Title	From Here to There
Creator:	Helmstetter, Valerie vhelmste@access.k12.wv.us
Source:	2009-2010 Secondary PBL Project
Project Idea:	SHIP4SPEED Transport Company specializes in transporting customer's freight by truck, railcar and plane in the most profitable and expedient manner. The SHIP4SPEED sales team has been working overtime to bring new business to the company with great success! They were able to attract new accounts of various products for the Charleston, W.V. to Charlotte, N.C. trucking route. The CEO of the company needs to make a decision on the best allocation of company resources for future shipments. Approaching your team of corporate salespersons, who have secured 10 different customers requesting your company's services, the CEO has requested a presentation of secured accounts. It is your team's corporate sales goal to prioritize the first three for shipment in order to maximize the company's transportation sources. Included in your team's analysis must be a comparison of the actual cubic capacity of the truck volume compared to the maximum combined cubic capacity of the selected items. Your team will be responsible for designing the maximum amount of units placed for transportation efficiency and speed. A diagram of detailing unit placement onto the truck for shipment will assist truckloads. The route needs to be designed according to the product delivery including anticipated delivery dates and times.
Entry Event:	Invite a representative from the trucking/railroad/barge industry; select a logistics planner, sales representative, dispatcher or truck driver, who deals with shipping to discuss volume and payloads to stimulate interest by sharing their knowledge regarding pricing, volume and transportation routes. Arrange classroom seating in teams and post a variety of maps and world globes to highlight transportation routes, include pictures of trucks, airplanes and railcars to emphasize the movement of goods. Bring examples of an HO railcar/boxcars, barge boats, model airplanes and toy trucks to class for students to examine when introducing shipping and transportation. Inquire about what they may all have in common. Answers may include Scale factor, Transportation, Shipping, Volume, Rectangles, and Squares etc.

Content Standards & Objectives:

Objectives Directly Taught or Learned Through Discovery	Identified Learning Target	Evidence of Success in Achieving Identified Learning Target
M.O.G.3.9 identify a real life situation that involves similarity in two or three dimensions; pose a question; make a hypothesis as to the answer, develop, justify, and implement a method to collect, organize, and analyze related data; generalize related data; generalize the results to make a conclusion; compare the hypothesis and the conclusion; present the project numerically, analytically, graphically and verbally using the predictive and analytic tools of algebra and geometry (with and without technology).	Know the vocabulary of numerical, analytical, graphical and verbal as it applies to data prediction in 2D/3D similarity Identify a situation involving similarity in 2D/3D using proportions Establish a hypothesis and conclusion regarding similarity Develop a presentation of the results that compares the hypothesis and conclusion regarding similarity in 3D	Students will be able to complete 85% the **Vocabulary Similarity HO Railcar Checklist** using their own definitions/drawings by the end of the PBL. Students will compare a scale model to a real-life situation using 3D similarity and volume in the **HO Railcar Presentation** in a classroom presentation. Students will develop a presentation on the sales/logistics plan of a trucking company in **Pick Three for Profit!** incorporating the applied formulas of surface area, area, perimeter, volume, and scale factor. Students will develop responses to the activity sheet in "Why are 2D features important when studying 3D solids?" from SAS Curriculum Pathways Web Inquiry #111. Students will be able to complete 85%

