Assignment 1

# Final Project Outline

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EDCP 553

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February 9th, 2026

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**Name of the math project:** 3D Paper Model: From Nets to Spatial Structures

**Grade level**: 8 – 10 mathematics, Richmond School District

**Project Idea:**

In this project, students will design and draw a 2D template composed of multiple geometric shapes that can be assembled into a 3D paper model of their choice, such as an animal, fruit, or vehicle. Through the process of planning, measuring, and constructing their designs, students will apply their understanding of nets of prisms, surface area, and volume to combine different geometric forms into a coherent structure. The transformation from a flat template to a completed 3D model emphasizes spatial reasoning and embodied learning, as students physically fold, assemble, and refine their designs. By integrating mathematical accuracy with creative choice, this activity positions mathematics as both a problem-solving tool and a medium for artistic expression.


Examples of final product

(source: https://www.polypapercraft.com/products/fox-low-poly-papercraft-kit)

**Mathematical topics:**

- Nets of 3D shapes and transformations from 2D to 3D
- Surface area and volume
- Geometric solids (prisms and related polyhedral)
- Spatial reasoning and visualization
- Mathematical communication through design and construction

**Embodied and arts-based pedagogical approaches:**

- Students design, cut, fold, and assemble 3D paper models to physically experience mathematical structures
- Using origami-inspired techniques, students fold and form-making to emphasize precision, symmetry, and geometric relationships
- Learning through touch and manipulation of materials support conceptual understanding
- Combining mathematics, visual design, and craftsmanship encourage creativity

**Annotated Bibliography**

Chen, K. (2006). Math in motion: Origami math for students who are deaf and hard of hearing. *Journal of Deaf Studies and Deaf Education, 11*(2), 262–266. http://www.jstor.org/stable/42658815

*Chen highlights origami as an embodied and visually rich approach to mathematics instruction that supports accessibility and engagement, especially for students who benefit from non-verbal learning modes. This article was intriguing because it reinforces the value of hands-on, movement-based learning, aligning with our project's emphasis on embodied geometry and inclusive pedagogy.*

Chiphambo, S. M., & Mtsi, N. (2021). Exploring grade 8 students' errors when learning about the surface area of prisms. *Eurasia Journal of Mathematics, Science and Technology Education, 17*(8), em1985. https://doi.org/10.29333/ejmste/10994

*This article discusses the challenge students have to use the volume of prisms formula to calculate the total surface area of a 3D image. It concluded that many students cannot differentiate a 2-D shape from a 3-D object when both of them are drawn on the paper. This is an important insight that makes us think about how we can design the project to let students understand better on how 2D shapes are transferred into 3D. Getting a 3D paper model will likely benefit students in viewing and imagining the object in real life rather than on a piece of paper.*

Downton, A., & Livy, S. (2022). Insights into students' geometric reasoning relating to prisms. *International Journal of Science and Mathematics Education, 20*(7), 1543-1571. https://doi.org/10.1007/s10763-021-10219-5

*Students can develop visualisation skills and spatial structuring reasons from hand on building materials by constructing cube models with justifications. The ability to compare 3D objects to 2D pictures through physical and mental transformations improve student's knowledge and reasoning. Thus, our project will focus on designing 2D templates to make 3D models. In this process, students have to predict, think and reflect on what kind of model they want to get during the design, which can engage students' learning and improve their reasoning skills.*

Edutopia. (2023, June 1). *Making a Math Lesson More Hands-On* [Video]. YouTube. https://www.youtube.com/watch?v=eRytt_ddTvI

*This video highlights how geometry lessons become more accessible and engaging when students build and manipulate physical models, such as constructing shapes and exploring dimensions with their hands. I found this resource especially useful because it models playful, embodied learning that mirrors our 3D paper model project and reinforces the value of hands-on experiences in supporting spatial reasoning and student engagement in math classrooms.*

Georgeson, J. (2011). Fold in origami and unfold math. *Mathematics Teaching in the Middle School, 16*(6), 354–361. http://www.jstor.org/stable/41183615

*This article explores how origami can be used to deepen students' understanding of geometric concepts such as symmetry, angles, and spatial relationships through folding. I found this source particularly helpful because it demonstrates how physical manipulation of paper supports mathematical meaning-making, directly informing our use of 3D paper models to connect nets, surface area, and volume.*

