PBI Curriculum Topic Study

Assignment

Part 1:
Use the template below to record the information you collect on your topic during your Curriculum Topic Study

[TWO DINEMSIONAL GEOMETRY GRADE 10]

Standards- and Research-Based Study of a Curricular Topic

Section and Outcome	Selected Sources and Readings for Study and Reflection Current Research on Topic
I. Identify Adult Content Knowledge	**What "big ideas" and major concepts make up this topic?** In order to make sense of what we see, the human mind relies heavily on its perception of shapes and patterns. **What new content did you learn or improve your understanding of?** I had never before considered how the area formula for a rectangle serves as the foundation for all other area formulas. I understood how it related to parallelograms and triangles, but not circles. It is neat how as the number of sides of the inscribed polygon increase, you are approaching a circle and that is where $A = \pi r^2$ comes from. Additionally, I knew about using the "method of exhaustion" in calculus, but I never before related it to an understanding of how we go from areas of polygons to areas of circles. **What examples were used to understand the ideas?** Everyday items, whether they are manmade such as vehicles, toys, and buildings or natural such as leaves, animals, flowers take on geometric forms. **What other new insights about the topic did you gain from this reading?** Although real objects don't perfectly match geometric figures, they can be approximated. Therefore we can use our knowledge of Geometry in studying things like coastlines, or nature. **IA. *Science for All Americans*** What enduring understandings should all adults, including teachers, know about this topic? It is important that all adults understand and be familiar with points, lines, planes; triangles, rectangles, squares, circles, and ellipses; rectangular solids and spheres; relationships of similarity and congruence; relationships of convex, concave, intersecting, and tangent; angles between lines or planes; parallel and perpendicular relationships between lines and planes; forms of symmetry such as displacement, reflection, and rotation; and the Pythagorean Theorem. How does the reading help you see what a K-12 education is aiming toward? A goal of a K-12 education is to help students (future adults) to understand the multitude of topics related to two-dimensional Geometry. All aspects of Geometry are relevant to the real-world. A K-12 education should help students to see that there are skills to learn that will be beneficial to them even after graduating. **IB. *Beyond Numeracy*** How does the reading help you identify the basic ideas underlying a math topic? The reading helps me to understand the basic ideas of area and volume by pointing out the most fundamental aspects and showing the relationships between the main features of each concept. Are there explanations or vivid examples you can use with students to explain concepts in an interesting, comprehensible way?

	The Beyond Numeracy text provided me interesting ways to understand area and how the area formulas are derived for each shape. I think using the examples provided in the text would be more meaningful and in turn help students to better understand where the formulas come from, instead of just requiring that they memorize. Memorization comes naturally when one understands why it is the way it is. Did you find anything that helped you understand mathematics in current events or everyday situations? I liked the mention of an 8 inch pizza being almost 80% bigger than a 6 inch pizza. The way companies advertise they promote the diameter and most people don't consider how much a change in the diameter will affect the total area. Instead of noticing that the 8 inch pizza is say $3.00 more than the 6 inch pizza, people should realize how much more bang for their buck they are getting when they order the 8 inch pizza.
II. Consider Instructional Implications	**What suggestions are provided for effective instruction of the topic?** To effectively teach this topic it is important for teachers to make connections for students. Connections between the Geometry they are learning now to the games, books and toys students had when they were young. Younger children interact with lines, points, shapes, etc. all the time and they don't hear these things referred to as geometric terms, but they are. The teacher must help students to make these connections. **What student learning difficulties, misconceptions, or developmental considerations are mentioned?** The texts mention that often times students struggle with visualizing the more abstract ideas. For example, when learning transformations and discussing what the coordinate points of a rotated figure would be, it is hard for students to visualize when the figure is a still two dimensional print on a piece of paper. If however, the students had a computer application that would show the shape rotating about a point then they could see what happens and not depend on understanding the abstractness of the idea. **Does the reading suggest representations or everyday experiences that are effective in learning the ideas in the topic?** Experiences that help students with the topic of two dimensional geometry include helping students to realize patterns on their own. The text suggests that students solve a problem using one method and then using a second method. Students are to see that there is more than one way to go about the problem and arrive at the correct answer. Providing students with the opportunity to explore how the area formulas are constructed and why they change depending on the specific shape they are working with will be a valuable part in teaching this topic. Additionally, the use of geometric software can help students to more easily visualize and manipulate figures and their properties. **IIA: *Benchmarks for Science Literacy*** How does the general essay help you gain a K-12 "big picture view" of the topic? The general essay on shapes in *Benchmarks For Science Literacy* explains how as children playing with toys, reading brightly colored books, and playing