			Vocabulary Formulas, Solids and Blooms Ball Checklist using their own definitions/drawings by the end of the PBL.
	M.O.G.3.16 derive and justify formulas for area, perimeter, surface area, and volume using nets and apply them to solve real world problems.	Know the dimensions used for the appropriate formula Know the formulas for area and perimeter Know the formulas for volume Know the formulas for surface area and the use of nets Be able to select the applicable formula for the given real-world problem	Students will create a **Create A Blooms Ball** to further develop the formulas for perimeter, area, volume, surface area and expand their knowledge of solids. They will also provide a writing reflection at the end of the activity. Students will design nets, compare the drawings and determine the possible variations for solid figures in "All Nets Are Not Created Equal" from SAS Curriculum Pathways Web Inquiry #1042. Students will create Excel spreadsheets and graphs to generate random values in discovering the relationships between area and perimeter in the website **http://www.techsteps.com/** and select the lesson "Perimeter vs. Area Connection". Students will investigate the use of nets by hands on exploration of physical models and team/classroom discussion of the results with the **Discovering Nets**lab. Students will build, fill two prism models and then compare two designs in a response sheet; then repeat the experiment with two cylinders, in order to investigate relationships with surface area, area and volume in the Illuminations activity. As an optional extension activity for further differentiated instruction, in **Patty's Paper**, students will design and build an open-top box for its cubic capacity to hold custom stationary. Students will develop physical models of comparison in the investigation of Euclidean and non-Euclidean geometry in **Modeling with String** and write a reflection based upon the comparison of the models.
	M.O.G.3.20 compare and contrast Euclidean geometry to other geometries (i.e. spherical, elliptic) using various forms of communication such as development of physical models,	Know that not all geometries are Euclidean Know the basic terms related to circles Know the basic terms of point, line, parallel, perpendicular and plane in	In **Drinking Water to Haiti**, students will devise a written report using spherical geometry in a real-world scenario. Students will be able to complete 85% the vocabulary **Non-Euclidean,**

	oral or written reports	Euclidean geometry Examine the differences between Euclidean and non-Euclidean geometry Investigate the role of lines in spherical geometry and develop a written report Investigate the role of perpendicular lines in spherical geometry Create a physical model of the relationships between points, lines, planes in non-Euclidean geometry	**Euclidean and Circles Vocabulary Checklist** using their own definitions/drawings by the end of the project.

21st Century Skills	Learning Skills & Technology Tools	Teaching Strategies Culminating Activity	Evidence of Success
Information and Communication Skills:	21C.O.9-12.1.LS1 - Student recognizes information needed for problem solving, can efficiently browse, search and navigate online to access relevant information, evaluates information based on credibility, social, economic, political and/or ethical issues, and presents findings clearly and persuasively using a range of technology tools and media. 21C.O.9-12.1.TT5 - Student uses advanced features of word processing software (e.g., outline, table of contents, index feature, draw tool, headers and footers, track changes, macros, hyperlinks to other file formats, etc.).	The instructor will develop student additional assistance based upon on the KWL using applets found online and Powerpoint for instruction on nets, formulas, Euclidean and non-Euclidean geometry. The instructor reviews features of the available word processing software technology as students prepare their written reports.	Students will navigate the internet for research pertaining to formulas, nets, Euclidean, non-Euclidean geometry and supplementary material related to the real-life scenarios. They will develop solutions based upon the results of their analysis and develop conclusions for presentation in the form of written reports using word processing, spreadsheets, digital media and PowerPoint presentation. Student teams work collaboratively to devise a written report in **Drinking Water to Haiti**. Students write an individual reflection based upon their investigation of creating physical models with a partner of Euclidean and non-Euclidean geometry in **Modeling with String**. Students will write a reflection at the end of the **Create A Blooms Ball** activity on the vocabulary knowledge developed.
Thinking and Reasoning Skills:	21C.O.9-12.2.LS4 - Student visualizes the connection between seemingly unrelated ideas and independently produces solutions that are fresh, unique, original and well developed. Student shows capacity for originality, concentration, commitment to completion, and persistence to develop unique and cogent products. 21C.O.9-12.2.TT2 - Student collaborates with peers, experts and others to contribute to a	The instructor provides learning opportunities for students to create independent original products using content knowledge. The instructor facilitates learning through providing collaborative student experiences on real-life applications of content knowledge.	Students will develop a group presentation on the sales/logistics plan of a trucking company in **Pick Three for Profit!** incorporating the applied formulas of surface area, area, perimeter, volume, and scale factor. In **Drinking Water to Haiti**, student teams will devise a written report using spherical geometry in a real-world scenario. Students will investigate the use of nets by hands-on exploration of physical models and participate in a team/classroom discussion of the results with the **Discovering Nets** lab.

