PHILLIPS EXETER ACADEMY

2020 Anja S. Greer Conference on Mathematics & Technology

Full Course Listing

01 - Statistics for the Common Core classroom

Leader: Javier Alvarez, Phillips Exeter Academy

During this course, aimed at teachers using the Common Core Standards, we'll look at instructional strategies, simulations and use of technology to enhance understanding and retention of statistical skills and concepts. We'll use Desmos, applets and graphing calculators to help our students get a better grasp of the concepts that tend to be difficult to understand. Throughout the course, we'll be looking at some instructional strategies that could help create a more dynamic and student-centered classroom.

02 - AP Statistics: Insights and Instructional Strategies

Leader: Javier Alvarez, Phillips Exeter Academy

Join us for a closer look at the AP Statistics curriculum and learn about the new unit structure in the 2019-2020 course framework. Bring to your classroom strategies and simulations that will help your students understand those difficult skills and concepts and help them be more successful on the AP® Statistics exam. Throughout the course, we'll also take a deeper look at some free response questions from released AP® Statistics exams and get a better understanding of the scoring process.

04 - Using Desmos Activities to Promote Student Exploration and Engagement

Leader: Christine Belledin, North Carolina School of Science and Mathematics

Did you know that Desmos can do more than just graphing? In this course we will explore ways to use Desmos Activities to enhance learning in your classroom. I will share activities that range in content from Algebra to Calculus, demonstrate how to edit and improve activities already available, and show how the teacher tools can help guide and promote student engagement. Once we have the basics down, we will work on creating our own Desmos Activities for topics specific to courses you teach. Bring your laptop and you'll leave the course with a collection of activities to use in your classroom.

05 - Using both Computer and Hands-On Activities that Enhance Exeter's Math 1 and Math 2 Problem Sets

Leader: Eric Bergofsky, Phillips Exeter Academy

This course will feature both computer/tablet activities with Desmos, Geometer's Sketchpad and/or GeoGebra, as well as complimentary or similar hands-on classroom activities for motivating students and enhancing their understanding of various problems in Exeter's Math 1 and Math 2 problem sets. Activities and problems will be selected based on the interests of the participants. The selected problems will be at the level of algebra and geometry, and can be integrated into a problem-based learning setting or a non-PBL curriculum.

06 - Activities to Enhance Learning About Differential Equations

Leader: Floyd Bullard, The North Carolina School of Science and Mathematics

In this class we'll look at a variety of activities that you can conduct in your calculus or differential equations class to enhance students' understanding of DE's. Several of the activities include simulating data, in contexts such as the spread of a disease, the dispersal of water pollutants, or a battle between two small squadrons of soldiers. Others involve using technology to determine numerical solutions to problems that are analytically intractible, in contexts such as extreme altitude skydiving. These approaches improve the accessibility of DE models to many students.

07 - Just A Bunch of Good Geometry Labs
Leader: Dan Butler, The Westminster Schools

By the time students get to precalculus, a great deal of their geometry know-how has gone the way of the slide rule. Let's bring some excitement back into geometry through great problems and great explorations, and rediscover how geometry really lies at the heart of all mathematics. In this course we will explore some interesting geometry problems that will excite both the students and the teacher. We will make use of GeoGebra, calculators, straw, plexiglass, soap bubbles, and, of course, our creativity.

08 - Just Five Good Precalculus Labs
Leader: Dan Butler, The Westminster Schools

Let's spice up our precalculus curriculum with some amazing labs. We will use Excel, The Geometer's Sketchpad, GeoGebra, the TI-84, hands-on materials and anything else we decide we need to explore some of the concepts of precalculus through great problems and interesting constructions. We will also take some time to discuss what needs to be in a precalculus course in light of the current state of mathematics education.

09 - A Novel Approach to the Teaching of Function Transformations
Leader: Rachel Chou, Menlo School

This workshop will include ready-made student-tested materials that give students a deep understanding of linear transformations of functions. From an initial task that will anchor student understanding, to advanced challenges that really make students (and their teachers!) think deeply about transformations, participants will be fully immersed in the world of transformations. In the latter part of the week, we will apply our work with transformations to polar functions, parametric functions, and the derivatives of single variable functions and their transformations.

