER grant on Teacher Noticing of Students' Multimodal Algebraic Thinking. Another new NSF grant is the **Together Math** grant to support a partnership with bilingual families. **Monica Anthony** successfully defended her dissertation and will be starting a tenure track position at Georgia Gwynette College. Congratulations **Dr. Anthony! Tarik Buli** was awarded the Wylie Dissertation Fellowship for 2021-22. Welcome our newest doctoral fellows **Peter Moon, Matthew Wilson, and Michael Krell (2020)**, as well as **Ayala Nuriely, Rachel Tabak, Veronica Carlan, and Milen Matthews (2021)**.

Contributions to support the Center for Mathematics Education Fey-Graeber fellows can be made online to the Center for Math Education Fellowship Fund at <https://ter.ps/cfmeumd>

CENTER FOR MATHEMATICS EDUCATION (@CFMathEd) FACULTY (continued from page 7)



JANET WALKOE is in the first year of a five-year NSF CAREER project in which she is exploring ways to support teachers in leveraging children's algebraic resources. Children gain a wealth of resources as they interact with the world. Many of these can be leveraged when learning formal algebra.

For instance, children have experience with the idea of "balance." These experiences can be leveraged when thinking about equality and the equal sign. Janet is also continuing work funded by the US Department of Education, along with colleagues and the District of Columbia Public Schools to design and implement curricula that supports math and computational thinking. The lessons involve programming small robots (sphero.com) in 4th and 5th grade math classrooms.



CARO WILLIAMS-PIERCE is an assistant professor in the College of Information Studies, and affiliated with the Center for Mathematics Education. She is currently working on publications about mathematical play and generalizing (learning), coordinating the Embodied Mathematical Imagination and

Cognition website and virtual events (www.embodiedmathematics.com), and contributing to two ongoing research labs with students. Her lab, tech.math.play, is working on a literature review of problem-solving in videogames; and her joint lab with Amber Simpson (University of Binghamton, SUNY), mmPlay, is examining representational fluency, gestures, and mathematical learning in robotics makerspaces. She regularly teaches classes on user-centered design, as well as a graduate course on Games as Emergent Experiences (which will be relevant and useful to anyone interested in learning in digital media).

CENTER FOR MATHEMATICS EDUCATION

(CfME) is a nationally prominent center for research and teaching addressing the improvement of mathematics education in K-16 and informal settings. We promote innovation in teacher preparation programs and focused outreach efforts to local urban schools. The promotion of access and participation of minoritized students in mathematics education is a tangible CFME commitment.

COLLEGE OF EDUCATION
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Terrapin Teachers Early Fieldwork Experiences Go Virtual—Avatars and Simulated Classrooms!

LEARNING FROM LOCAL SCHOOLS IS ESSENTIAL for prospective teachers in the Terrapin Teachers program, which provides STEM majors a pathway to teaching certification along with their STEM major. The early fieldwork experiences are the cornerstones of Step 1 and Step 2, but this year the instructional team had to reimagine these courses in the context of COVID 19. “It is definitely a big loss to not be able to spend time in our local partner schools,” says Sarah Henson-Darko, Master Teacher in Science, who leads sections of Step 1 and 2 this semester. “However, we treated the shift online as an opportunity to yet again turn a close eye to our courses, which is an ongoing commitment of ours, with regular reflection and modifications. Our first priority, in this completely unusual time, was to treat our students as people first.”

Step 1 and 2 play a critical role in the Terrapin Teachers program. “They serve as introductions to the teaching profession and to local schools; undergraduates learn all the possible ways they can get certified to teach, how and from whom to seek more information,” says Dr. Anita Sanyal, another Master Teacher in Science who collaborates with principals and teachers at partner schools in preparation for Step 2 and teaches one of the sections this semester. The class is beneficial to more than just its students: “We see this work benefiting not just our undergraduates, but also as helping to provide meaningful science/math inquiry experiences for K-12 students, promoting meaningful interaction between K-12 and undergraduate students in a broader sense—connecting school students to the experience of going to college—and as providing opportunities for teachers to engage in teaching and mentoring the next generation of prospective teachers.”