	content-related knowledge base by using technology to compile, synthesize, produce, and disseminate information, models, and other creative works.		Students will **Create A Blooms Ball** to further develop the formulas for perimeter, area, volume, surface area and expand their knowledge of solids. They will write a reflection at the end of the activity. Students will create Excel spreadsheets and graphs to generate random values in discovering the relationships between area and perimeter in the website **http://www.techsteps.com/** and select the lesson "Perimeter vs. Area Connection". Students will develop physical models of comparison in the investigation of Euclidean and non-Euclidean geometry in **Modeling with String** and write a reflection based upon the comparison of the models. Students develop team approaches by using jigsaw methods, partners, and team role division as a means of problem solving through collaboration to improving content knowledge. Student teams will compare a scale model to a real-life situation using 3D similarity and volume in the **HO Railcar Presentation** in a classroom presentation.
Personal and Workplace Skills:	21C.O.9-12.3.LS6 - Student maintains a strong focus on the larger project goal and frames appropriate questions and planning processes around goal. Prior to beginning work, student reflects upon possible courses of action and their likely consequences; sets objectives related to the larger goal; and establishes benchmarks for monitoring progress. While working on the project, student adjusts time and resources to allow for completion of a quality product. 21C.O.9-12.3.TT8 - Student uses technology to seek strategies and information to address limits in their own knowledge.	The instructor provides resources for student(s) to manage project implementation through the designing of questions, development of goals and the process of completion in attaining their product. The instructor provides opportunities and assistance for students to develop technology use as they apply skills to project research.	Student teams utilize the **Weekly Group Learning Log** as an organizational tool for monitoring progress and adjusting goals. Student teams will develop a presentation of a scale model to a real-life situation using 3D similarity and volume in the **HO Railcar Presentation Checklist**. Students will develop a group presentation on the sales/logistics plan of a trucking company using the **Pick Three for Profit! Presentation Checklist** incorporating the applied formulas of surface area, area, perimeter, volume, and scale factor. Students will create Excel spreadsheets and graphs to generate random values in discovering the relationships between area and perimeter in the

			website **http://www.techteps.com/** and select the lesson "Perimeter vs. Area Connection". In **Drinking Water to Haiti**, student teams will devise a written report using word processing featuring spherical geometry research in a real-world scenario. Students will investigate Euclidean and non-Euclidean geometry research in **Modeling with String** and write a reflection using word processing based upon the comparison of the models.

Performance Objectives:	**Know** Know the vocabulary of numerical, analytical, graphical and verbal as it applies to data representation as it applies to data predictio in 2D/3D similarity Know the dimensions used for the appropriate formula Know the formulas for Area and Perimeter Know the formulas for Volume Know the formulas for Surface Area and the use of nets Know not all geometries are Euclidean Know the basic terms related to circles Know the basic terms of point, line, parallel, perpendicular and plane in Euclidean geometry **Do** Identify a situation involving similarity in 2D/3D using proportions Establish a hypothesis and conclusion regarding similarity Develop a presentation of the results that compares the hypothesis and conclusion Be able to select the applicable formula for the given real-world problem Examine the differences between Euclidean and non-Euclidean geometry Investigate the role of lines in spherical geometry Investigate the role of perpendicular lines in spherical geometry Create a presentation of the relationships between points, lines, and planes in non-Euclidean geometry Compare perimeter vs. area graphically Present the results by justifying your conclusions in Excel workbook Explore volume as a comparison between two figures Investigate surface area with nets Develop multiple representations for solving geometrical relationships Engage in collaborative learning relationships to achieve multiple learning strategies in problem solving Implement technology tools in the collaborative learning environment
Driving Question:	How can efficient applications of geometry affect transportation?
Assessment Plan:	**HO Railcar Presentation:** Your customer wants to see your fleet of rail cars. He is visiting you tomorrow for an inspection to insure that his product can accommodate the volume of his shipments. Currently, all of your rail cars are in use and unavailable. He has 10,000 skids of water treatment compounds manufactured in Charleston, WV. They will be packaged on individual skids measuring 48 in by 48 in by 48 in. How could you meet his wishes using an HO scale model of a corporate boxcar and develop a presentation to demonstrate the internal capacity of an actual boxcar? **Drinking Water To Haiti:** Earthquake has struck Haiti! They need drinking water desperately and there are five desalination units