10 - Alternative Engaging Activities & Approaches for a Precalculus Course
Leader: Rachel Chou, Menlo School

Are you in search of student-centered challenging tasks that foster depth of understanding in a Precalculus course? We will look at student-tested engaging activities for studying polar, parametric, and exponential functions. Have you ever compared different types of polar spirals? Let's really look at Lissajous curves! Did you know that all exponential functions of the form: $f(x) = abx + c$ are geometrically similar to each other? We will end with a look at an alternative approach to studying matrices in the classroom. (This unit starts by using matrices to execute geometric transformations!)

11 - Mathematics in Art, Architecture and Design
Co-Leaders: Ken Collins, Charlotte Latin School; Ron Lancaster, University of Toronto

Art, architecture, and design incorporate a wide range of mathematics including geometry, algebra, and trigonometry in an imaginative and engaging environment. These fields offer interesting applications that can be used in many courses as well as the foundation for cross curriculum classes or short courses. We will explore many examples that appeal to students and can be used in a variety of classes. We will include classroom ready activities that illustrate how we use high school mathematics in art, architecture, and design.

12 - Recreational Mathematics - Inspiration, Engagement, and Enrichment

Co-Leaders: Ken Collins, Charlotte Latin School; Ron Lancaster, University of Toronto

Recreational mathematics involves patterns, games, puzzles, mathematical magic tricks, origami and mathematical curiosities. In this course we will demonstrate a variety of ways to use recreational mathematics in the classroom; for example, as a class warm-up; a link to applications; an enrichment activity and a way to encourage collaborative learning and the development of mathematical imagination. Making mathematics engaging and interesting in this way will show students that mathematics is a pleasurable activity that can be enjoyed throughout their lives.

13 - Teaching a Discussion-Based Math Course

Leader: Diana Davis, Swarthmore College

Discussion-based courses are so wonderful for student engagement and understanding, but they're challenging to teach well, especially the first time. In this course, you'll learn to create a classroom environment that fosters student discussions. You'll have the powerful experience being a student in this kind of a classroom yourself, and we'll discuss our class dynamics to learn from them, while leaving time for the many questions you may have about implementing it in your own classroom.

14 - Writing a Problem-Based Curriculum

Leader: Diana Davis, Swarthmore College

Exeter's problem-based curriculum works very well for Exeter students. Your students, with their background and in your school environment, likely need something different. We will do two things in parallel: (1) We will carefully study how the Exeter materials are constructed, with exploratory problems that build day by day. (2) You will write your own curriculum, and we will discuss and revise it as a group. All are welcome, whether this is your first experience with a problem-based curriculum, or whether you've already written something and want to refine it.

15 - Cultivating Curiosity in a Digital Age

Leader: Taylor Donovan Wyatt, Cate School

In this course we will use technology to support Problem-Based Learning. Exeter’s problem sets take center stage while Desmos, Notability, and Google Drive create opportunities for even bigger ah-ha moments as well as smooth pedagogical systems. We will discuss pedagogy for working with tablets so that they are tools for curious students rather than distractions. The mathematical content will primarily be at the algebra and geometry level (Math 1 and 2) and can be incorporated in both PBL and non-PBL settings.

16 - Exeter Math 1: A Student-Centered Problem-Based Approach to Algebra 1

Leader: Stephanie Girard, Phillips Exeter Academy

Use the Exeter Math 1 materials to explore problem solving through a discussion format to build content with students, rather than for them. Empower students to discover, develop and apply general principles and transferable techniques through accessible and contextual problems. Content spans Algebra 1 topics, to include linear relationships, absolute value, quadratics and some typical and atypical "word" problems. We will use technology (tablet graphing applications) to supplement learning in this dynamic classroom format. Come see what Exeter Math is all about, at this introductory level!

17 - Enhanced Calculus

Leader: Julie Graves, North Carolina School of Science and Mathematics

Do you have the sense that your calculus course has become a head-down march through the AP Calculus syllabus? Do your students imitate techniques without understanding the power of calculus to model the world we live in? If so, please join us as we explore new applications to enhance your calculus course. We will explore modeling problems that involve probability (distribution functions for random variables), economics (marginal utility and elasticity of demand), and differential equations (modeling combat and chaotic logistic growth).

