

## Volume VI Number 2

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### WELCOME TO SIMIODE AND OUR NEWSLETTER

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SIMIODE - Systemic Initiative for Modeling Investigations and Opportunities with Differential Equations is about offering a Community of Practice for teaching differential equations using modeling and technology upfront and throughout the learning process. Learn more at our dynamic website, [www.simiode.org](http://www.simiode.org). SIMIODE is now entering its seventh year as a community, its third year of National Science Foundation funding, and starting the sixth year of this newsletter.

Please drop us an email to [Director@simiode.org](mailto:Director@simiode.org) and let us know how we can improve SIMIODE and this Newsletter. If you have an idea for coverage you would like us to publish in the Newsletter then let us know or perhaps write up an "item" for our next issue. We would love to hear from you.

We recognize that most are finishing up this traumatic, but opportunity filled, semester in the era of the pandemic and we would welcome your sharing your experiences and engaging colleagues in conversations about distance, online, virtual, ether, one-on-one, etc. teaching experiences. Early conversations find faculty planning for more of the same in the fall and using their summer time to better prepare. Join our Forums in our **Community of Practice** section of SIMIODE and get new ideas and shared experiences. Post news of your efforts and discoveries.

SIMIODE is a 501(c)3 nonprofit organization, based in Cornwall, New York in the United States.

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### SCUDEM V 2020 - GOING VIRTUAL

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SIMIODE Challenge Using Differential Equation Modeling - SCUDEM V 2020 is going virtual. Key features include:

- teams of three high school or undergraduate students will select one of three area problems (physics/engineering, chemistry/life sciences, humanities/social science) to work on during the period 23 October -14 November 2020 and upload 10 minute video presentation for judging;
- teams can consist of students from one school or many schools (SIMIODE will facilitate team formation from individual student and mentor/coach registration); and
- team and individual student and mentor/coach registration opens 1 September 2020.

Be sure to check out the [convincing videos](#) in which students and faculty share their enthusiasm and experience in engaging in modeling with differential equations in SCUDEM events past. You can see all the previous events' problems and all student submissions for each year of SCUDEM, e.g., [SCUDEM IV 2019 results](#).

There are no registration fees for SCUDEM V 2020 in developing countries and there is modest \$10US registration for all other individuals.

We invite all to visit and join the [Facebook Group - SCUDEM Mathematical Community](#) to see more joy in modeling with differential equations.

See the results of our [SCUDEM Lite 2020](#) in which 8 teams produced impressive videos for judging this March in a prelude to SCUDEM V 2020 going virtual.

In our [12 July 2019 Blog](#) we highlighted the results from a recently published article, "Building mathematics self-efficacy of STEM undergraduates through mathematical modelling," in the *International Journal of Mathematical Education in Science and Technology*, in which the authors conclude that SCUDEM increases students' self-efficacy in mathematical modeling. Do SCUDEM for your students!

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### SCUDEM LITE FOR INTERMOUNTAIN MAA SECTION

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SCUDEM Lite 2020 happened in late March 2020 with 8 student teams submitting 10 minute videos to YouTube for faculty judging and feedback. While small in numbers the event was very successful. You can see the report along with links to all the student teams' videos at [SCUDEM](#)

SCUDEM Lite 2020 was to be offered at the Spring 2020 MAA Intermountain Section Meeting, 27-28 March 2020, at Westminster College - Salt Lake City, UT USA. However, due to the current health pandemic the live event was turned into a virtual opportunity for students to model and produce a video to share their model with judges and others, now including you the reader of this Newsletter.

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## **SUMMER 2020 SIMIODE NSF WORKSHOPS - POSTPONED UNTIL SUMMER 2021**

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SIMIODE will not offer our NSF SIMIODE Summer Workshops sponsored by the National Science Foundation during the summer of 2020. Rather we will offer them in the Summer of 2021. Details, albeit referring to summer 2020 offering, can be found at these locations.

**SIMIODE Practitioners Workshop** - Ideal for those who would like to learn more about how to foster a modeling-first approach in the classroom. Workshop includes hands-on demonstration, group discussions, and activities facilitated by experienced faculty. MINDE (Model INstructors in Differential Equations) Fellows selected for this workshop have a \$300 registration fee and are provided all materials and room and board for 5 days.