	games, children are interacting with geometric ideas all the time without even knowing. Geometry is not some topic that becomes relevant to a person August of their tenth grade year and stops existing in June of their tenth grade year. It is everywhere, always has been, always will be. **IIIB: *Principles and Standards for School Mathematics*** How do the essays, tasks, and student work help you think about the instructional implications of the topic? Instructional implications of this topic include discussions of patterns and relationships, as well as mathematical inquiry. Through mathematical inquiry students should discover patterns and relationships related to two dimensional geometry and the area of regular polygons, in particular. The area formulas are much more meaningful when students understand where they came from. When students break up a polygon into smaller parts and find the area of those smaller parts they can see an alignment between what they already knew and what they are currently learning.
III. Identify Concepts and Specific Ideas	**Which learning goals align well with the topic?** Teaching students the skills to be able to effectively use their mathematical inquiry to explore patterns and relationships between shapes and then to be able to compute values, estimate numbers with a certain degree of reasonableness to find out information about those shapes are all learning goals that align with this topic. **What concepts, procedures, specific ideas, or skills make up the learning goals in this topic?** Specific ideas students should learn when working with this topic consist of the fact that patterns exist and knowing how to recognize and apply them in the real-world is important. Since it is significant for students to explore ideas and to make multiple representations, it will be essential for students to share their findings with others. This way students can see a variety of ways of thinking about a task and hear the reasoning behind the different approaches taken. Computation and judging reasonableness are skills that should be addressed with this topic. Once students have come to a conclusion, they must consider the reasonableness of their answer. If they find that their answer is unreasonable they should check their computation. **How do these goals help you determine what you can eliminate or place less emphasis on?** With these goals in mind. I know that I can eliminate the thought of "giving" students the formulas. Instead, through patterns and mathematical inquiry, they will come to a conclusion about what they think the area formulas should be. This will help students to truly understand the formula. They will never have to memorize it because they will understand it and can essentially derive it anytime they need it. **How do the learning goals in the *Benchmarks* compare to the ideas in *Principles and Standards for School Mathematics?*** What *Benchmarks for Science Literacy* refers to as mathematical inquiry, *Principles and Standards for School Mathematics* refers to as analyzing characteristics and properties to develop mathematical arguments. Both mean the same thing. Students are to test theorems, prove conjectures, explore relationships and analyze properties. Both texts discuss the use of different

	representational systems when representing ideas. Examples could include choosing between using angles, distances, or the Cartesian coordinate system. Again, using spatial and visual reasoning along with geometric modeling to solve problems is the same as finding patterns and representations. Both texts align when discussing the standards related to two dimensional geometry. **IIIB: *Principles and Standards for School Mathematics*** What facts, concepts, principles, and broader generalizations are embedded in the standards? Ideas embedded in the standards include the analysis of properties and attributes of shapes, the ability to deduct information, transformational skills, as well as the drawing and visualizing of geometric images. How do the expectations listed help clarify what the standard involves? The expectations help to specify the important aspect of each standard. The standards are more of an umbrella of an idea and the expectations serve to identify exactly what students should understand in order to have met the given standard.
IV. Examine Research on Student Learning	**What specific misconceptions or difficulties might a student have about ideas in this topic?** **Are there any suggestions as to what might contribute to students' misconceptions and how to address them?** Diagrams can provide students with an area of struggle. Many times students view a diagram and believe that all known information is provided when really a simple addition to the diagram using information they know to be true can provide them with more knowns. This is important especially when working with finding the area of regular polygons, most everything they do will include a diagram. Students assume that all known information is given and don't consider that some information was left for them to fill in, using their knowledge of the topic. To help students with this problem, we can offer up multiple diagrams, with different information in each that they can then make connections and merge into one diagram. Both the use of manipulative and pictures are good, however in moderation and only when used appropriately. It is difficult for young children to recognize and name triangles and rectangles. Students think that the vertex of a triangle must be perfectly in the middle of the base length, and that rectangles do not have right angles, squares do. This comes down to looking at the aspect ratio. Children want an aspect ratio of one. The base and the height to be similar in length. When this does not occur they are lead astray. Students often struggle with understanding the difference between two and three dimensional shapes. This is partially because when the same name is used there is no discrimination between the two. In the primary grades students only learn about plane figures and then later on they have a hard time with solids. Initially students assimilate the idea of area with the idea of length, but as they progress and enter secondary schooling they are better able to differentiate between the two.