18 - Math Modeling in Algebra and Precalculus

Leader: Maria Hernandez, North Carolina School of Science and Mathematics

Mathematical modeling can help us engage our students as active problem-solvers and foster mathematical curiosity. We will explore ways to help our students navigate the modeling process through a variety of real-world problems. The problems include exploring CO2 levels in the atmosphere, the path of a playground swing, ball bounce data and the satiation rates of the praying mantis. The math topics span from advanced algebra to precalculus. We will collect data using videos and calculator probes, and then build models using TI calculators, spreadsheets, Desmos, GeoGebra and LoggerPro.

19 - Math Modeling in Calculus

Leader: Maria Hernandez, North Carolina School of Science and Mathematics

Math Modeling can engage students as active learners in Calculus. We will explore problems that give students a chance to develop their voice in the classroom. These include geometric models or data collected from videos in which students explore the motion of a cycloid or water flow. Calculus concepts that are tied to such contexts as the distribution of income or how to optimize the number of pooled blood tests are also included. Connecting our work to the modeling cycle, we will discuss strategies that help students deepen their understanding and become better mathematical modelers.

20 - The Exeter Math Program - A Problems Oriented Approach

Leader: Jeff Ibbotson, Phillips Exeter Academy

The Exeter Math Curriculum consists of a number of problem collections that have been organized in such a way as to emphasize learning through discussion. We will dive into the problems for Math 2, Math 3, and some additional ones from Math 4 if time allows (all Exeter Math books are available on-line). We will work some of these problems in order to get a hands-on idea of how it all fits together, in particular, vector approaches to geometry, parametric equations, geometric dissections, three dimensional geometry, and combinatorics and probability problems (including Markov Chains).

21 - Number Theory for Teachers

Leader: Jeff Ibbotson, Phillips Exeter Academy

Number theory is currently a hot topic in the news. Its uses in cryptography are well known and this topic can open the door for many students to explore some deep math involving simple curves. We will explore Pythagorean triples and their construction through simple circle geometry. We will also look at elliptic curves and solve for rational points on those curves. The instructor has written a problem-based approach to the subject and has taught such a course for high school students. We will use Desmos, Excel and the graphing calculator to assist in solving diophantine equations.

22 - Attending to Diverse Student Identities in the Mathematics Classroom

Leader: Stanley Lo, University of California San Diego

This course will explore the diversity of student identities. We will examine student identities and their intersectionality: how students' sense of self as a mathematics person may intersect with their sociocultural identities (such as ethnicity, gender and race) to create opportunities and challenges for learning. Together, we will consider some of the following related complex issues: cultural capital, implicit associations, microaggressions, mindsets, privilege, and stereotype threat. We will also collaboratively develop concrete strategies on creating more inclusive learning environments.

23 - Geometry's Greatest Hits

Leader: Philip Mallinson, Phillips Exeter Academy

Participants will explore some of the nuggets I have picked up in my fifty years of teaching and learning. Each nugget may be used to illustrate topics in a standard geometry class. Topics may include, but are not limited to, origami, tessellations, polyhedra, non-Euclidean geometry, architecture, history, games and puzzles, some properties of mirrors and salt (not in the same activity), Big Geometry. Each day we will engage in an activity which may lead to an unfamiliar result or an unfamiliar model but a result which you will be able to use to enrich and amplify your own geometry class.

24 - Logic and Coding and Arduinos (Ohm My!): An Introduction to Circuits

Leader: Greta Mills, Oxbridge Academy

Coding might be one of the most important skills we can teach our students, and Arduinos are a fun and inexpensive way to start! This course will focus on the use of Arduinos (open-source microcontroller) and simple code to introduce participants to circuits, logic, and coding. No prior background is needed; participants will need to preload the open source software on their computer, which should have a USB port for uploading code to the Arduino. We will code a musical keyboard, program traffic signals, program sensor-controlled motors, create simple electronic games, and more!

25 - Trigonometry, Redesigned: Collaboration, Discourse, and Modeling

Leader: Greta Mills, Oxbridge Academy

Whether you teach trigonometry as a stand-alone course or as part of an Algebra 2 / Precalculus sequence, the topics are perfect for reinforcing the modeling process through collaboration, discussion, and projects. Participants will learn how to introduce and scaffold trigonometry concepts, and how to use questioning and inquiry in a discussion-based lesson. We will use trigonometry (and other ancillary functions) to model a wide range of phenomena, including the path of a bungee jumper, the sound of a plucked ukulele string, the timing of a seconds pendulum, and more!

