Using Technology to Save Endangered Species

by Paige Laurain, 2018 CTI Fellow
West Charlotte High School

This curriculum unit is recommended for:
Standard and Honors Math 3 / Grades 10, 11, and 12

Keywords: Math Education, North Carolina Math 3, Circles, Completing the Square, Radians, Degrees, Central Angles, Inscribed Angles, Secants, Chords, Tangents, Area of a Sector, Arc Length, Radius, Diameter

Teaching Standards: See Appendix 1 for teaching standards addressed in this unit.

Synopsis: This curriculum unit will have students explore some of the current ways conservationists use technology and mathematics to protect endangered species. Students will start by identifying what an animal's home range is, and how we can use properties of circles to interpret it. Students will then practice flying drones, and analyze how drones are currently being used to stop poachers by applying properties and theorems of circles. They will hypothesize what other forms of technology could be used to support conservation efforts, and how. This unit focuses on three species explicitly; the rhino, elephant, and tiger. These animals were selected because they are all endangered, and technology is currently being utilized in some way to protect them. Students will apply Math 3 concepts such as area of a sector, arc length, equations of circles, angles within a circle, and segments within a circle to anticipate how to protect an endangered species and conserve its home range. At the end of the unit, students will choose an additional endangered species, identify what is currently is being done to protect it, and suggest alternative ways to use technology to save it. Students will also determine how to best protect an animal's environment. Lastly, students will use the animal's daily travel range and the range a drone can travel to identify how many drones would be needed to protect that species in its natural environment.

I plan to teach this unit during the coming year to 80 students, and the Math 3 team will teach it to 200 students in standard and honors math 3.

Introduction

Rational

The curriculum unit focuses on using the Math 3 standards to teach students about how technology, such as drones, and an understanding of an animal's home range can help protect endangered species. The animals I am focusing on are the rhino, elephant, and tiger because their habitats are, in fact, currently being monitored by drones. These animals are also endangered due to loss of habitat and poaching. Currently, three out of the five species of rhinos are considered by the International Union for Conservation of Nature (IUCN) as critically endangered. One subspecies of the Javan rhino, found in Vietnam, is extinct. This is problematic not only because we are losing an entire species, but also because they have a huge impact on the ecosystems in which they live. Within their habitats, they prevent overgrowth of the plants they eat, disperse seeds through their dung, have symbiotic relationships with other animals such as the oxpecker, and use their horns and feet to dig up minerals used by other species.[1] If they are removed from their ecosystems, the effects can be long lasting and damaging to other species. This unit will encourage students to analyze how each animal interacts within its home range, and encourage them to identify potential technological solutions to protect them.

While mathematics is my key focus in the classroom, I also want my students to be able to identify problems in our world and find solutions for them. This is important because problem-solving not only helps students become successful in their mathematics class, but also in other courses and everyday life. Being resourceful is something our students face daily, and eventually they will be charged with looking at the world's dilemmas and identifying potential responses. We are preparing students for jobs and obstacles that currently don't exist. Access to technology is quickly increasing in daily culture, and therefore we have to prepare students to analyze how it can be utilized in multiple contexts. In this particular CU, students will identify what we currently know about particular species, how technology is used to track and protect them, and then brainstorm other ways we could use technology in conservation efforts.

Student Demographics

West Charlotte High School presently has 1,442 students enrolled 9-12th grade during the 2018 - 2019 school year. The school is set up similar to a college campus with 14 different academic buildings as well as north campus and south campus trailer classrooms. The school offers International Baccalaureate Programs in Middle Years and the Diploma Program. We also offer advanced placement courses, Junior ROTC, and both exceptional children's and English language learner's programs. Students are engaged in the arts through band, chorus, and various art courses including crafts, ceramics, and photography.

English II Proficiency	Math I Proficiency	Biology Proficiency	ACT Proficiency	4-Year Graduation Rate
34%	35%	30%	20%	86%

Table can be found at https://ncreportcards.ondemand.sas.com/src/reports/600576_2016_High.html

The table above reflects the current student proficiencies on North Carolina state standardized tests, the ACT, and our graduation rate. We are a Title I Priority school and currently part of the Learning Community 1 zone in Charlotte Mecklenburg School (CMS) district. The school has a higher population of freshman than any other grade level. The Math 3 classes are comprised of approximately 30 students each. The curriculum unit I am pursuing focuses on geometry, specifically circles, that is meant to be taught about a month into the Math 3 course.

West Charlotte students also have the opportunity to explore career pathways. We offer courses such as culinary arts, fashion design, marketing, and computer coding which allow students to explore potential occupations upon graduation. Students are also able to work for E2D, a non-profit focused on eliminating the digital divide for students in low-socioeconomic areas. West Charlotte students work to refurbish old computers that E2D sells for $50. This provides students not only with an after-school job, but also technological training that can lead to additional careers or degree pursuits. In addition to career preparation, students have access to extracurriculars through our athletic programs. Students participate in football, soccer, cheerleading, baseball, softball, tennis, track, cross country, and golf teams. Students also develop leadership skills through after school student run clubs such as S.A.V.E (students against violence everywhere), the anime club, girls who code, and Be More Media.

The 2018-2019 school year is the first year in which students will be grouped into disciplinary houses. Students selected their house based on their currently career interests. Each house has at least one career and technical pathway comprised of four to six courses that allow students to build industry relevant knowledge of their chosen career field. These courses are embedded with industry credentials that support students upon graduation, either through higher education or the job market, to pursue these careers. The career and technical pathways allow students to both apply for high quality internships, as well as obtain certifications in technical careers.