that convert salt water into fresh water for drinking use. Your sales team is assigned the logistics issue of getting them to Haiti as quickly as possible. Desalination units in Tokyo, Japan; Beijing, China; Santiago, Chile; Dubai, UAE and Miami, Fl are awaiting shipment to Port-au- Prince as quickly as possible. With the globe's legend, approximate the distances for the most concise flight path using string as a manipulative tool for measurement. The team should be prepared to justify its calculations in a written flight plan from each airport destination, include a description of spherical geometry, its use of lines and how it relates to their solution.

Pick Three! Scenario Presentation:
The SHIP4SPEED sales team has been working overtime to bring new business to the company with great success! They were able to attract ten new accounts of various products for the Charleston, W.V. to Charlotte, N.C. trucking route. The CEO has requested that the team develop a presentation based on the most efficient combination of three products for transportation. Each product must be used at least twice in order to meet minimum capacity agreements with different retailers. Included in your team's analysis must be a comparison of the actual cubic capacity of the truck volume compared to the maximum combined cubic capacity of the selected items. Your team will be responsible for designing the maximum amount of units placed for transportation loading efficiency and speed. A diagram of detailing unit placement onto the truck for shipment will assist truckloads. The route needs to be designed according to the product delivery including anticipated delivery dates and times.

Modeling with String:
For this investigation, you and your partner will need a spherical object, string or yarn, buttons/or stickers, cardboard and scissors. Document your discoveries through drawings or photos and include evidence of your written results in the final analysis. With your partner, investigate Euclids postulates regarding points and lines using the resources as physical models to verify their construction. Develop a model of Euclids fifth postulate. Students should be able to relate it to the projective lines axiom. Demonstrate projective geometry through the origin using a plane, family of lines and a horizontal line for 3D imaging using the materials provided. Students should be able to recognize the shifts that can occur with their model, and if will it mimic any real world application. Compare parallel, perpendicular and intersecting lines in non-Euclidean and Euclidean geometry using the materials provided. Compare and contrast your investigations between Euclidean and non-Euclidean geometry discussing similarities and differences in your reflection.

Discovering with Nets:
Students investigate nets using real objects found at home such as empty saltine, pizza and raisin boxes, etc. in order to derive the relationship of perimeter, area and surface area in a rectangular prism. They will identify the edges, vertices, bases, and lateral faces to their selected figure. Students develop a chart of separate 2D figures and calculate their perimeter, area and surface area to derive the relationship between them. Next, they test various configurations of net arrangements on dot paper, attempt to build their net and record their results on the data sheet provided.

Create A Blooms Ball:
Building upon the **Vocabulary Formulas, Solids and Blooms Ball Checklist,** students explore the vocabulary through creating a regular dodecahedron. Each of the 12 circles drawn is related to a vocabulary term or investigation. At the end of the activity, students will explore additional polyhedron and consider its construction as well. Write a reflection on the dodecahedron that you have constructed discussing its geometric components and explain at least one other regular polyhedron and its construction. Provide a general overview of reflecting upon what you have learned during this experience.

Major Group Products	HO Railcar Presentation Drinking Water To Haiti Pick Three! Scenario Presentation
Major Individual Projects	Modeling w/ String Discovering with Nets Create A Blooms Ball

Assessment and Reflection:	**Rubric(s) I Will Use:**	Collaboration		Written Communication Model with String Rubric Blooms Ball Writing Rubric Drinking Water to Haiti Rubric	X