Mixed-reality avatar. Photo courtesy of Mursion.

Sarah and the rest of the instructional team took advantage of existing resources to preserve Step 1’s work in the classroom as much as possible. We were already using the avatars and the simulated classroom from Mursion as a way for our students to

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rehearse before teaching in a school,” she explained. “In the online version of this course, we shifted the simulated classroom to be the central fieldwork experience, and added in more rehearsal time with peers ahead of time.” In some ways, this has allowed for some streamlining of educational experience: “We can pick content for our students to work with that best meets our goals, which has allowed us to reduce the number of different lessons we prepare and instead have multiple groups teaching the same lesson. This opportunity for collaboration, extending beyond individual teaching teams and encompassing multiple teaching teams, is an authentic replication of professional learning communities formed in schools.” CfME doctoral student Margaret Walton, who teaches a section of Step 1 this semester, adds, “For their field experiences, TT students usually plan, rehearse, and enact lessons in teams. We’ve been able to maintain this structure by using Zoom breakout rooms and Google Docs, which allow students to collaborate. Student feedback about group work has been positive: many have told me that they appreciate the regular interaction with one or two other people in the class.”

Reimagining these cornerstone courses is a tall order, and falls on the shoulders of the teaching team—a mix of full-time faculty, a doctoral student, and Master Teachers, some of whom are supporting their own children’s learning at home. Nevertheless, these instructors have worked tirelessly to build community and deliver a course well-fitted. “Instructors have used student-created digital introduction slides on a loop at the beginning of Zoom meetings, started class off with a Welcome Whipshare that invites a share from all students in response to a question like “What is something that has brought you joy in the last week?”, and frequently gather feedback from short Google forms to adapt instruction in the short-term,” Sarah explains. “We work hard at building an online community, and intentionally commit time for this goal every single class session.”

“A Place to Have Fun with Math”: University of Maryland’s Partnership with Buck Lodge Middle School



Dr. Monica Anthony

BEFORE RECENT PhD RECIPIENT DR. MONICA ANTHONY began teaching TLPL413—*Teaching and Learning Middle Grades Mathematics*, she took it as an undergraduate. University students concentrating in the Mathematics and Science Area of the Middle School Education program usually take TLPL413 in the fall of their junior year. It was

in this class that Dr. Anthony decided she was destined for middle school mathematics instead of calculus. Later, as a doctoral student at the Center for Mathematics Education (CfME), she pursued and obtained the opportunity to teach the course that had left such a large impression on her as a student. She taught the most recent iteration, in Fall 2020, with CfME doctoral candidate William Viviani. The goal of TLPL413 is to address “all the pedagogical moves” that go into teaching middle school mathematics, with a focus on understanding student thinking. The course owes its inception to Dr. Anna Graeber, an emeritus faculty.



An important element of this unique course is its long-standing partnership with Buck Lodge Middle School, part of the Prince George’s County Public School (PGCPS) system. This partnership dates back almost to 1990 and provides an opportunity for pre-service teachers (PSTs) to enact what they are learning in class. However, the partnership with Buck Lodge is much more than that, both for the local community and the University of Maryland. An after-school program that aims, in the words of Dr. Anthony, “to go beyond classroom mathematics to help students develop a love and affinity for mathematics,” the Buck Lodge program is an emblem of the University’s potential to benefit the surrounding communities. Grounded in fun as much as in math—its emphasis on math games goes back to its founding nearly thirty years ago—the program is completely voluntary for middle schoolers and frequently

enrolls 80 students or more. These students then work, play, and build relationships with University students, who in turn have the opportunity to learn from and with Buck Lodge’s highly diverse student body. Over the years, the partnership between Buck Lodge and the University has blossomed to include more formal teacher training placements as well.

One sign of the value Buck Lodge sees in the program is its provision of food and transportation to students who volunteer to participate. Tracey McCormack, a long-time mathematics teacher at Buck Lodge and one of the main forces behind the partnership, coordinates such logistics along with many other aspects of its integration with the middle school. Another sign of the middle school’s esteem is that the joint program has existed for so long that some Buck Lodge parents attended when they were middle schoolers. For Dr. Anthony, the Buck Lodge partnership represents the best that the University has to offer, showing the local community that “we’re here and we care about the schools around us.”