Hendroanto, A., & Fitriyani, H. (2019). Analyzing the need of math geometry drawing tools in mathematics classroom. *Journal of Physics. Conference Series, 1188*(1), 12051. https://doi.org/10.1088/1742-6596/1188/1/012051

*In most classrooms, geometry drawing tools are limited to rulers, compasses, or protractors. From the survey, many teachers and students indicate the potential limitations and ineffectiveness of certain tools in drawing geometric shapes or angles. It may be a better idea to explore more alternative drawing opinions that teachers and students can use. These can be resources and materials inspiration that teachers can encourage students to use in their projects. We can let students reflect on the limitations of their measurement in using tools and if there are any other methods they can use to get the shape they want.*

Husniati, A., Budayasa, İ. K., Juniati, D., & Lant, C. L. (2020). Analysis of deaf students understanding math concepts in the topic of geometry (rectangle shape): A case study. *Journal for the Education of Gifted Young Scientists, 8*(3), 1213-1229. https://doi.org/10.17478/jegys.780213

*This article discusses how the use of visual and tactile cues can help deaf students understand the geometric shapes. Connecting to the other annotated articles talks about the significant number of students in grade 8 who have a hard time understanding and*

*describing the definition of surface area and volume. We can take the strategy from this article to engage more lessons in hands-on making rather than abstract concepts.*

Lancaster, R. (2025). The math teacher's home base: Origami in the classroom. *Ontario Mathematics Gazette, 63*(4), 33-36.

*By folding the paper, students can get the symmetric shape and angles they need without measuring tools. We use this idea as the extension of the question raised from another annotation that talks about the alternative way to draw the geometric shape without tools. There are certain angles hard to measure (i.e 30 degrees, 60 degrees) but we can encourage students to get them from paper folding. We believe students can take ideas from Origami when they design their template (i.e. they can fold the paper to make sure two shapes are identical).*

Machaba, M. F., Sibanda, A., & Fasinu, V. (2024). Grade 8 learners' perceptions and misconceptions on their learning of surface area and volume in mathematics.*International Journal of Management, Knowledge and Learning (Spletna Izd.), 13* https://doi.org/10.53615/2232-5697.13.377-400

*This article discusses misconceptions on surface area and volume from grade 8 students. We learned about how students define those concepts and their thinking process in solving the problem in this paper. In our project, we can develop from students' knowledge and offer them a better understanding of the surface area and volume from concrete examples.*

McLeod, J. C., Wilson, P. L., Pomeroy, D., & Alderton, J. (2022). Crafting connections in post-COVID classrooms: Learning university mathematics through craft. *International Journal of Mathematical Education in Science and Technology, 53*(3), 728–737. https://doi.org/10.1080/0020739X.2021.1984597

*This study examines how craft-based activities foster connection, engagement, and deeper mathematical understanding in post-pandemic learning environments. I found this source particularly relevant because it positions craft as a legitimate mathematical practice, supporting our belief that creative, tactile work like 3D paper modeling can strengthen students' conceptual understanding and emotional connection to mathematics.*

TEDx Talks. (2015, April 7). *Hands-on learning | Sean Rice | TEDxPascoCountySchoolsED* [Video]. YouTube. https://www.youtube.com/watch?v=blZG-RSmMWk

*In this TEDx talk, a middle school student reflects on how hands-on learning experiences make education more engaging, meaningful, and connected to real understanding for learners. I found this video helpful because it underscores the value of tactile, embodied activities in classrooms — aligning with our project's focus on creating 3D paper models to deepen spatial reasoning and make abstract geometry feel more concrete and student-centered.*

Poole, C. (2011). *Welcome to Math Craft World! (Bonus: How to Make Your Own Paper Polyhedra)*. WonderHowTo. https://mathcraft.wonderhowto.com/how-to/welcome-math-craft-world-bonus-make-your-own-paper-polyhedra-0130467/

*This website introduces a community space dedicated to mathematically inspired art and provides step-by-step guidance on creating paper polyhedra from nets and connecting flat templates to 3D shapes. I found this source useful because it models the kind of hands-on paper folding and net construction that underpins our project's focus on surface area, volume, and embodied exploration of geometry, while also offering accessible, practical instructions for classroom implementation.*

**References**


Chen, K. (2006). Math in motion: Origami math for students who are deaf and hard of hearing. *Journal of Deaf Studies and Deaf Education, 11*(2), 262–266. http://www.jstor.org/stable/42658815

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