Unit Goals

One reason I chose to create a curriculum unit about animals and their home ranges is because students struggle to see the relevance of the Math 3 content in the real world. In North Carolina, students take end of course (EOC) tests at the end of specific years or courses to assess whether they are on track to be career and/or college ready. This year, 2018-2019, will be the first year that Math 3 is an EOC course. Unfortunately, the importance the state puts on these tests suggests to teachers that certain topics or skills are more important than others. This pressure forces teachers to focus on the rote memorization of the standards as opposed to integrating creative and applicable lesson plans that show the usefulness of the content.

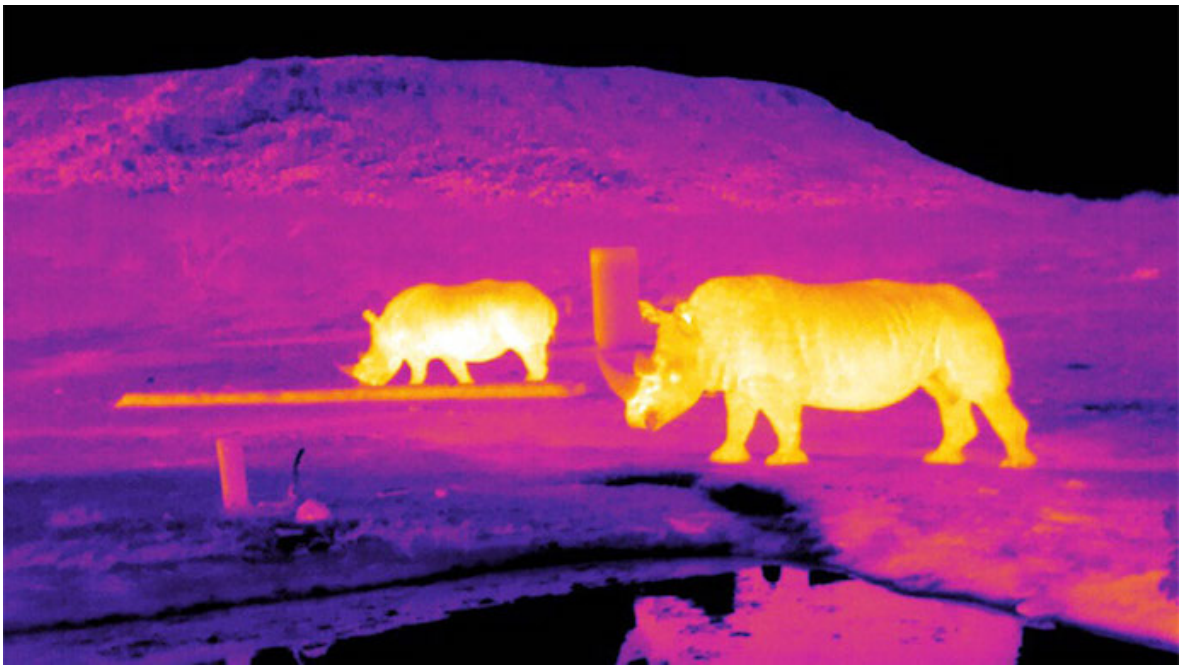
In addition, my students by nature are very curious. Students always ask the “why” questions; “why are we learning this?” or “why is this important?” They consistently want to engage in material they feel is relevant to life outside of school. This curriculum unit is designed to help students make connections between mathematics and the real world. The goal is for students to analyze real world situations or problems, and determine how Math 3 standards can be used to solve those scenarios. As a result, my hope is that student engagement and retention of the information will increase. In this particular unit, scholars will focus on the question: “How are circles currently being used to identify and execute conservation initiatives”?

Students are also given very little choice in what they learn in school. In most standardized math classes, the course pacing and content does not leave room for inquiries outside of the normal course of study, nor does it allow for creativity or the application of topics geared towards student interest. This stifles student's ingenuity and imagination, and does not prepare them to be twenty first century learners or workers. Another goal of this curriculum unit is to bring choice back into the classroom. Through this unit, students will be able to choose an animal to research. They will analyze the relationship their animal has to its environment through the circle standards we are already learning in class, and determine which conservation efforts are effectively working to save these animals. They will also suggest alternative conservation efforts that could be used.

Content Research

An animal's home range is the area it uses to live; this includes eating, sleeping, mating, and raising its offspring.[2] Home ranges are as diverse as the animals themselves. They differ between species as well as among animals of the same species, and they may even vary within an individual animal's life over time. The bigger the animal, the more space it needs to occupy to survive. Animals are very familiar with their home ranges. They know where they can obtain food and water, where they could encounter danger, and where they can seek shelter.[3] They are also able to identify if there are any reasons to change their home range, such as a new intruder in their territory, or if a water hole dries up. While some species are able to share or overlap their home ranges, others are more territorial. It is common for male animals to share their home ranges with female animals, however they will mark and defend their home ranges against other males of their own species.

Large animals mean large home ranges, and many endangered species are hard to protect because their natural habitats are so vast. It is difficult to track an endangered species without disturbing them and their environments. Poachers frequently come up with new and innovative tactics to sneak on and off animal reservations, which makes protecting the animals arduous. One way conservationists are tracking animals and their poachers is through drones and infrared cameras. Drones, which originally were created by the military as a weapon, are now being used for conservation efforts. Poachers frequently attack wildlife at night, when it is hard for both the animal and wildlife guards to see them coming. When drones are deployed with infrared cameras attached, both animals and poachers can easily be identified. On video, the environment looks pink and purple in color, however anything that gives off heat, such as animals and humans, appear yellow. The warmer the object, the brighter it appears.[4] Conservationists are also using a program that astrophysicists use called Astropy[4], which has in the past identified galaxies by their thermal energy, and created a thermal profile for those galaxies so we can recognize them in the future. Similarly, it can create thermal profiles for different species of animals, and determine which species it is filming based on its thermal profile. This enables conservationists to only track the animals they are studying and trying to protect.