		Critical Thinking & Problem Solving Discovering with Nets Rubric Drinking Water to Haiti Rubric HO Railcar Rubric Model with String Rubric	X	Content Knowledge Discovering with Nets Rubric Drinking Water to Haiti Rubric HO Railcar Content Rubric Model with String Rubric Pick Three Content Rubric	X
		Oral Communication Pick Three Presentation Rubric HO Railcar Presentation Rubric	X	Other	
	Other Classroom Assessments For Learning:	Quizzes/Tests		Practice Presentations Pick Three Practice Presentation Checklist HO Railcar Practice Presentation Checklist	X
		Self-Evaluation Vocabulary Formulas, Solids and Blooms Ball Checklist Vocabulary Non-Euclidean, Euclidean and Great Circle Checklist Vocabulary Similarity and HO Railcar Checklist Final Project Self-Evaluation	X	Notes Individual student notes	X
		Peer Evaluation Peer Evaluation PowerPoint Final Project Group Evaluation	X	Checklists/Observations Vocabulary Formulas, Solids and Blooms Ball Checklist Vocabulary Non-Euclidean, Euclidean and Great Circle Checklist Vocabulary Similarity and HO Railcar Checklist Group Observation Checklist	X
		Online Tests and Exams		Concept Maps	
	Reflections:	Survey		Focus Group	
		Discussion Discovering Nets HO Railcar	X	Task Management Chart KWL Chart Weekly Group Learning Log	X
		Journal Writing/Learning Log Weekly Group Learning Log Blooms Ball Writing Rubric	X	Other	

Map The Product:

Product: HO Railcar Presentation

Knowledge and Skills Needed	Already Have Learned	Taught Before the Project	Taught During the Project
1. Ability to write and solve proportions	X		
2. Apply properties of similarity in 3D			X
3. Apply scale factors	X	X	
4. Apply formulas for perimeter, area, surface area and volume		X	X
5. Create a visual image of comparison for multiple representation by drawing or digitally			X

	6. Prepare a plan by working collaboratively prior to presentation			X
	7. Utilize research skills through technology tools			X
	8. Use technology to seek strategies and address information limits within their own knowledge			X
	9. Uses advanced features of word processing software			X
	10. Presentation skills		X	
	11. Collaborative skills in problem-solving		X	

Resources:

School-based Individuals:
Technology Integration Specialist

Technology:
Computers with Internet Access/Java Enabled
Word Processing Software
Spreadsheet Software
Powerpoint Software
Flash Drives
Printers
Graphing Calculators

Lessons & Applets:
http://illuminations.nctm.org/ActivityDetail.aspx?ID=176 applet exploring scale factor between two figures
http://illuminations.nctm.org/LessonDetail.aspx?id=L797 Lesson comparing volume of two prisms and two cylinders
http://www.sascurriculumpathways.com/ProductEntrance/Launch/launch.jsp?unit=111 Exploring why 2D features are important in 3D figures
http://www.sascurriculumpathways.com/ProductEntrance/Launch/launch.jsp?unit=1042 Exploring Nets
http://www.techsteps.com/ Perimeter vs. Area Connection
http://www.cs.dartmouth.edu/~akapadia/java/latlon/latlon.html great circle distance calculator applet
http://enlvm.usu.edu/ma/nav/activity.jsp?sid=nlvm&cid=3_4&lid=308 Globe applet
http://illuminations.nctm.org/ActivityDetail.aspx?ID=205 applet for creating nets

Other Online Resources:
http://en.wikipedia.org/wiki/Great-circle_distance comparison of non-Euclidean and Euclidean geometry
http://www.yourchildlearns.com/megamaps.htm assorted 2D maps
http://wvde.state.wv.us/strategybank/ learning styles inventory, KWL, Blooms Ball
www.bie.org/ The Buck Institute for Education

Community:
Local Transportation representative from the trucking/railroad/barge industry
Logistics planner
Sales representative
Dispatcher or truck driver of various business agencies

Materials:
Boxes (various shapes and sizes such as cereal, saltine, raisin and pizza)
String
Scissors
Poster Board/Oaktag Manila Paper/Cardstock
Spherical Object for model
Buttons/Stickers
Compass
Protractor
World Globes
Maps
Rectangular dot paper or graph paper