Is there an age or grade when students may be more likely to learn certain ideas in the topic?

Research shows that we can do more at all grade levels. American students are behind and both our culture and curriculum play vital roles. Both *NCTM Research Companion* and *Benchmarks for Science Literacy* explain the four steps developed by the van Hieles (as described below). It is not necessarily the grade that the student is in that determines the level they are at, but instead, where they are developmentally. This is different from person to person, and more drastically different from culture to culture.

How does the research draw attention to important prerequisite knowledge?

Students are continuously building upon their prerequisite knowledge. The concrete examples they used when they were younger to identify a rectangle still remain relevant when they also check the properties to see that there are two sets of parallel sides, all meeting at a ninety degree angle. The knowledge of these properties are then essential when the time comes for students to write proofs. They must know the properties of specific shapes to make valid statements to prove their argument.

IVA: *Benchmarks for Science Literacy*

How can the research be used to complement the benchmark ideas?

The research complements the benchmarks because it explains how students (people) learn geometry in four stages. The initial stage, students identify shapes and figures, this is what they are doing when they are young children and in their primary schooling years. In stages two and three students are using and developing properties about the shapes to come to conclusions about the type of shape they have. This is happening through the middle grades when students learn about the properties of specific shapes, and then lastly, the fourth stage, students "produce short sequence of statements to logically justify a conclusion and can understand that deduction is the method of establishing geometric truth." This is an extensive way to say that students are able to prove theorems. This is what they work on in high school geometry through the use of two-column proofs.

IVB: *Principles and Standards for School Mathematics*

Are there questions or tasks that might be helpful to use to find out what students know about the topic?

Performing pre-assessments is always a helpful way to learn what students know about a topic. Paying close attention to the vocabulary used and the mathematical reasoning and processing that takes place is critical to understanding and prior misconceptions a student may have.

Are there suggestions for helping students avoid or overcome misconceptions?

There are great construction and interactive geometry games that can help students to better visualize and therefore overcome their misconceptions. If they can see and understand more clearly, it could help them to make sense of it the right way. Helping students to make connections between what they already know and what they are learning is imperative. If they know how to find the area of a rectangle, explain to them what surface area is and how it is found on a rectangular prism. Students should see that they are using their area formula of a plane figure and applying it to each face of their rectangular

	prism. What implications for teacher practice and learning are indicated by the research? Implications for teacher practices include providing students with opportunities to see concepts through multiple mediums. It is great to discuss the section in the book, but to also have students physically creating or manipulating attributes and manipulating parts of an image on a computer game to see the result are all essential aspects of building the conceptual understanding.
V. Examine Coherency and Articulation	**V: *Atlas of Science Literacy*** How does a map help you trace a concept or skill from its simple beginning in K through 2 to a culminating, interconnected, sophisticated idea attained by the end of Grade 12? The map helps me to see when students initially learned a topic and then where it was revisited later on in their path from K-12. I am able to see where the foundation is laid for topics that will be introduced at a later date, and I see the lateral connections from one topic to another. What connections can you identify among ideas or skills in the topic? A connection among ideas in this topic is that while in the early years students are using numbers and shapes to represent concrete things, and then in the later grades students are using abstractions to represent things. Throughout their entire schooling they are representing things, just what they're representing changes depending on where they are developmentally. What connections can you identify to different content areas within or outside of mathematics? Many of these skills and topics relate closely to algebra. We can represent using angles, but we can also represent using a coordinate grid. Looking at patterns and relationships is a cornerstone of all of mathematics, as well as the sciences. Similarly, symbolic statements in math relate to the symbolic punctuation used in grammar. We have standard conventions we follow and each variable, or punctuation has a meaning/ purpose. How does the map help you see the K-12 vertical articulation of student learning in the topic? With the map I can see that students simply build on what they already learned in the primary grades. The level of sophistication of a topic is increased as the student increases developmentally. Initially students represent using concrete items such as blocks and later they represent using abstract items such as variables. What prerequisite ideas can you identify that are necessary for learning the topic? Prerequisite ideas necessary for learning the topic include the idea and understanding of points, lines, shapes and that they differ from one another. Students need to be able to compute basic operations and understand how to plot points and read a graph. How do the storylines or conceptual strands in a map help you think about the way to coherently organize the concepts and skills in a topic? The strands in the map help me to see which ideas should be taught together