**SIMIODE Developer's Workshop** - Those with experience and ideas for writing differential equations modeling scenarios for classroom use are encouraged to apply. DEMARC (Differential Equations Model and Resource Creators) Fellows who are selected for this workshop are fully funded, including travel up to \$600, room and board, and a stipend up to \$600. Applicants are asked to provide evidence of successful modeling scenario development. The workshop will provide training and support for creating new modeling scenarios.

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## **PLANNING FOR SIMIODE ONLINE HYPERLINKED TEXT - SEEKING YOUR INPUT**

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Kurt Bryan, Rose-Hulman Institute of Technology, Terre Haute IN USA, will author a **hyperlinked text in SIMIODE which will bind resources so faculty can teach a complete differential equations course motivated by modeling**. Dr. Bryan (with co-author Tanya Leise, Amherst College, Amherst MA USA) has authored several pieces in *SIAM Reviews* over the years. For example they explain "[The \\$25,000,000,000 Eigenvector: The Linear Algebra behind Google](#)". He has also authored (with Allen Broughton, Rose-Hulman Institute of Technology) [Discrete Fourier Analysis and Wavelets - Applications to Signal and Image Processing](#). We are seeking problems or exercises, NOT on the scope of Modeling Scenarios, but which can be included in the text with credits to contributor. The text will have the traditional topics flow, but will be rooted in modeling as a motivation and teaching approach with links to SIMIODE and other resources. We expect the text to come on line in 2022, so we have plenty of time to get great ideas in place. Contact [Director@simiode.org](mailto:Director@simiode.org) with your materials, ideas, questions, and suggestions.

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## **SIMIODE IS A COMMUNITY OF PRACTICE - FORUMS FOR CONVERSATIONS**

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We are pleased to announce that SIMIODE is a [Community of Practice](#) in the broad sense as defined by [Etienne and Beverly Wenger-Trayner](#). SIMIODE is more than a set of resources and ideas for using modeling to motivate and teach differential equations. SIMIODE is Community and welcomes conversations, blogs, forums, and exchanges about practices, examples, experiences, materials, stories, student feedback, successes and improvements, and much more. Join us at [SIMIODE Community of Practice](#) and engage in meaningful conversations and exchanges. There are several places in SIMIODE in which we offer Forums on member interest topics. Once inside [Community of Practice](#) scroll down to Forums (Fora) for SIMIODE Members. Examples include [Use of Modeling Scenarios](#) and [Student Conversations about Modeling in Differential Equations Course](#). These and other Forums can be found in the [Forum Page](#) as well.

Also there may be forums found in your Groups, for example in the Teachers Group (our biggest group) we just added a Forum to other forums present called, "Modeling with Numerics" about fostering an exchange of ideas and experiences in using modeling to motivate numerical methods and programming for post calculus coursework, particularly differential equations. You can find Group defined Forums in your Dash Board once inside a Group of interest under Forum. Registered members can form a Group, invite members, and create their own Forums OR contact [Director@simiode.org](mailto:Director@simiode.org) about forming a broader Forum for others to visit.

We have several ways to grow a Community of Practice. One way of doing so is introducing yourself to the community by making your profile rich in detail about your interests and background with use of tags and contact information. In SIMIODE one can search for colleagues by name or by interests using information you put on your Profile in the form of tags. We encourage folks to put themselves out there for others to find them and build connections. It could be a grad school buddy, a colleague from a former school, a person with the same advisor, a neighboring school associate, a friend, etc. When you make contact then pick up a conversation about uses of modeling in differential equations, the reason you are in SIMIODE!

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## **PUBLISH YOUR CLASS EFFORTS IN SIMIODE**

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If you are teaching differential equations of some sort you have probably written and assigned projects. Consider publishing your materials online in SIMIODE using our peer reviewed, double blind referee system. More and more colleagues are accepting our invitation for sharing and publishing their teaching materials in SIMIODE for others to enjoy. Join in with us!

SIMIODE maintains a [double-blind, peer-reviewed process](#) for quality online publication of Modeling Scenarios and Technique Narratives. However, we encourage authors to submit their ideas at any stage of development and/or class projects for immediate feedback of a less formal nature. We will render constructive support and encouragement as well as technical feedback. In the past the SIMIODE Director, Brian Winkel, as Founding Editor of the journal *PRIMUS*, found this to be a very good way to foster confidence, help prospective authors contribute to the broader community, and get their ideas published. Please drop us a note with your ideas and/or materials to [Director@simiode.org](mailto:Director@simiode.org). We will respond quickly!