	Straightedge Tape Compass Colored chalk or markers
Manage the Process:	***Organization*** Prepare all student documents for task management by either creating student team portfolios, a management resource center for all documents to be placed or accessed or uploading electronic files on the school server from which copies can be accessed as needed. Items needed for task management will include student rubrics, **Final Self-Evaluation**, **Final Group Evaluation**, **KWL Chart**, **Group Observation Checklist**, **Weekly Group Learning Log** and **Peer PowerPoint Evaluation**. Instructors may find the **Pick Three!** and **HO Railcar Storyboards** useful in planning their PBL implementation. ***Getting Started*** Student teams will be needed for the PBL and these can be created in using a variety of methods depending upon your classroom setting. One method would be for students to take a learning styles inventory from the **Teach 21 Website**. Team member development can be based upon the results of compatible learning styles. Another method would be to allow students to have self-selection in the team creation process. Again, team development is critical to the collaborative nature of PBL learning so it is important to establish effective teams. This project suggest teams of four but teams can be adjusted for inclusion classes or differentiated for learning needs. The **Team Roles** can be modified accordingly by redistributing the tasks if smaller groups are needed or the addition of a marketing manager if necessary. Teams should agree to individual roles and acceptance of responsibilities in the form of a team contract. Ask the teams to design their own contracts of responsibilities for the duration of the PBL. If the class is unfamiliar with or new to this type of learning experience, the instructor should be prepared to recommend students searching the internet for examples of student contracts or provide an example from **The Buck Institute for Education**. The Teach21 Strategy Bank website provides tools such as learning styles inventories or getting to know one another icebreakers for students to use in deciding the best placement of team members in various roles. ***Entry Event*** Invite a representative from the trucking/railroad/barge industry; select a logistics planner, sales representative, dispatcher or truck driver, who deals with shipping to discuss volume and payloads to stimulate interest by sharing their knowledge regarding pricing, volume and transportation routes. Introduce the Driving Question for the PBL. Arrange classroom seating in teams and post a **variety of maps**, in addition, world globes to highlight transportation routes include pictures of trucks, airplanes and railcars to emphasize the movement of goods. Bring examples of an HO railcar/boxcars, barge boats, model airplanes and toy trucks to class for students to examine when introducing shipping and transportation. Inquire about what they may all have in common. Answers may include Scale factor, Transportation, Shipping, Volume, Rectangles, and Squares etc. ***Project Scenario*** Announce the Driving Question “How can efficient applications of geometry affect transportation?” Handout the **Memo from the CEO** requesting the following scenario: The SHIP4SPEED sales team has been working overtime to bring new business to the company with great success! They were able to attract ten new accounts of various products for the Charleston, W.V. to Charlotte, N.C. trucking route. The CEO has requested that the team develop a presentation based on the most efficient combination of three products for transportation. Included in your team’s analysis must be a comparison of the actual cubic capacity of the truck volume compared to the maximum combined cubic capacity of the selected items. Your team will be responsible for designing the maximum amount of units placed for transportation efficiency and speed. A diagram of detailing unit placement onto the truck for shipment will assist truckloads. The route needs to be designed according to the product delivery including anticipated delivery dates and times. Deadlines for scaffolded projects and the project scenario should be provided for student planning. Teams may find it helpful to enter the dates into a school planner or a blank calendar sheet for organization purposes. Discuss the **KWL Chart** - other variations for classroom modification are located at the WV **Teach21**

website. Students should be encouraged to use this instrument as a source of communication and self-assessment in managing their learning. Teachers can learn gain valuable feedback by reading these as a guided journaling tool either as individual or whole group instruction. It will assist in overall development of the PBL progression of skill comprehension and provide assistance if adjustments to learning need to occur. A large classroom chart placed on the wall or in a prominent position used with students adding to it throughout the course of the PBL. The teacher can address topics as needed or at the beginning/end of class.

Non-Euclidean, Euclidean and Circles Vocabulary Checklist

The **Individual Student Vocabulary Checklist** provides a tool to review and assess student vocabulary knowledge necessary for the scaffolding activities on Euclidean and non-Euclidean geometry. Student instruction can be modified and adjusted according to the responses provided on the checklist prior to beginning the **Model with String Lab** and **Drinking Water To Haiti**.