	and which ideas follow which. For example, discussing number lines, table and graphs all related to a bigger discussing of graphical displays. How do the map and its narrative section improve your overall understanding of the topic? Both the map and the narrative section prior to, help me to see the order in which ideas are taught that relate to my topic. As a high school teacher I would typically view the high school standard and not be aware of the elementary standards, but the map helps me to easily identify what the students learned and have been building upon since elementary. Or what they didn't learn but should have learned.
VI. Clarify State Standards, 21st Century Skills, and District Curriculum	Which suggestions from Sections II-V align well with your state or district standards or frameworks? Where do you see gaps that need to be addressed? The current state standard requires students to explain the derivation and apply formulas for area of polygons. This follows the ideas mentioned above about having students create meaning for themselves by exploring the concept and coming to their own conclusions. This standard asks students to derive and explain the formulas. This will help to make the formulas make more sense because the students would have developed them on their own. The standard does not tell the teacher how to go about teaching the standard and I think this is where the teacher should pull information from the above sections and teach students through electronic geometric programs, and manipulatives. Students should also be asked to check the reasonableness of their answer. How does the addition of cognitive performance verbs affect the learning of the ideas in the topic? Are the verbs in your state or district standards appropriate for the nature of the content and research-identified difficulty of the ideas in the topic? The verbs used, "derive" and "explain" are appropriate according to the research on two dimensional geometry. These verbs will help students to develop a meaningful understanding of the formulas for area. By the time students reach high school they should be at a level developmentally where they understand the idea of a proof and can construct one on their own. How do the readings improve your content understanding of the concepts and skills associated with the topic in your standards, curriculum guide, or materials? In observing high school Geometry teachers teach Geometry I have witnessed many of them treat the proofs like they are an aspect of the course too advanced for the students, but since it must be covered, according to the state and district standards, the teachers teach it. They stand at the front of the room and tell the students what to put on each side of the two column proof, instead of leaving the students to attempt this on their own before discussing findings as a class. After the readings I now understand the importance of the proofs and that literate adults should be able to prove a statement using a string of valid statements. **VIA: *State Standards:*** Link Sections II-IV to learning goals and information from your state standards or frameworks that are informed by the results of the topic study. Which learning goals in your state standards are integral to learning the ideas in the topic?

	The state standard integral to the understanding of this topic reads: "Classify and understand relationships among quadrilaterals. Relate geometry to algebra by using coordinate geometry to determine regularity, congruence, and similarity. Use properties of congruent and similar quadrilaterals to solve problems involving lengths and areas, and **prove** theorems involving quadrilaterals." Then there are four benchmarks listed underneath that standard. The first two of moderate cognitive complexity and the second two of high cognitive complexity, so the benchmarks require more of the students than identifying or classifying. Students are to be comparing, contrasting and proving. How did the reading Sections I through V help you better understand the meaning and intent of your standards or framework? The readings helped me to understand that when the benchmark uses the verb to prove, it is critical that the students, not the teacher prove the idea. Yes this will take longer than just telling and showing students the proof, but it will be much more meaningful and they will actually have learned that specific benchmark. How do the endpoints in the Grades 9-12 section of your standards related to the topic compare with the adult literacy ideas in Section I? The adult literacy ideas include having an understanding of the relationships of polygons. This is taught in the grades 9-12 section of the standards under the Geometry body of knowledge. The standards go into more depth to provide support for the relationships adults are to understand. How does a comprehensive study of Sections I through V help you consider students' "opportunity to learn and demonstrate" your state standards? Overall, the readings help me to see that it is important that the students have the ability to create meaning for themselves. There are multiple ways to understand a topic and I should allow for the students to explore their own path instead of force my path onto my 25 students. Though I may have learned a topic from reading the textbook, as the teacher of diverse learners, I should provide multiple avenues for my students whether it be through visualizations, online manipulation, or physical manipulation of figures. **VIB: *District Curriculum Guide or Instructional Materials:*** Link Sections II-IV to learning goals and information from your district curriculum guide or instructional materials that are informed by the results of the topic study. Which concepts or skills essential to developing a coherent understanding of the topic are included in your district curriculum guide or curriculum materials? The district curriculum guide requires that students be able to describe, classify, compare and prove relationships of quadrilaterals. All are essential aspect to understanding this topic and can be accomplished at varying levels of education. How do the study results help you see why certain lessons in your curriculum program need to be taught and not skipped over? The study results stated that many students graduate on level two of four. This means that they are unable to prove ideas. This section of geometry is much more impactful if students able given the chance to prove the area formulas.