Infrared image of rhinos in South Africa (via Endangered Wildlife Trust/Liverpool John Moores University)

Rhinoceroses are one of the animals students are going to observe in this unit. They are the second largest land mammals, after the elephant. There are five species of rhinos still alive; two are found on the African continent and three are in Asia. Rhinos are herbivores and can live in a variety of habitats including savannas, dense forests, tropical, and subtropical regions.[5] Their gestation period is 14 to 18 months, and the calves are raised by the mothers. Even though they are able to eat vegetation once they are a week old, they nurse for an entire year. Rhinos are currently on the list of endangered species. Humans are the only predator of adult rhinos, and they are poached for their horns which are used in jewelry, dagger handles, "medicines," and other traded commodities.[5] Their habitats are also infringed upon by growing cities, farms, and other human-dictated destructions of their habitat. To select an appropriate home range, rhinos require water, wallows, and mineral licks. They also need vegetation and are known to eat over 200 different species of plant, herbs and shrubs.[6] Male rhino's home ranges are autonomous of other male rhinos due to mating competition. By contrast, female rhinos however can independently or in a group chose their home range. Mating is the main reason for the rhino's home ranges to overlap. Rhinos can only travel 5-15 miles daily, however their home ranges can reach up to 642 acres.[6]

Elephants are another animal group that students will learn about through this curriculum unit. There are two species of elephants; the Asian and the African elephant. Both live on their respective continents and there are many differences between the two species. African elephants are larger and live in Sub-Saharan Africa, the tropical rainforests of Central and West Africa, and in the Sahel Desert of Mali. They are considered vulnerable by the International Union for Conservation of Nature (IUCN). Asian elephants live in India, Nepal, and Southeast Asia in scrub and rainforests. They are considered endangered by the IUCN. Elephants live mainly in herds that consist of old, young, and female adult elephants. Male elephants can be part of the herd or have their own individual home ranges. One of the reasons elephants are endangered is

because of poaching. Similar to the rhino, they are hunted for the ivory in their tusks. The average distance that elephants will travel in one day is at most 12 miles, however unusual distances of 111 miles have been observed in Etosha region of Namibia.[7] Their home ranges change dramatically in size. During the dry season it has been observed that their home ranges are very small, and the herds stay close to a water source. During the rainy seasons, their home ranges expands drastically.[7]

The last animal that students will learn about is the tiger. The tiger is the largest cat in the world. They live in a variety of environments and are mostly nocturnal. The tiger uses its stripes as camouflage so they can ambush their prey. They are carnivores and hunt deer, wild pigs, water buffalo, and antelope. When necessary, they will also hunt sloths, dogs, leopards, crocodiles, pythons, monkeys, and hares.[8] They attack by using their body weight to knock their prey to the ground and bite their neck. It is rare, however when threatened tigers will attack humans and cattle. They are solitary and territorial animals unless it is mating season. There were once nine subspecies of tigers: Bengal, Siberian, Indochinese, South Chinese, Sumatran, Malayan, Caspian, Javan, and Bali. Of these, the last three are extinct, one is extinct in the wild, and the rest are all endangered.[8] Tigers are poached for their meat, and their bones which are used as medicine. Their habitats are also decreasing in size due to farms, deforestation, and general expansion of human occupied areas. Tigers are known to travel anywhere from 4-37 miles a day which is dependent on their access to food, water, and the condition of the environment through which they need to travel.[9]

Technology is currently being used to protect these animals. In an article in *The Conversation* entitled "Satellites, Mathematics and Drones Take Down Poachers in Africa," Representatives from the University of Maryland's Institute for Advanced Computer Studies explained how analyzing specific data allowed park rangers to anticipate future poaching attacks. The institute found that they could identify where Rhinos would be with 90% accuracy because many of their ankles were tagged. This narrowed down the area that they would need to patrol at night. They also identified that most poachers worked under a full moon so they could see their prey, as well as with 160 km of a specific road.[10] By looking at the radius of 160 km around the road, as well as where that circle intersected with the Rhino's home ranges were, park rangers used drones to find the Rhinos. The drones help the rangers keep watch on multiple areas at once, and if an unidentified vehicle or persons is spotted, the rangers are able to quickly get to that area and apprehend them.

In addition to the University of Maryland's study, an organization called *Air Shepherd* is also using drones in South Africa, Zimbabwe, and Malawi to protect rhinos and elephants. They found that poaching of both animals has increased in South Africa 9000% since 2007.[11] Every 9-11 hours a rhino is killed, and every 14 minutes, an elephant is poached.[11] At this rate, rhinos and elephants will be extinct in the next ten years. To combat this, *Air Shepherd* has implemented a six step approach to end poaching. They first collect data on where the animal's home ranges are. They use that data to determine threat areas and where they should fly their drones. Then they preposition park ranges so they are stationed within the rhinos or elephants home ranges. This allows them to quickly mobilize towards any threat identified. Next, they position a control vehicle within the animal's home range. This is the vehicle they use to fly their drones. Once the pre-work has been completed, they launch and fly their drones within the

animal's home ranges. The drones have infrared cameras attached to them, that sends data such as animal and human movement directly back to their control vehicle. If a potential poacher is spotted, the drone operators contact the nearest park rangers so that they are able to apprehend the suspects. Lastly, *Air Shepherd* uses the data collected by the drones including animal and human movement, to evaluate future threats to the animals. This method has proven successful thus far. In one area where previously 19 rhinos were killed each month, the drones have been utilized and there have been no deaths for the last six months.[11]