The benefits certainly accrue both ways. Not only do University students gain valuable experience and expertise designing and implementing mathematics tasks for small groups of Buck Lodge students, but the coursework of these aspiring teachers provided Dr. Anthony with the basis of her dissertation. There, Dr. Anthony investigates what PSTs do with the freedom her course gives them to plan and implement their own lessons and activities. What do their choices say about PSTs’ beliefs, resources, and goals?

Unfortunately, despite valiant attempts from both University and PGCPS personnel, the global COVID-19 pandemic has put the Buck Lodge partnership on hiatus for the first time since the 90s. But a program this popular could only stay down for so long, William Viviani was able to restart this program in Fall 2021.



William Viviani and Monica Anthony with their Fall 2020 TLPL413 students.

For Dr. Anthony, the Buck Lodge partnership represents the best that the University has to offer, showing the local community that “we’re here and we care about the schools around us.”

FACULTY SPOTLIGHT: Angela Stoltz



Dr. Angela Christine Stoltz (left) and her best friend, Dionne Daisey Williford, a Nanticoke tribal member (right)

ANGELA CHRISTINE STOLTZ is the newest Clinical Assistant Professor to the Center for Mathematics Education and she merges unique interests in mathematics education and environmental justice and sustainability in ways that forefront core values and world views of marginalized communities, in particular, Indigenous communities.

As the Professional Development Coordinator in the Middle School program Dr. Stoltz manages the placements of both undergraduate and graduate middle school teaching candidates, and supports them in completing assessments required by the College. Dr. Levin remarks that Dr. Stoltz is impeccably organized, conscientious, and communicates well with all stakeholders, including middle school faculty. Additionally, Dr. Stoltz is the secondary, P12 programs (Physical Education, Art, TESOL, etc.) and Middle School Mathematics Science PDS point person. She organizes mentor, intern, and supervisor orientations; serves as a liaison; and works to foster community and capacity building for the group..

Her passion for environmental justice and commitment to Native American local tribes is evident in her leadership in multiple initiatives. Dr. Stoltz is collaborating with tribal members who serve on the Maryland Commission on Indian Affairs at the Governor's Office to jointly increase recruitment, representation, and retention of Native American students at UMD across multiple units and colleges on campus. She was the Solar Decathlon Competition team's student leader for client relations in 2017, which designed a house using innovative techniques to create an energy-efficient, solar-powered SmartHouse such as rainwater capture, waste reuse and passive heat capture that preheats air and water and supports the solar appliances. These innovations connect indigenous

knowledge systems that support our connection to the land and our overall well-being and western scientific knowledge. Through this collaboration reACT, Team Maryland had the opportunity to develop and foster a relationship with local Native Americans, including the Nanticoke Indian Tribe.

She has published several journal articles with University of Maryland colleagues such as Jing Lin. Dr. Lin says, "Dr. Angela Stoltz is an amazing scholar and active agent of social change. She is incredibly knowledgeable about Indigenous Knowledge and provides great insights and brilliant scholarship into our collaborative publications on eco-justice, peace, and sustainability. Dr. Stoltz also plays a leading and instrumental role in promoting education for

"She is incredibly knowledgeable about Indigenous Knowledge and provides great insights and brilliant scholarship into our collaborative publications on eco-justice, peace, and sustainability."

Native Americans. She is leading the Maryland Indigenous Higher Education Alliance (MIHEA). She and the MIHEA were actively involved in the networking that led to the university's adoption of the name, Yahentimitsi, as well as the event itself. (<https://www.washingtonpost.com/education/2021/11/01/maryland-dining-hall-yahentamitsi-piscataway/>) Without a doubt, Dr. Stoltz is an incredible asset to the Center for Mathematics Education!



Chief Daisey, Nanticoke Indian Tribe (1931-2021).