You can see how to submit your materials [here](#). What you do is important to your students, but it is also worthy of sharing with colleagues and their students. Step up and write up your projects for SIMIODE. You will have an online refereed publication at SIMIODE. You will be pleased to know others are using your ideas, building on your success, and enjoying what you share with your students. So, what are you waiting for? Just do it!

One purpose of SIMIODE is to offer colleagues solid, refereed teaching material on which they can base a modeling first course in differential equations. Thus publishing your new ideas and activities for students is a main objective of SIMIODE so others can see your fine work and engage their own students in similar manner.

However, it is reasonable to ask yourself, "Why should I prepare, submit, and publish in SIMIODE?" [Here](#) we give you many good reasons to publish in SIMIODE. Check them out and see that many fit you. Then join us by sending us your efforts.

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## COMMENTS HELP CREATE COMMUNITY AT SIMIODE

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For each Resource posting in the SIMIODE community members have the opportunity to post COMMENTS. This is strongly encouraged as it will build conversations which will connect colleagues, improve material, and foster community. Any posted Comment will be emailed to the author of that resource and conversations can then begin.

Giving feedback, reactions, and corrections to authors is very important for the individual author and the wider SIMIODE community. If you visit and scan/read or actually use a Modeling Scenario or Technique Narratives please offer comments. You may even wish to upload a new resource which has significant added-value. If so then contact [Director@simiode.org](mailto:Director@simiode.org) to inquire how you can do this. We would welcome such efforts.

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## NEW MODELING SCENARIOS IN SIMIODE

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Sarah and Blain Patterson, Applied Mathematics, Virginia Military Institute, Lexington VA USA, co-authored an activity on the [fake news](#) which enables students to model the spread of fake news and investigate ways to deter distributing misinformation.

Erdi Kara, Mathematics and Statistics. Texas Tech University, Lubbock TX USA, offers an opportunity to explore a model which describes the process of entry into marriage by an individual.

Urmi Ghosh-Dastidar, Mathematics Department, New York City College of Technology, CUNY, Brooklyn NY USA guides students through [modeling cholera](#) and a general waterborne pathogen model.

Brian Winkel, Director, SIMIODE, Cornwall NY USA offers two modeling opportunities based on falling objects [styrofoam balls](#) and [building ice](#).

Will Mitchell, Macalaster College, St. Paul MN USA considers [harvesting in a fishery](#) over a 25 year horizon.

These are but a few of the many new publications in SIMIODE for you to use with your students. We invite you to search for topics of your interest and include SIMIODE materials in your teaching.

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## MATHEMATICS + CANCER: AN UNDERGRADUATE BRIDGE COURSE IN APPLIED MATHEMATICS

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The full citation is, Stepien, Tracy L., Eric J. Kostelich, and Yang Kuang. 2020. Mathematics + Cancer: An Undergraduate Bridge Course in Applied Mathematics. *SIAM Review*. 62(1): 244-263.

This is an amazing article in support of a unique approach to an applied mathematics course based on the relationship between mathematics and cancer. We believe so strongly in this work as a source of modeling activities and ideas for students and research that we quote (extensively) from the article after we render the abstract.

Abstract: Most undergraduates have limited experience with mathematical modeling. In an effort to respond to various initiatives, such as the recommendations outlined in [S. Garfunkel and M. Montgomery, eds., *GAIMME: Guidelines for Assessment & Instruction in Mathematical Modeling Education*, SIAM, 2016], this paper describes a course on the mathematical models of cancer growth and treatment. Among its aims is to provide a template for a "bridge" course between the traditional calculus and differential equations sequence and more advanced courses in mathematics and statistics. Prerequisites include a course in ordinary differential equations. Linear algebra is a useful co-requisite but no previous programming experience is required. The content includes classical models of tumor growth as well as models for the growth of specific cancer types. Relevant research articles are provided for further study. Material for student projects and effective communication is supplied, as well as suggestions for homework assignments and computer labs. This paper aims to assist instructors in developing their own "Mathematics + Cancer" course.

We quote from the Introduction of the paper.

