

## SYMMETRY, CHIRALITY, AND PRACTICAL ORIGAMI NANOTUBE CONSTRUCTION TECHNIQUES

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### Short description of the workshop: aims and underlying ideas

*The workshop will illustrate several educational and entertaining applications of origami in the classroom. The activities illustrate symmetry, chirality, and duality in simple modular origami as well as the flexibility of Pentagon-Hexagon Zig-Zag (PHiZZ) units in constructing more sophisticated models. Additional illustrations of counting and graph coloring will be provided.*

*The workshop will highlight a variety of materials, including recycled papers and packaging material and their preparation, ordinary office sticky notes, and traditional origami paper. We will consider how to illustrate interesting mathematical concepts with simple models, demonstrating several concepts and encouraging participants to develop further illustrations. We will make a more detailed study of using PHiZZ units to construct models such as Buckyball, tori, and carbon nanotubes.*

*Participants will construct a variety of units used in modular origami models, study previously assembled models, and learn how to construct models themselves.*

### Planned structure:

Planned timeline	Topic	Material / Working format / presenter
<b>(30 minutes total)</b>	<b>Duality, Symmetry, and Chirality</b>	Paper-folding, small group construction and discussion.
(5 minutes)	Waterbomb base, Preliminary base, and Card Unit (illustrations of duality)	
(10 minutes)	Cube and Octahedron (illustrations of duality and counting)	
(5 minutes)	Cuboctahedron and Capped Octahedron (illustrations of duality and tiling space)	
(10 minutes)	(discussion)	

<b>(60 minutes total)</b>	<b>PHiZZ Unit Constructions</b>	Paper-folding, small group construction and discussion.
(5 minutes)	PHiZZ unit rings and induced curvature	
(20 minutes)	Construction of models (Graphene sheets, Buckyballs, tori, nanotubes, Klein bottles)	
(25 minutes)	Nanotube varieties (armchair, zig-zag, chiral)	
(10 minutes)	Discussion	

### References

Hull, T., *Project Origami: Activities for Exploring Mathematics*, 2 ed., CRC Press, Boca Raton, FL (USA), 2013.