Teaching Strategies

The two most significant teaching strategies I will use to engage students in the Math 3 circles unit are blended learning and PEAK strategies. Blended learning is the replacement of face-to-face learning with online instruction and research. All West Charlotte students are given a laptop that they are expected to carry from class to class and take home with them. One way students will learn new information is through the online platform Nearpod. Teachers are able to upload guided notes into nearpod through google slides or a PowerPoint presentation. They then can also include interactive slides such as a poll, quiz, collaboration board, or the draw feature. The draw feature provides an opportunity for students to show their work. Teachers can then highlight successful students by showing their work to the whole class. From previous use in my own classroom, I have found that students love to be recognized for being successful and the draw it tool allows students to be acknowledged in real time. While this lesson plan has students learning online in a few lessons, all of the content can be adapted and delivered in a traditional way.

Peak strategies will also be used to teach this unit. PEAK was developed by Spence Rogers and is a collection of essential concepts, strategies, techniques, and processes for ensuring performance excellence for all kids. The PEAK strategies that are utilized in this unit plan are launch buttons, model exactly, and over and over. Launch buttons are auditory, visual, or physical cues or signals that indication to the students that it is time to start an activity or follow a direction. The purpose of this is to improve and strengthen classroom management, amplify the amount of students who follow directions correctly the first time, and save instructional time. In my class I utilize phrases such as "I need everyone's attention in 5, 4, 3, 2, 1" and by the time I get to one students are quiet. I also use the phrase "When I say go" and then follow the phrase with the students expected movement, voice level, and purpose. This decreases the number of students asking "What are we doing…?"

Model exactly is another peak strategy that will be used in this statistics unit. Model exactly means that when teaching a procedure, model EXACTLY what the student will be asked to do after you model and explain – NOT a similar one, but exactly the same one or thing."[12] While you do this, students are silent and not writing. This can lead into the over and over strategy that requires students to write the same problems over and over as many times as they can in a predetermined amount of time. The purpose of this strategy is to help students internalize the steps to solving a particular type of problem so they can replicate those steps with similar problems.

Another strategy that will be utilized but isn't entirely a PEAK strategy is "think, pair, share". Students first think about a question prompt given by the teacher, then pair up with a partner to discuss their answers. Lastly, they share out whole group what they discussed with their partner. The purpose of this is to ensure any student who doesn't understand the content has an opportunity to learn from a peer and construct their own answer. PEAK does incorporate think, pair, shares into their content delivery, but provides a variety of alternative ways for students to pair and share their information. One suggestion is to have students think about a question and write it on an index card. When asked to pair with a neighbor, they first switch cards as many times as they can within a time frame so that no student is embarrassed if they don't know the answer. Then students are able to look at a few cards before having a conversation about the question with their peers. This strategy allows students to have a couple of answers ready by the time they get to their partner so that they are able to contribute to the conversation. When the teacher cold calls students to facilitate a whole class discussion, no student is able to opt out of participating because they have been given multiple opportunities to learn the content. The value of constructing a think, pair, share in this way is that it increases the success of students being able answer the problem, improves motivation because students know they can't fail, and increases retention.

The circles unit in Math 3, as suggested by Charlotte Mecklenburg Schools and the State of North Carolina, consists of writing, converting, and interpreting equations of circles, solving for segments and angles inside and outside of circles, area of a sector of a circle, and arc length of a circle. The unit will last 7 days including 2 days for the end assessment.

Day 1

Objective: Students will be able to writing the standard equation of a circle, identify the radius and center of a circle, find the area and circumference of circles, and graph circles from their equations.

Students will start the day with a warmup. At West Charlotte, we use one preview question, and one review question for the warm-up. The preview question will ask students to identifying the radius and center of a circle on a graph, then find the area and circumference of that circle. The purpose of this question is to recall the previous knowledge students have and bridge the gap if they've forgotten. We will then start class by introducing a drone. I will fly it around the room and facilitate a discussion on what drones are used for, and how to fly them. Students should be asked questions such as "What do you currently know about drones?" "How are drones currently being used?" and "Can you think of anyways we could use drones to save an endangered species?" Students will brainstorm ideas to the last question for 3 minutes to help them start thinking about the unit. Then we will write out their answers on an index card and participate in a think, pair, share to start facilitating the idea of using drones in conservation. I will then explicitly tell students that they will be exploring the use of drones and mathematics to promote conservation efforts.

Next, I will then instruct students through guided notes on writing the standard equation of a circle, identify the radius and center of a circle, find the area and circumference of circles, and graph circles from their equations. During the notes, I will use the model exactly strategy so that

students can focus on how to write an equation, and graph the circles from the equation. This strategy is not necessary for finding the radius and center of a circle, and finding the area and circumference because these concepts have already been addressed in the warm-up. After the model exactly strategy, which we call the "I do" part, we have similar problems in the "We do" section where I facilitate a discussion of the problems and a "You do" section where students independently try problems on their own. During the "You do" section I will walk around the classroom and give students immediate feedback on their work so they can reflect and fix their mistakes.

After the notes students will work on an independent practice. Students will also start learning about the rhino through the independent practice. A description of what a home range is will be given at the beginning of the independent practice so that students can correctly describe what they are learning about. They will also watch a video entitled *Black Rhino Range Expansion Programme by Green Renaissance* which was created by the World Wildlife Foundation South Africa. This video gives students a visual understanding of what they will be learning about, as well as how endangered rhinos are. Students will then transition into the independent practice where they will be asked to write equations, graph, and find the area, circumference, radius, and center of a circle while referencing facts about rhinos. Students will also apply graphing, the area, and the circumference to the equation they write. The independent practice will end with students reflecting on what they learned about rhinos. *See appendix 2.*

Day 2

Objective: Students will be able to convert between the general form and standard form of a circle.