STEP Platform: Moving Beyond Procedural Understanding



William Viviani

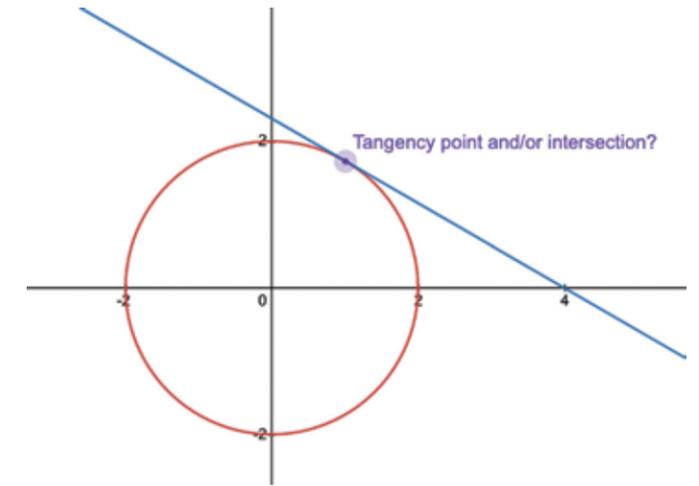


Kayla White

WHAT IS A TANGENT? The answer may depend on what math class you're in. Dr. Daniel Chazan and CfME doctoral candidate William Viviani are working with Terrapin Master Teacher Kayla White to understand how students' working definitions change from previous classes to calculus, and thus to better understand and work with student thinking on different concepts.

Tangents are normally introduced in geometry as "a line that touches a circle at exactly one point," Willy explains, "but for calculus, this kind of thinking translates to students arguing that a tangent to a function may not cross the function at any other point, may not be tangent at any other point, and/or may not cut through the function, like an inflection point. Students who make those arguments may be in the process of transitioning to a calculus definition, but still hold onto the geometric definition."

Identifying and responding to these inevitable sites of conflict is critical for teachers looking to help students adapt their definitions to new classes and new concepts in mathematics. In their work, Daniel, Willy, and Kayla use the Seeing The Entire Picture (STEP) platform designed by the University of Haifa's Center for Mathematics Education Research and Innovation, which provides students with immediate and helpful feedback on their work on tasks and allows teachers to organize and filter student responses. "Teachers can use STEP to gauge how a class may be thinking as a whole, and zoom in on specific student responses and track changes in their thinking over time," Kayla, who's been using the STEP platform in her BC Calculus class at Paint Branch High School for the past 4 years, explains. "Using student responses from STEP, teachers are then able to make decisions on how to advance student thinking

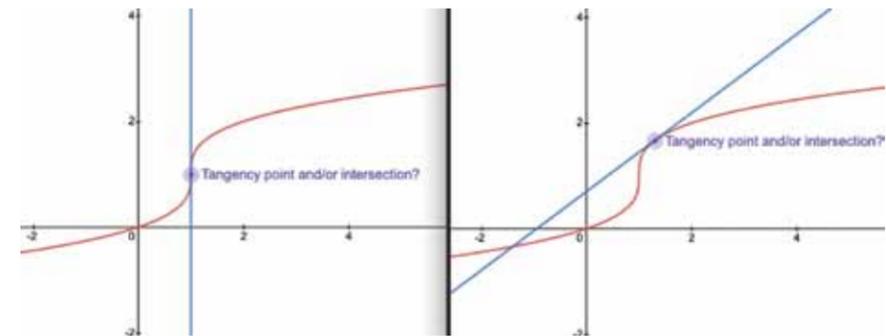


In Geometry, tangencies refer to circles and touch the circle at one point, and appear to sit outside of (or on one side of the image).

and facilitate classroom discussion by highlighting specific student responses that represent both common and unique student thinking and using those responses to facilitate student discourse."

In the virtual context of this past school year, STEP has been particularly important in building class relationships. "The STEP platform has helped me feel a connectedness to students and their learning," says Kayla. "By engaging in these tasks throughout the year, students are able to engage in content rich tasks that push their thinking and reasoning past just procedural understanding."