26 - Lab Calculus

Leader: Jose Molina, Phillips Exeter Academy

This course will cover highlights from a year-long calculus class that merges lab investigations with a problem-based curriculum. This is an alternative to AP that emphasizes qualitative approaches to problem solving more than symbolic solutions with algebra, while also incorporating writing for understanding. Some of the labs will focus on foundational aspects of calculus, while others will delve into calculus-based models (income inequality, probability distributions, the "Tilt-a-Whirl", skydiving). You will need to bring a tablet or laptop computer.

27 - Math across Cultures and Through the Ages

Leader: Stuart Moskowitz, Humboldt State University

Traditional school math leads students to think math is not relevant. Bringing real math from around the world into the classroom naturally integrates math across the curriculum. When students learn historical events & multicultural approaches for procedures, theorems, & concepts, the math becomes meaningful, interesting, & relevant. Embrace diversity among students by exploring math from all cultures while building pride for one's own heritage & respect for others. Topics include Native American gambling games, the Alhambra's influence on MC Escher, Stonehenge geometry, and much more.

28 - Use Puzzles to Study Math – Use Math to Solve Puzzles

Leader: Stuart Moskowitz, Humboldt State University

Nothing's more hands-on for getting kids & teachers to learn & love math! From Tangrams, Pentominos & Sudoku, to disappearing rabbits, trick locks, & pencils threaded thru your buttonhole, puzzles enhance number sense & strengthen spatial & problem solving skills. Use algebra to learn how bunnies disappear. Build wood, wire, & string puzzles to study elementary concepts in geometry, topology & graph theory. Learn how Lewis Carroll & Fibonacci explain the 64=65 Vanishing Area puzzle. By week's end you will have a collection of puzzles for your junior high or high school curriculum.

29 - Beyond Riemann Sums & Euler - an Intro to Numerical Methods

Leader: Philip Rash, North Carolina School of Science and Mathematics

Left-hand sums, right-hand sums, and Euler's method are great, but wouldn't it be even better to know some more powerful ways to approximate integrals and solutions to differential equations? And just how does your calculator approximate values of the transcendentals (e.g. sine)? (Spoiler alert - it's not Taylor Polynomials!) In this course we'll learn more about popular numerical methods, carefully quantify their error, and implement them in various computing environments. Some prior computer programming experience is helpful, but not required.

30 - A Few Great Simulations for AP Statistics

Leader: Philip Rash, North Carolina School of Science and Mathematics

Many topics in the AP Statistics curriculum lend themselves to simulations. In this course we'll use simulations to learn about sampling distributions, confidence intervals, variances of random variables, and more. We'll use a variety of simulation tools, including manipulatives, TI calculators, and online applets.

31 - Mathematically Model Real-World Data with Social Implications: Opioids, Climate, Payday Loans, More

Leader: Tom Reardon, Austintown Fitch High School and Youngstown State University

Analyze, model, and interpret real data, while creating social awareness of important current issues. Use modeling equations to interpolate, extrapolate, calculate percent inc/dec/error. Interpret the data and its consequences using graphs, tables, normal curves. Relevant topics to investigate include Opioids, Hot Car Temp Deaths, Climate Change, US Debt, Plastic Straws, Payday Loans, Vaping... Learn how to create your own modeling activities. Graphing calculators are provided but data can be used with any graphing technology. Get all data sets, student sheets, teacher notes and solutions.

32 - Prepare Your Students Completely for ACT/SAT Exams: Strategies, Test Items, Activities, Tech Ideas

Leader: Tom Reardon, Austintown Fitch High School and Youngstown State University

For the past 3 years I have been creating ACT/SAT math prep for students and teachers, authoring 3 days of PD on each exam. Incorporate insightful test-taking strategies into your lessons. Get actual test items to use daily with students. Obtain clever activities that encourage multiple solution paths. Teach students to think more creatively, efficiently. Integrate graphing technology to help students learn and retain the math concepts longer, not just improve scores on the exams! De-emphasize memorizing procedures. Promote conceptual understanding. Think graphically as well as algebraically.