Students will start day two with their warm-up. The review question will be similar to yesterday's independent practice where students were given a scenario about a rhino, and then asked to use the math standards from that day to answer it. The preview question will ask students to identifying the radius and center of a circle given in general form. This question will be scaffolded because students do not have any previous knowledge of converting circle equations, however they did learn completing the square in Math 2. Next, students will again reflect on technology and conservation. I will show the ted talk YouTube video entitled *Lian Pin Koh: A Drone's Eye View of Conservation*. The video is 13.5 minutes long, however the first two minutes gives a brief overview of how Nepal is using drones in conservation efforts for elephants, tigers, and rhinos. After watching the video, students should reflect using a nearpod discussion board on the positive and negatives of using a drone as a conservation effort. As a class, we can then discuss the pros and cons posted together.

Students will then work through guided notes using nearpod. Before starting the mathematics, students will see images of elephants who have been poached (age appropriate) and allowed to submit a response on another bulletin board slide of nearpod. This creates a think tank of expressions students have to poaching on the endangered species. The goal is to evoke a reaction, and discuss why we have that reaction. Students will today's objective using the I do, we do, you do method, and I will show exemplar student work so that students can identify and fix any misconceptions they have. This will also allow me to gather data on student

understanding of the day's objective. Students will then complete independent practice. This independent practice will focus on elephants. Students will convert equations of circles, and then identify the radius and center of the circle from the equation. From there students will graph the equation and identify information from the problems about elephants' home ranges.

Day 3

Objective: Students will be able to use the properties of angles in a circle to identify and solve for angles and arcs within and outside of the circle

Students will start day three with their warm-up. The review question will ask students to identify what they learned about elephants from yesterday's independent practice. The preview question will ask students to identify properties of central and inscribed angles. Students do not have previous knowledge of this concept so they will be given formulas to apply to the circle given. On this day we will incorporate technology by having students practice flying drones. I have access to 6 drones at West Charlotte, and we will take 20 minutes today and tomorrow to provide an opportunity for students to fly them.

The guided notes will also be completed through Nearpod. The notes will open with information on using parts of animals for medicine in Asia. This is a cultural component that we do not experience as often with Western medicine. Students will then answer the question "do you think animals should be used in medication? Why?" on a bulletin and we will read the responses together. The purpose of this conversation is to facilitate a discussion on under what situations is killing an animal appropriate. It also allows us to explore how other culture's interpretation of this question vary from our own. I will then transition into the mathematics through the I do, we do, you do model and provide exemplar responses through nearpod. Students will end class with their independent practice. This time, students will apply angles and arcs to the tiger's home range. The end of the practice will ask students to write a summary on what they have learned about their home ranges and the conservation efforts that are being implemented to stop poaching.

Day 4

Objective: Students will be able to use tangents, secants, and chords to identify and solve for properties of a circle.

Students will start day four with their warm-up. The review question will ask students to identify what they learned about tigers from yesterday's independent practice. The preview question will ask students to solve for the length of a chord inside a circle. Students do not have previous knowledge of this concept so they will be given formulas to apply to the circle given. Students will then spend another 20 minutes flying drones. Not everyone would have had the opportunity the previous day, and I want every student to have this experience to reference during their final project. We will then come back to class and discuss what connections they see between the Ted Talk video that students watched on day two and flying the drones themselves.

Day four's guided notes will again be completed through Nearpod. Our bulletin board question for today is "What was the most challenging aspect of flying the drones?" After reading the responses together, we will complete the I do, we do, you do questions from the guided notes. Here, students should look at intersecting chords, secants outside of the circle, tangents, and a tangent with a secant line. Today's independent practice will make connections between the pathways of drones and all three animals within their home ranges.

Day 5-6

Objective: Students will be able to solve for the sector area and arc length of a circle given the angle in both degrees and in radians.

Students will start both days five and six with their warm-up. The review questions will be on angles in a circle one day, and line segments in a circle the other. This will give students a second opportunity to learn the previous day's lessons. The preview question will ask students to solve for both the arc length and the area of a sector given the angle in degrees one day, and in radians the next. Students do not have previous knowledge of these standards and will therefore be given the formulas.

To teach these concepts, I will use the traditional method of guided notes. To increase the rigor of this standard, I would start the guided instruction with showing an example of both finding the arc length and area of a sector. Then ask students to write their own steps to solving this type of problem. Students could then participate in a think, pair, share centered around what are the steps to find the arc length and area of a sector? Once students have identified the steps to solving these problems, I will use the model exactly strategy to clear any misconceptions students still have. I will also implement the over and over strategy here so that students internalize the steps. Before students start the independent practice, they will watch a YouTube video from Al Jazeera news entitled *Habitat loss imperils Indonesia elephants.* This video shows the struggle some farmers of Indonesia have with keeping both their crops and elephants safe. The independent practice will require students to find the area of a sector in regards to the tiger, elephant, and rhino losing their habitat. The anylysis in the "practice" will allow us to explore why, besides poaching, these species are endangered. To practice finding the arc length, students will use the idea of a drone patrolling part of the circumference and of an animal's home range. *See appendix 3.*

Day 7-8

Objective: Students will be able to apply concepts of circles, home ranges, and using technology for conservation to identify current conservation efforts and propose new ones.