Over the past four years, the research team has continually rebuilt their tasks in STEP, hoping to make tasks that "best provide



In Calculus, tangencies are not limited to touching the graph at exactly one point or existing all on one side or the other of the graph.

students with the learning opportunity they're hoping for while giving teachers enough information to make some claims about what students are thinking, and then make tasks that will advance that thinking further," says Kayla. "These kinds of nuanced problems provide instructors

ways to engage students in rich discussions that would otherwise be pretty superficial," Willy adds. This tool and the developed tasks pave a way for richer discussions and give teachers a window into student thinking.



SPHERO MATH PROJECT IN DCPS

WITH THE GROWING PRESENCE OF TECHNOLOGY IN OUR WORLD, children’s preparation in computing and computational thinking is essential. These skills might not just be useful for computer science learning, but also in other subjects like mathematics. However, many learners—particularly students in under-resourced schools—have relatively little opportunity to engage in meaningful computational learning early in their academic careers.



The Sphero.Math project, led by CfME faculty Dr. David Weintrop and Dr. Janet Walkoe, works closely with teachers and staff from DCPS to design lessons that not only introduce students to computational thinking

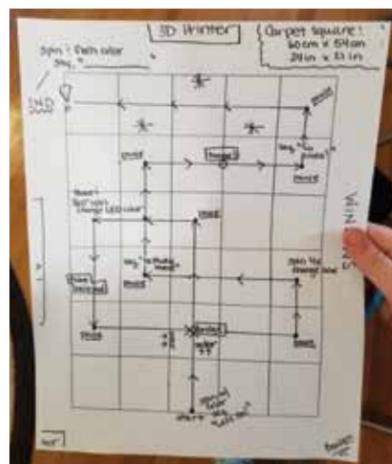
and programming, but also align with 4th grade mathematics topics to support learning in that subject. “We’ve been really intentional about making the computational thinking (CT) and math mutually supportive in the Sphero.Math lessons we’ve developed,” explains doctoral student Margaret Walton, a research assistant with Sphero. Math who has designed lessons, observed classes, and analyzed video data for several years. “That means that the CT in the lessons supports math learning and vice versa. For example, in one lesson students try to find what doubling the side of a square does to its area. At the same time, students learn about coding with functions and how the program output changes when you change one of the parameters.”

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“We’ve been really intentional about making the computational thinking (CT) and math mutually supportive in the Sphero.Math lessons we’ve developed...”

Integrating CT into elementary math classrooms also means that everyone will get to engage with these practices at an early age. “All schools offer math and all students take math,” Dr. Weintrop explains. “Given the importance for all learners to develop foundational computational skills, embedding these ideas into existing courses can ensure all students have the opportunity to learn these skills.” While many introductions to CT exist only in elective courses, Sphero.Math’s integration model could demonstrate a way



A Sphero obstacle course that students are trying to navigate.



A to-scale map of the course providing dimensions of each carpet square.

that all students can get early exposure to these valuable skills.

Working closely with DCPS personnel is essential to designing lessons that fit the needs and interests of their destined classrooms. Cathy Moessner, a teacher at Powell Elementary School, has worked for several years to write and revise lesson plans that incorporate work with Sphero. This model can also make for Margaret notes, “It’s important to make sure that you’re meeting the needs of schools while also conducting research. In our case, we’ve been able to align Sphero.Math lessons with DCPS’ math curriculum, which serves to reinforce the math that students are already learning, as opposed to an extra thing that teachers have

to do.” Dr. Weintrop agrees, describing himself as “a strong advocate of research-practice partnerships as a model for designing and executing research projects as it ensures the questions being answered address a pressing need for educators. Further, by welcoming teachers and district leaders into the process of crafting a program of research, they become stakeholders in the work and invested in the project’s success. The result is a level of district support (e.g. access to teachers, classrooms, and resources to support the project) that otherwise would not be available.” Even through the pandemic, Sphero.Math has been able to continue developing lessons alongside DCPS personnel and observe how lessons are carried out in class, thanks to close connections built with the district.