	Therefore, the teacher should not simply give students the formulas, or prove the formula for them, instead the teacher should insist that students develop the proofs on their own, initially. How do the results help you identify the appropriate sequence of instructional opportunities in your curriculum? The results help me to understand the order in which students learn the concept of two dimensional geometry. With this knowledge I can assess where my students are and what lack of understanding they may have. I can then fill that void because I know what it was they should have learned at each level. How do the results help you recognize that some topics need to be revised within or at different grade levels with new contexts and increasing sophistication of concepts? It is so important that students understand that everything is building on their earlier knowledge. What they learned in K-5 is essential for what they learn in 6-8 and then later in 9-12. If students do not make connections the earlier material will need to be retaught and aligned closely with the current material. The increasing sophistication of the concepts should help to reinforce what students learned earlier in their schooling.

- How will this topic study guide the development of your PBI unit?

Throughout the process of completing the curriculum topic study of two dimensional geometry I was able to learn the big ideas of the topic. The big ideas that are relevant in the elementary ages such as identifying shapes, as well as the big ideas related to the secondary grade levels like deriving and proving concepts. I can then take the big ideas relevant to secondary grades and be sure to include them in my PBI unit. Prior to completing this curriculum topic study I would not have understood the importance of having students prove things on their own. With each experience I have had, the high school teachers have never placed much emphasis on the importance of the skill of proofs. The teachers typically seemed to stress out about the proofs and the students especially moaned and groaned when the word proof was mentioned. I believe that if teachers taught students the proofs are nothing to become scared or stressed out over and provided them with the tools and skills necessary to develop proofs that the students' attitudes would then change for the better.

As I develop my PBI unit, I will keep these things in mind. I plan to develop my PBI unit so that the students understand that the knowledge they have (or will have) is all they need to formulate and write proofs. I want students to know that all a proof is is an argument to prove something. An argument constructed by a string of valid statements. The students already know the information, now all they need to do is make connections and bring it all together in an argument. Once students understand that a proof is not a scary thing, they should have a better attitude towards proving things. I hope to show them that they do not have to memorize countless formulas if they understand where the formulas come from. If they understand the parts of the

shape and what area is they can derive the formula necessary for each problem depending on the information they have been given.

The curriculum topic study has also helped me to understand possible misconceptions and difficult areas my students may have. I will now be more prepared to work with these should they exist. I can also plan my PBI unit so that it addresses the common misconceptions and explains to students why they are misconceptions. This way I could possibly catch it before it becomes a bigger problem, before it has time to develop further.

- What new knowledge and insights have you gained by using this process?

In completing the curriculum topic study, I feel like I have placed my topic, two dimensional geometry, underneath a microscope. I have zoomed in and analyzed down to the detail of the benchmarks created by the state and district, but then I have also taken the microscope and zoomed all the way out and observed the meat of the topic, what literate adults should know. Before this process I would have taught the topic and discussed the material in the section from the textbook. Now after this process, I know better than to do that. I now know that there are both vertical and horizontal connections to be made when teaching the topic. I am aware of the timeline in which the students learn different aspect of two dimensional geometry, from kindergarten through grade 12. This process has helped me to identify the more important aspects of the topic and the less important aspects so that I can spend my time wisely when planning for and teaching this topic. I think that ideally teachers would complete, or read a curriculum topic study for each topic they teach so that they can gain a better

understanding of where the students are coming from, where they're going, where they may struggle, and what they desperately need to know.

- How have your ideas changed and what other information do you still need?

I have not had any change of ideas because I had not really developed any ideas about my PBI unit until I completed my curriculum topic study. I knew that the curriculum topic study would enlighten me with information imperative to effective teaching practices with regards to my topic. Therefore, I will now take the information from my curriculum topic study and apply it when creating my PBI unit.

I would like to administer a pre-assessment to my students on my PBI topic to see their current level of understanding. This could help me to see what information they are missing that they should have learned earlier in their schooling. It would also show me what prior misconceptions they bring to the class. I could then prepare and better address these situations at the time of teaching the PBI unit.