On the last two days of the unit, students will pair up for a project proposal. They will first choose and research a new endangered species. After identifying which endangered species they want to explore, the students will research facts about each species including how far it can travel in one day, thereby facilitating an estimate area of the animal's home range. Students will graph the animal's home range on a coordinate plane. Students will then create a plan and identify how many drones they would need to protect the animal within their home range and

show where in the animal's home range (already graphed on the coordinate plane) the drones would have to be positioned. The goal is for students to use the least amount of drones possible, while still covering every inch of the animal's home range. Lastly, they will research other forms of technology that are being used to currently protect that animal and expand on that idea to include additional forms of technology that could be used to promote conservation. Students will justify their answers in a letter written to the World Wildlife Fund and make suggestions on how to best protect their endangered species. *See appendix 4.*

Appendix 1

Common Core Standards

1. Make sense of problems and persevere in solving them. *Students will make sense of how to protect an endangered species through visual representations.*

2. Model with mathematics. *Students will model an animal's home range using a circle equation and determine the number of drones that would be needed in order to protect the animal.*

3. Attend to precision. *Students will use precision to place drones within the animal's home range in the final product.*

North Carolina Standards

NC.M3.G-C.2 Understand and apply theorems about circles. Understand and apply theorems about relationships with angles and circles, including central, inscribed and circumscribed angles. Understand and apply theorems about relationships with line segments and circles including, radii, diameter, secants, tangents and chords.

Students will apply theorem about relationships with angles and line segments to interrupting animal's home ranges.

NC.M3.G-C.5 Using similarity, demonstrate that the length of an arc, s, for a given central angle is proportional to the radius, r, of the circle. Define radian measure of the central angle as the ratio of the length of the arc to the radius of the circle, s/r. Find arc lengths and areas of sectors of circles.

Students will use the arc length and area of a sector to determine how land development affects an animal's home range size.

NC.M3.G-GPE.1 Derive the equation of a circle of given center and radius using the Pythagorean Theorem; complete the square to find the center and radius of a circle given by an equation.

Students will use the equation of a circle to graph an animal's location, determine the approximate size of their home range, and determine how to place the drones to best protect them in their final product.

Appendix 2

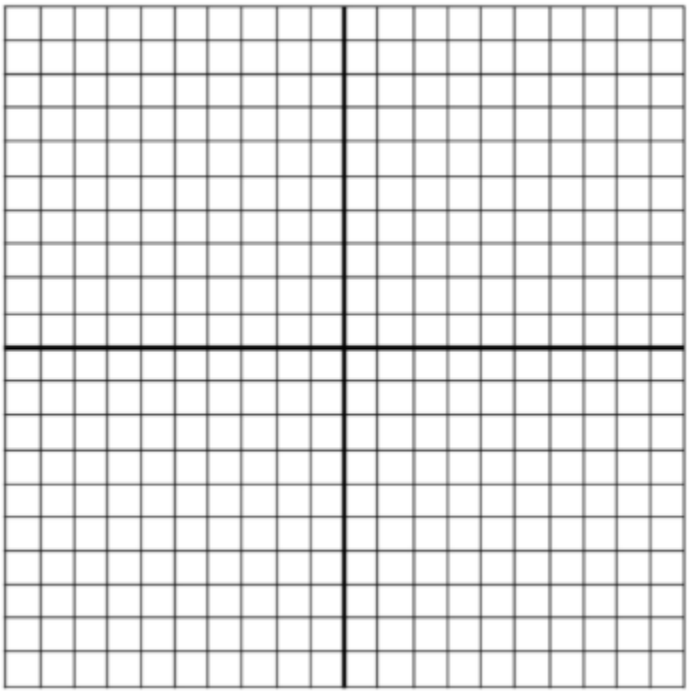
Name: _____ Date: _____

Home Ranges of Rhinos – Circles Day 1

Directions: An animal's home range is an area over which an animal or group of animals regularly travel and live; this includes where the animal eats, sleeps, mates, and raises its young. Answer the following questions to learn about a Rhino's home range.

1. A rhino is found at the point (3,4) and can travel an average of 8 miles on any given day in search of food. Write an equation to represent the Rhino's home range.

2. Graph the Rhino's home range below:



3. There is a watering hole located at (-3,9). Is the watering hole within the rhino's home range? Use two different methods to justify your answer.

4. The rhino's preferred food source is grass. There is a patch of grass located at (1,2). Is this patch located within the rhino's home range? Use two different methods to justify your answer.

5. Identify the radius of the circle you graphed above.

6. A conservationist is trying to determine how much space they need to monitor in order to protect the rhino from the previous problems.

    a. What is the difference between the area and the circumference of a circle?

    b. Find the area and circumference of the rhino's home range.

    c. Which is a better calculation to protect the rhino? Why?

Appendix 3

Name: _____ Date: _____

Lose of Home Range – Area of Sectors and Arc Length

The elephant, tiger, and rhino are endangered not only due to poaching, but also a loss of habitat. Rapid deforestation as a result of human expansion has depleted the animal's home ranges resulting in more human wildlife interactions and increasing the ease of poaching. It also creates fragmented and disconnected habitat zones limiting their ability to breed. Answer the questions below to interpret how rapidly elephants, tigers, and rhinos are losing their home ranges as well as how drones can be used to protect them.

1. A tiger can travel at a maximum of 37 miles per day. Given the area of a circle is $A = \pi r^2$, find the maximize size of the tiger's home range.

2. Currently, experts estimate that existing tiger habitats have declined by 50% in the last 21 years. If the tiger's home range above decreased by 50%, what would the area it's home range be?

3. Using the area above, solve for the angle measurement of the new area of the sector in both degrees and radians.

4. An elephant travels an average of 12 miles a day. Given the area of a circle is $A = \pi r^2$, find the average size of the elephant's home range.