Model with String Lab

Students are investigating the differences between Euclidean and non-Euclidean geometry. With one of the spherical objects in the classroom, inquire about "How should the distance between two points be measured on the object?" "What would provide the shortest distance?" Using a lab handout, students must first determine exactly what are Euclid Postulates, Euclidean Plane geometry and non-Euclidean geometry. It is important to have plenty of resources for students to manipulate such as spherical objects, string or yarn, buttons/or stickers, cardboard and scissors. They will also need to have access to text, internet, word processing, digital cameras or other media if they decide to extend their investigative reporting. In designing their physical models, the classroom instructor will need to listen and watch carefully for student errors. The classroom **KWL Chart** can be used to assist the investigation and correct student misconceptions.

Drinking Water To Haiti

Instructors will need enough world globes for each student team to use in their investigation. Please read the globes before using to make sure that the legends are clearly visible and all cities can be located on the globes. If the selected cities in the Academic Prompt question are not identifiable on the globe, you may need to adapt the cities according to those available. It will be important to encourage all team members to participate in the measurement process. Students may need a short sample lesson on reading a globe's legend if they have not had geography or unit conversion depending on instructional need. It would also be a good time to review the student vocabulary checklist for related terms and the **KWL Chart**. Remind student of the differences between a non-Euclidean and Euclidean definition of distance with a **simple explanation**. Possible applets to be used for distances can be easily found using the internet; some suggested sites **http://www.cs.dartmouth.edu/~akapadia/java/latlon/latlon.html** and a globe applet to demonstrate great circle paths **http://enlvm.usu.edu/ma/nav/activity.jsp?sid=nlvm&cid=3_4&lid=308**

Vocabulary Formulas, Solids and Blooms Ball Checklist

The **Individual Student Vocabulary Checklist** provides a tool to review and assess student vocabulary knowledge necessary for the scaffolding activities on perimeter, area, surface area, volume and nets. Student instruction can be modified and adjusted according to the responses provided on the checklist prior to beginning the **Discovering Nets** and **Create a Blooms Ball**.

Create a Blooms Ball

As students work together in their groups to investigate the various meanings of the vocabulary, consider the method of jigsaw instruction where the original team is numbered one through four, assigned three sections of the topic to become expert on – new groups are then recreated within the classroom to learn the assigned knowledge at an expert level- they return to their original team to "teach and share" what they have learned. Student access to the internet is very helpful for research and word processing. Students write an individual reflection at the end of the activity describing their experience and what they have learned in the jigsaw learning and construction of their Blooms Ball.

Techsteps

This is a subscription service available to all West Virginia teachers. It requires a login and password to gain access.
Perimeter vs. Area Connection is a mathematics selection, found under the Enrichments tab, where students are given the challenge to find the relationship between the perimeter and area of a rectangle.

Using several different randomly generated rectangle dimensions, students will calculate the perimeter and area for each rectangle in an excel spreadsheet, graph perimeter vs. area and investigate the graphical relationship including viewing the curved boundary. Differentiation: Students will compare circles in order to examine the relationship between circumference and area to extend the application of the learning knowledge. In addition, it may be necessary to create student partners during the entire lesson by questioning students to find out who has not had experience with Excel spreadsheet with those who have experience.