33 - Evidence-Based Assessment: An Alternative to Testing

Leader: Johnothon Sauer, William Mason High School

Most of us want our students to show their work and explain their reasoning, but many find it difficult to make this happen in a traditional testing environment. In this course, you will experience an alternative method of assessment first-hand as you will create and present a mini-project similar to the ones I use to assess my high school students. We will also discuss the difficulties of transitioning away from traditional testing, and the benefits of allowing the students to creatively demonstrate their understanding of the material. A device capable of taking videos is required.

34 - Discussion-Based Common Core Algebra 1

Leader: Johnothon Sauer, William Mason High School

In this course, we will work through a set of discussion exercises that were specifically written to help students succeed in mastering the skills required in a common-core-based algebra 1 course. We will also discuss how the exercise set was built, and how to use a similar method to create a set of exercises for your classroom. Included will be conversations about creating a syllabus and grading policies that can ease the transition to a Harkness-based format in a classroom with 25-30 students.

35 - An Alternative to Traditional Precalculus

Leader: Jessica Schenkel, Brooks School

What course(s) does your school offer to students who struggled through Algebra 2? An Alternate to Traditional Precalculus gives you a free, full-year course of eight units that is built around problems and topics that engage teenagers. You can teach the entire course or choose parts to supplement an existing course at your school! A laptop is required, as we will be using DESMOS and EXCEL (or Sheets) frequently. Check out my website and sign up for this course to learn more about how you can use these resources to get your students excited about math again! https://www.jschenkelmathstudio.com/

36 - Beginning Math Teacher Workshop

Leader: Jessica Schenkel, Brooks School

This course is designed for teachers in their first 5 years of teaching. Regardless of your background, this course will provide an opportunity to reflect on past experiences and leave you refreshed and full of ideas for the 2020-2021 school year. Jessica will share her experiences, successes, and failures as a teacher and department chair in public, day, and boarding schools. We will review trends in math education, how to put relevant research to practice, classroom management techniques, curriculum design. and how to create a classroom that supports the development of a growth mindset.

37 - Python Programming for Beginners
Leader: Matt Pigg, Oregon Episcopal School

Python is a wonderful teaching language for math because its syntax is easy to learn. We'll learn programming basics including logic and looping and then plot lines of best fit, generate the Fibonacci sequence, explore prime numbers, and model the spread of an infectious disease. You'll leave the workshop with a full course's worth of self-paced modules and problem sets for learning Python yourself or for assigning to students. This course is for true beginners so those with some prior coding experience might prefer the other Python workshop.

38 - Python Programming for Math Modeling and Stats
Leader: Matt Pigg, Oregon Episcopal School

You'll learn the basics of Python and how to use it for simulation activities. These activities will include simulating the game of craps, modeling the spread of an infectious disease, plotting regression models, optimizing customer service, and scraping ESPN and Twitter data. You'll leave the workshop with a full course's worth of self-paced modules and problem sets for learning Python yourself or for assigning to students. This course moves quickly, so a previous course in any programming language (even long ago) is helpful. True beginners may prefer "Python Programming for Beginners."

39 - Counting and Probability: Building a More Meaningful Understanding
Leader: Nat White, Groton School

Chances are good that your students engage more when categorizing their peers based on interests than they do counting how many outfits Al Gebra can make from 5 pairs of pants and 7 shirts. This course will start from categorizing students (ages and interests) and build skills from there to look at conditional probability (and medical testing), expected value (and playing the lottery), and the binomial and geometric distributions (looking for a qualified candidate…). Tools will include spreadsheets, Venn diagrams, histograms, and natural frequencies.

40 - Drugs, Rumors, Loan Sharks, and Sneak Previews of Higher-Level Math in Core Courses
Leader: Nat White, Groton School

We'll use difference equations to model how the body processes a drug, how rumors spread, and why it's expensive to be poor. Along the way, we'll reinforce skills with sequences, time-series analysis, spreadsheets, and exponential, logarithmic, and logistic functions. The water cycle will add dimensions and get us talking about matrices and eigenvectors, and the simple measurement of a coastline provides a good introduction to both log transformed data and fractal dimension. These activities are appropriate in algebra and precalculus courses.