5. Currently, it is estimated that 2/3 of the elephant's habitat has been taken due to human expansion. What is the sector area that's left of the elephant's home range?

6. Using the area above, solve for the angle measurement of the new area of the sector in both degrees and radians.

7. As human populations expand; more land is being converted to agriculture. Habitats are shrinking and becoming more fragmented, and people and animals are increasingly coming into contact - and conflict - with each other. Animals can damage farmer's crops and fields, affecting the farmers' livelihoods. They can even hurt people. In an effort to separate people and rhinos, a drone is searching an arc length of 134 ft. to identify potential problems. What degree would the sector have in order for the rhino to be seen by that drone?

8. A rhino is traveling within a 75 degree sector and getting dangerously close to a village. It can travel approximately 5 miles per day. A drone is scanning the arc length anticipating the rhino's arrival. What is the distance the drone would have to search in order to see the rhino?

Appendix 4

Name: _____ Date: _____

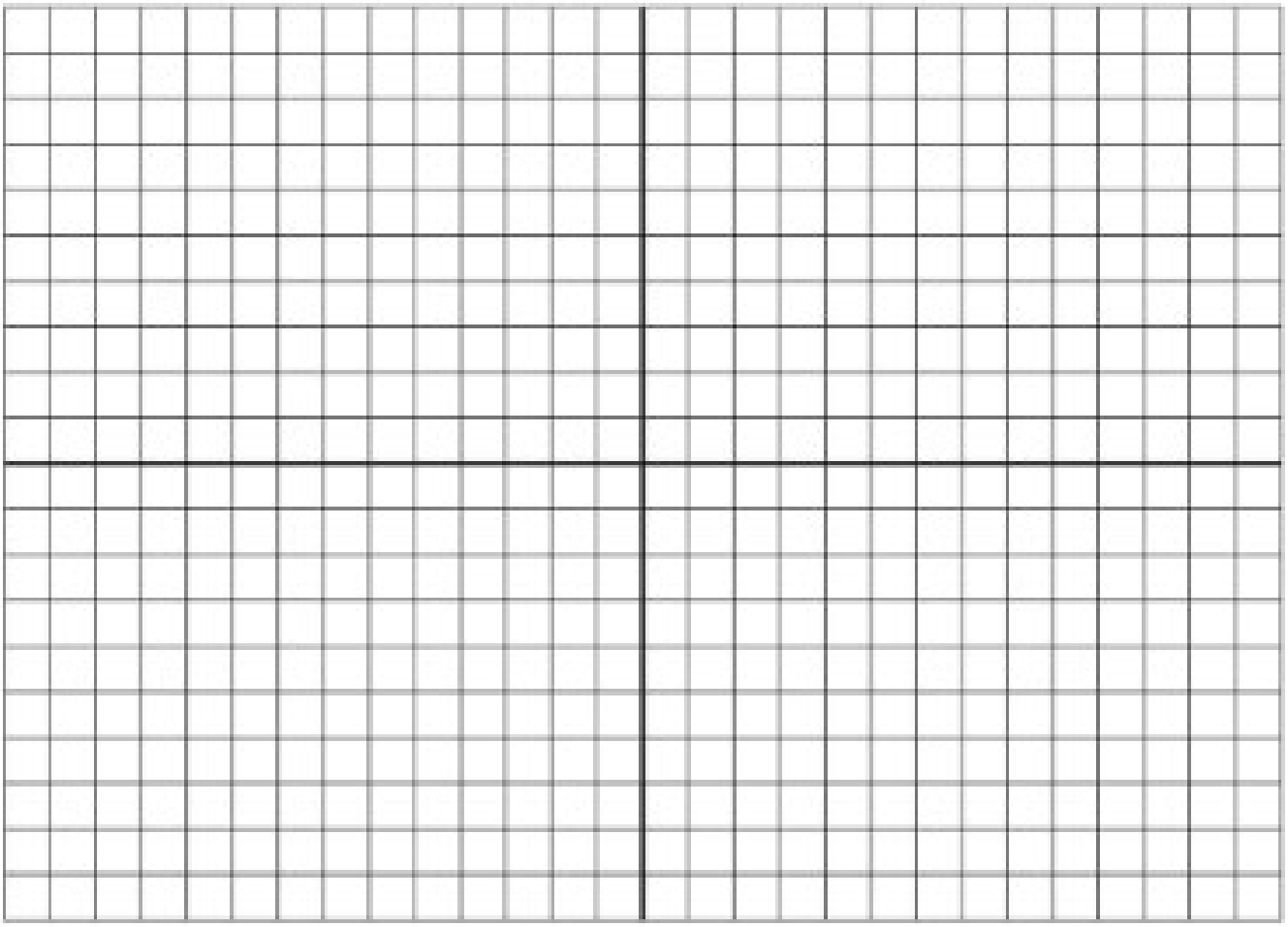
Endangered Species Project

1. Use the World Wildlife Foundation website found below to determine which endangered species you want to research: https://www.worldwildlife.org/species/directory?direction=desc

Species:

2. Gather information on your chosen species. Include information such as lifespan, habitat, location, how far it can travel in one day, and why it is endangered. Write the information below in a paragraph. Make sure to cite any sources used.

3. Plot your animal in the center of the coordinate plane. Then use the distance it can travel to graph it's estimated home range.



4. Write the equation for your home range in standard form. Identify the center and the radius.

5. Find the total area and circumference of your home range.

6. Conservation drones can travel anywhere from 15 – 62 miles in any direction. Assuming they have to fly away from you and back, how far can you travel in any one direction?