Discovering Nets

This is designed to be a hands-on student investigation to introduce nets, 2D and 3D geometry. Students can be asked to bring in a paper example of a rectangular prism such as a pizza, raisin or cereal box to use in the exploration. The goal is to create classroom discussion while students explore features of 2D/3D geometry. In "All Nets Are Not Created Equal", student teams will be asked to draw nets of four given solid figures, keeping all attempts for later evaluation; test the drawings to see if they can be folded into the desired solids; and determine the number of ways a net can be drawn for each given figure. Students can access this activity at http://www.sascurriculumpathways.com/ProductEntrance/Launch/launch.jsp?unit=1042. (Mathematics-Geometry-3D Figures-Classroom Activity 1042) Upon completing the activity, students respond and reflect to a series of questions regarding their learning. The response activity can be used as a formative assessment.
Differentiated Assignment: It can be adapted as an expanded written reflection in a word document or in an informal classroom discussion depending upon student needs. Further investigations for students who are having trouble visualizing nets can be developed with Teacher Tool: Illuminations Java Applet for Nets http://illuminations.nctm.org/ActivityDetail.aspx?ID=205 . This is a teacher tool to create nets for paper use or generate as a technology tool for demonstration and discussion.
SAS Activity "Why are 2D are features important when studying 3D solids?" http://www.sascurriculumpathways.com/ProductEntrance/Launch/launch.jsp?unit=111 (Mathematics-Geometry-3D Figures-Web Inquiry 111) Students explore the characteristics of 2D and 3D figures in a web inquiry on surface area and volume to determine their relationship. Differentiation: The research/response sheet can be adjusted for use as an individual, partner or team activity depending upon instructional need. The response activity can be used as a formative assessment.

Vocabulary Development Checklist Similarity

The **Individual Student Vocabulary Checklist** provides a tool to review and assess student vocabulary knowledge necessary for the scaffolding activities on scale, similarity, proportion, and volume. Student instruction can be modified and adjusted according to the responses provided on the checklists prior to beginning the activities of **HO Railcar**, and **Pick Three!**

Explore Popcorn

In their teams, students can work as pairs or teams to investigate the relationship between dimension and volume in prisms and cylinders. They will design and fill their containers with popcorn to determine the resulting volume. The concepts of student created conjectures developed throughout the lesson result in a comparison of square vs. rectangular prism volumes. Students develop conjectures regarding the radius and circumference to the base of a cylinder in terms of its dimensions when determining volume. The response activity sheet and models created are handed in for evaluation. Alternative options for assessment and extensions for the lesson are included in the Instructional Plan.

HO Railcar

Student teams prepare a presentation on the cubic capacity of a boxcar using similarity between two figures (a boxcar and HO boxcar). They can research the information readily on the internet for dimensions in order to devise a solution. In planning their presentation, student teams should be encouraged to utilize a planning guide such as the **HO Railcar Storyboard** in the preparation of a presentation. Student
teams can use the **HO Railcar Presentation Checklist** as a template for designing the necessary mathematics in preparation for their presentations. Instructors should use the Content Presentation Rubric to assist students in their development. The teams may want to use the following applet for their investigation or instructors may need to demonstrate it in the classroom depending on the **KWL Chart** regarding scale factor . For the instructor's convenience, a **Sample Solution** is provided along with a **Cube Calculator** for generating cubic capacity. The instructor may choose to use the provided **Oral and Content Presentation** rubrics for assessment.

	Pattys Paper Differentiation: Instructors may decide to use this additional academic prompt for the teams or individuals who need to extend the learning or provide additional instruction if necessary. Students will create a shrink-wrapped box for **Pattys Paper** to pack its customized stationary by designing the net and providing its volume calculations. **Pick Three!** Students explore the combination of **Three Products** using volume and surface area to derive a solution. In planning their presentation, student teams should be encouraged to utilize a planning guide such as **Pick Three Storyboard** in the preparation of a presentation. Working in collaborative teams, they will develop a presentation of the **Project Scenario**. Student teams can use the **Pick Three! Presentation Checklist** as a template for designing their mathematical solutions. This is a wonderful opportunity to share the classroom experiences by inviting parents, other teachers and members of the community to watch the presentations. Instructors may want to consider inviting a panel of judges to assist in grading the presentation. Instructors my also choose to use the provided **Pick Three! Oral** and **Content Presentation** rubrics for assessment.
Project Evaluation:	Students will complete a final self-assessment/reflection on the end of the project upon its completion. They will also meet in their student teams to discuss and develop **Group Final Evaluation/Reflections**. The information gathered will assist the instructor to improve the learning experience and adjust future PBL implementation.
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