ANDREW BRANTLINGER has been working on completing several articles from his recently completed NSF grant on the career trajectories of alternative route mathematics teachers — some recently published, some under review, and others nearing completion.

Most of these involve collaborations with UMD graduate students including Willy Viviani, Sean Gruber, Tarik Buli, Chris Hurst, Matt Griffin, and Frances Henderson. He has enjoyed teaching the Mathematics and Science Education Policy, Professional Development and Teacher Preparation course and methods courses (e.g., *Qual II, Mixed Methods*) in the doctoral program. He also has had fun teaching several courses in the M.Ed in Middle Grade Mathematics program. He continues to explore possibilities of starting a STEM teacher pipeline initiative with PGCPs and MCPS.



DANIEL CHAZAN returned from sabbatical in 2021. During the sabbatical, in addition to more traditional scholarly outputs, Dan published two posts in the American Mathematical Society’s blog on Teaching and Learning with colleagues (including Willy Viviani of CfME and Kayla White of Terrapin Teachers).

He taught the Foundations of Mathematics Education Curriculum course in Spring 2021. For the first time, this course enrolled students from other Big 10 campuses. In addition to serving on the editorial board of *For the Learning of Mathematics*, Dan was on the International Program committee for International Congress on Mathematics Education 14 which was held in a hybrid format during July 2022. Dan is also the editor for Research Commentaries in the *Journal for Research in Mathematics Education*.



LAWRENCE M. CLARK is working on three projects: 1) Mathletics. NSF funded; focus on middle school African American and Latino students; engagement and enrichment project: data fluency and statistical applications in sports contexts; exploring tensions between athletic

identity development and STEM identity development; 2) Implicit Perceptions Project: A Comparison of Preservice Teachers’ Perceptions of Student Thinking, Student Ability, Student Mathematical Practices, and Teacher Practices in Racialized and De-racialized Depictions of Mathematics Classroom Interactions; 3) MSDE-funded UMD PDS 2025 Project—development of four “demonstration” PDS schools in MCPS and PGCPs; development of a Mentor Teacher Academy; redesign of the year-long internship and exploration of a teacher career ladder in Maryland schools (Kirwan Commission recommendation).

IMANI GOFFNEY will continue working on two of her previously funded research projects from NSF and from a private foundation in Texas, focusing on equitable mathematics teaching practices in elementary and middle school classrooms. She is looking forward



to completing a few manuscripts, drawing on data from this work. She also currently leads the elementary mathematics methods group who use her NSF funded curriculum. In addition to TLPL 711 Research on Mathematics Teaching, she will also be teaching a newly-designed course for the Honors College entitled, *From Oakland to Wakanda—Reimagining American Public Education*, with an emphasis on STEM Education.



DANA GROSSER-CLARKSON is looking forward to continuing working in the Terrapin Teachers program teaching the secondary math methods courses as well as Math 470. She is using the Math 470 course for a way to help develop positive mathematics identities for our future teachers. Dana hopes to continue working with some CfME doctoral students to explore several aspects of this course.



CAROLINA NAPP-AVELLI will be teaching elementary math and methods courses. She is excited about starting the second year of the NSF-Together grant in collaboration with Dr. Quintos. She continues her international collaboration with several non-profit organizations, providing professional development to math coaches and teachers in Guatemala, Ecuador, and Argentina.



BEATRIZ QUINTOS will start the second year of Together Math grant, an innovative model that merges professional development and parental engagement in mathematics education. We will welcome a new cohort in the M.Ed in Middle Grade Mathematics as she works with CFME faculty to ensure we prepare teachers with a sound perspective on social justice and anti-racist pedagogy.



ANGELA STOLTZ works with our Middle School Science and Mathematics interns in their coursework and field placements and with in-service teachers in our partnership school districts. In addition, Angela works with faculty/staff across campus on interdisciplinary sustainability education initiatives such as the CfME supported STEAM Education Study Abroad course in Mexico and educational outreach projects relating to the University’s Solar Decathlon Projects. Angela is on the Dean’s COREJ project and is working with local tribal members and university faculty/staff to increase Indigenous recruitment, retention, and representation on campus. (continued on back cover)