7. Plot as few areas of drones as necessary above on the coordinate plane to cover the entire animal's home range. What is the fewest number of drones that would be necessary?

8. Next, research what conservation efforts are currently being implemented to protect your species. Focus specifically on one's that use technology. Explain them in at least 1 paragraph, citing sources when necessary.

9. Brainstorm with your partner! Reflect back on the reasons why your species is endangered (you answered this in #2). Can you think of any additional technology that currently exists or that could be created that would help protect your species? Write about it below, in at least 1 paragraph citing sources when necessary.

10. You are a conservationist writing to the World Wildlife Foundation in an effort to save your species. Write an argumentative essay on what should be done to protect your species. Include the information you researched above, the potential use of drones, and any additional technology that could be utilized. See the rubric to receive full credit.

Rubric for the Assessment of the Argumentative Essay

	3	2	1	0	Score
A. **Introduction** Background/history Define the problem Thesis Statement **Conclusion**	Well developed introductory paragraph contains detailed background , a clear explanation or definition of the problem, and a thesis statement Conclusion summarizes the main topics without repeating previous sentences; writer's opinions and suggestions for change are logical and well thought out.	Introductory paragraph contains some background information and states the problem, but does not explain using details. States the thesis of the paper. Conclusion summarizes main topics. Some suggestions for change are evident.	Introduction states the thesis but does not adequately explain the background of the problem. The problem is stated, but lacks detail. Conclusion summarizes main topics, but is repetitive. No suggestions for change and/or opinions are included.	Thesis and/or problem is vague or unclear. Background details are a seemingly random collection of information, unclear, or not related to the topic. Conclusion does not adequately summarize the main points. No suggestions for change or opinions are included.	_____
B. **MAIN POINTS** Body Paragraphs Refutation	Three or more main points are well developed with supporting details. Refutation paragraph(s) acknowledges the opposing view and summarizes their main points.	Three or more main points are present but may lack detail and development in one or two. Refutation paragraph(s) acknowledges the opposing view but doesn't summarize points.	Three or more main points, but all lack development. Refutation paragraph(s) missing and/or vague	Less than three main points, with poor development of ideas. Refutation missing or vague.	_____
C. **ORGANIZATION**	Logical, compelling progression of ideas in essay;clear structure which enhances and showcases the central idea or theme and moves the reader through the text. Organization flows so smoothly the reader hardly thinks about it. Effective, mature, graceful transitions exist throughout the essay.	Overall, the paper is logically developed. Progression of ideas in essay makes sense and moves the reader easily through the text. Strong transitions exist throughout and add to the essay's coherence	Progression of ideas in essay is awkward, yet moves the reader through the text without too much confusion. The writer sometimes lunges ahead too quickly or spends too much time on details that do not matter. Transitions appear sporadically, but not equally throughout the ssay.	Arrangement of essay is unclear and illogical. The writing lacks a clear sense of direction. Ideas, details or events seem strung together in a loose or random fashion; there is no identifiable internal structure and readers have trouble following the writer's line of thought. Few, forced transitions in the essay or no transitions are present.	_____
D. **WORKS CITED**	Source material is smoothly integrated into the text. All sources are accurately documented in the desired format both in the text and on the Works Cited page.	Source material is used. All sources are accurately documented, but a few are not in the desired format. Some sources lack credibility.	Source material is used, but integration may be awkward. All sources are accurately documented, but many are not in the desired format or lack credibility.	Lacks sources and/or sources are not accurately documented. Format is incorrect for all sources.	_____
E. **MECHANICS** Sentence Structure Punctuation & Capitalization	Sentence structure is correct. Punctuation and capitalization are correct.	Sentence structure is generally correct. Some awkward sentences do appear. There are one or two errors in punctuation and/or capitalization.	Work contains structural weaknesses and grammatical errors. There are three or four errors in punctuation and/or capitalization.	Work contains multiple incorrect sentence structures. There are four or more errors in punctuation and/or capitalization.	_____
				TOTAL	

Comments:

Grade Equivalent: **A= 13 - 15 points**
B= 10 - 12 points
C = 7 - 9 points
D = 4 - 6 points
F = 3 or less

Grade: _____

Resources

"Rhinoceros." WWF. Accessed September 15, 2018. http://wwf.panda.org/knowledge_hub/endangered_species/rhinoceros/.
The world wildlife foundation gives brief but concise overviews of each endangered species. This webpage specifically references the rhino. A basic understanding of each species is beneficial when teaching this unit to help facilitate conversations about the animals.

Bradford, Alina. "Facts About Elephants | African Elephants & Asian Elephants." LiveScience. September 25, 2014. Accessed October 12, 2018. https://www.livescience.com/27320-elephants.html.
This is another website that gives a brief but concise and accurate understanding of the African and Asian elephants.

"Argumentative Essay Rubric - Home | Pier." Accessed November 19, 2018. https://pier.macmillan.yale.edu/sites/default/files/files/Argumentative essay rubric.pdf.
This is the argumentative essay rubric I would use to grade the student's argumentative essays in their final product. The Macmillan Center utilizes Yale University's resources to develop and implement educational resources that are available to the public.

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ca-36638.

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Rogers, Spence. “Teaching for excellence: essential concepts, strategies, techniques, and processes for ensuring performance excellence for all kids.” Conifer, CO: Peak Learning
Systems, 1994. Spence Rogers gives a list of best practices that engage students, help them feel successful, and increases retention of classroom content.

"Lian Pin Koh: A Drone's-eye View of Conservation." YouTube. November 18, 2013. Accessed October 28, 2018. https://www.youtube.com/watch?v=FIrgjCNcDBI.