"This paper describes an undergraduate course, accessible to students who have completed a standard sequence of calculus and ordinary differential equations, on the mathematical modeling of cancer. The content and format of the course are derived from the authors' experiences in advising undergraduates in a program funded by the National Science Foundation's Mentoring through Critical Transition Points (MCTP) initiative. Our objectives in developing this course are threefold. First, we are interested in providing a model of a "bridge" course between the traditional calculus sequence and higher-level courses besides the typical "introduction to proof" class. Second, our effort is an attempt to develop an introductory course in applied mathematics that addresses a compelling scientific and social problem. We motivate the relevant mathematical ideas at a level that is intelligible to a broad student audience and in a way that will help students make informed choices about more advanced courses in statistics, probability, numerical analysis, partial differential equations, and dynamical systems, for example. Our third goal is to adapt some of the pedagogical features of an undergraduate research experience—reading papers from the primary research literature, completing a collaborative project, and giving a talk—to a semester course format.

"Our course is also an attempt to respond to recent programmatic initiatives of professional mathematical societies, including those by the Mathematical Association of America's (MAA) Committee on the Undergraduate Program in Mathematics (CUPM) and by the Society for Industrial and Applied Mathematics (SIAM) and the Consortium for Mathematics and Its Applications (COMAP). The *2015 CUPM Curriculum Guide to Majors in the Mathematical Sciences* makes four 'cognitive recommendations' for overall programmatic goals, stressing students' development of communication skills, ability to apply theory to applications, facility with technological tools, and 'mathematical independence and experience [of] open-ended inquiry.' The *Guidelines for Assessment and Instruction in Mathematical Modeling Education (GAIMME)* report by the SIAM and COMAP working groups discusses 'transferable skills' that undergraduates can develop in the context of a modeling course, including identifying tractable questions, using reliable sources, working collaboratively, and communicating effectively. The *Modeling Across the Curriculum* report, which was funded by a National Science Foundation grant to SIAM for 'an initiative to increase mathematical modeling and computational mathematics in high school and college curricula,' recommends developing accessible curriculum materials in addition to discussion of the modeling process.

"Furthermore, by providing students with a research experience during a regular class, we are able to reach a diverse group of students who may not otherwise have the opportunity to participate in, for example, a supported project of the National Science Foundation's Research Experiences for Undergraduates (REU) Program. Many REUs are inaccessible to minority, first-generation, and/or nontraditional students who, for financial, logistical, or child-care reasons, cannot attend an out-of-town program on a full-time basis for eight to twelve weeks. Our course represents an effort to provide a scalable, cost-effective alternative to a traditional REU. The enduring lessons the course aims to impress upon the students are similar to benefits students can obtain from participating in REUs: exposure to problem-solving experiences, awareness of STEM research fields and career options, and adding relevance to standard mathematics courses by applying theoretical knowledge to real-world cancer biology problems.

"A final objective of this article is to motivate further efforts to develop courses with analogous goals on topics drawn from other areas of the mathematical sciences. We hope that the outline presented here, and the supplementary materials, will serve as a useful template."

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## SIMIODE SOURCES FOR YOUR OWN MODELING SCENARIOS

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SIMIODE offers [potential modeling scenario ideas](#). There are now over 500 of these! These are materials, thoughts, pointers, summaries, articles, etc. to encourage and support your modeling scenario ideas. You must be registered and signed in to view these resources. Consider these ideas and use them to design your own modeling scenarios for your students and then publish this material in SIMIODE.

Of course, you can publish your own source materials, perhaps ideas you have not been able to get to, but want to or wish to engage with others in producing a Modeling Scenario. Just upload them for all to see. Use the "Start a new Potential Scenario Idea" button and contribute.

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## WORDS FROM THE DIRECTOR

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SIMIODE is a [community](#) which is alive, vibrant, and rich in resources and individual talents to assist colleagues who wish to teach differential equations using modeling to motivate students. There are a number of ways you can add to the community:

**Contribute materials.** You can learn more about this at our [Author Information](#) section and get even more details once you have signed into SIMIODE. There you will find types of materials and instructions on how to contribute and begin the process leading to publication in SIMIODE. **Register to referee and review submitted materials.** Good scholarship merits attention and our double-blind, peer-referee system affords quality reviews of submitted materials. Please, visit our [Manuscript Management system](#) and register as a referee.

**Post slides from your presentations, classes, or talks.** When you give a talk you can post your slides, details of the talk or meeting, and comments at [Resources: Presentations](#). Now that you have spread the word beyond the SIMIODE community bring it back home for your fellow SIMIODE members to see. As always please let us hear from you with your concerns, your news, and your activities. Contact us at [Director@SIMIODE.org](mailto:Director@SIMIODE.org).

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