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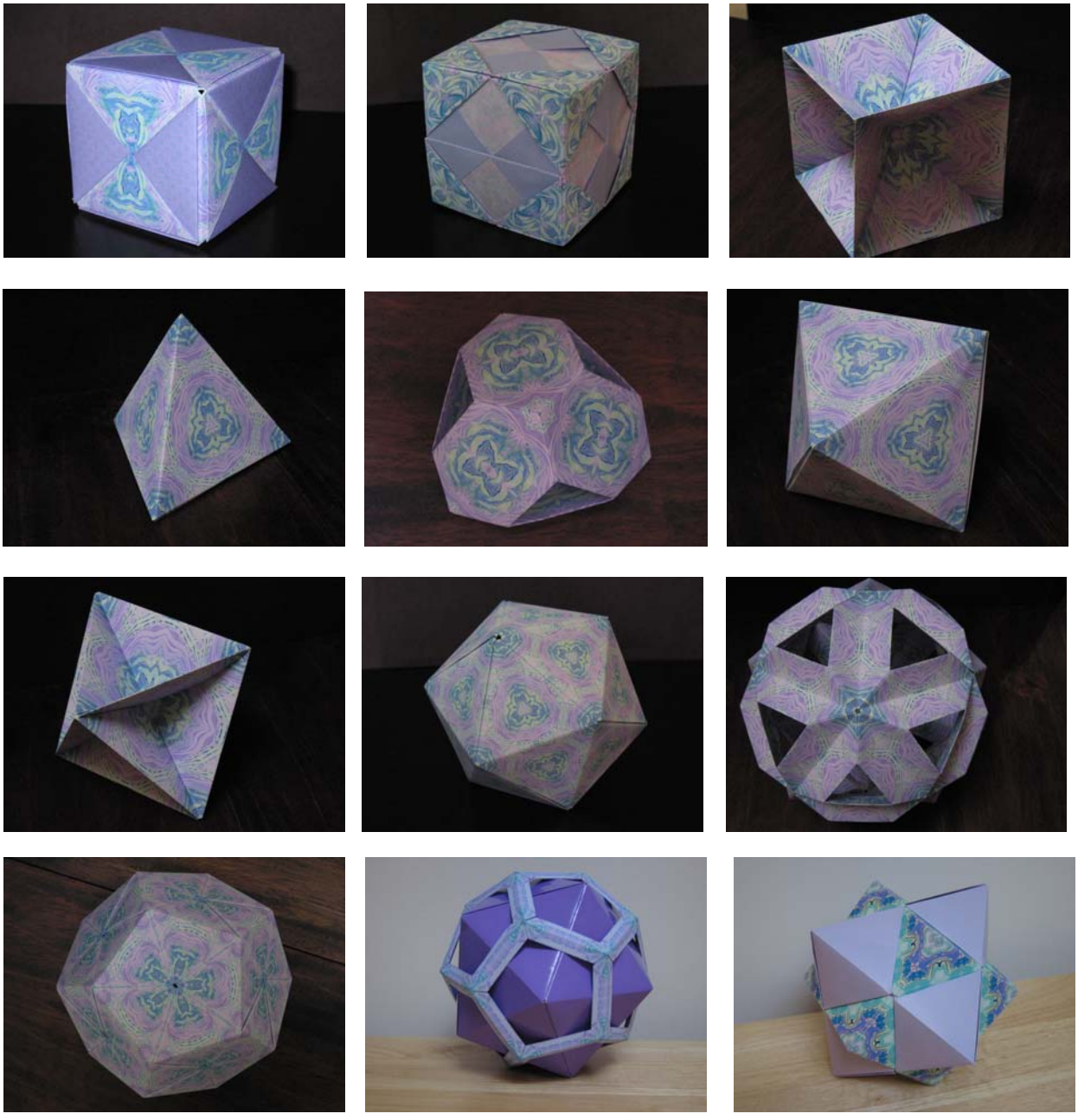
Shapes, Space, and Symmetry – The Archetypes of Nature



Summary Description:

Since the ancient Greeks first began measuring the Earth ("Geo" – "metric" = measure of the Earth), the three-dimensional figures known as geometric solids have provided archetypes of the natural world. Today, study of these basic geometric forms has applications in such diverse fields as geology, crystallography, mineralogy, organic chemistry, solid state physics, metallurgy, botany, anatomy, architecture and art.

The proposed project is to introduce a new course, in which students would explore geometric solids through a creative, hands-on approach involving aspects of mathematics (geometry), crystallography (point group symmetry), computer graphics, and traditional Japanese techniques of paper folding (origami). Specifically, students would learn the geometric and crystallographic (symmetry) properties of the 5 Platonic Solids (and some of their variants) by constructing models (similar to those on the cover page) from self-designed and printed geometric papers, and would then conduct research into real-world (natural or man-made) examples/applications of these forms.

The broad goals of the course would be: 1) to introduce students to the idea that mathematics is inherent in the natural world and thus an essential part of science; 2) to help students to improve their skills and gain confidence in their abilities in math; 2) to introduce students to the subject matter of diverse fields of science (e.g. geology, mineralogy, chemistry, physics, anatomy); 3) to increase computer literacy and skills; and 4) to inspire creativity and thus emphasize the essential interaction between the analytical and the creative in science. It is hoped that this course would strongly engage student interest because of its focus on individual creative activity, and for this reason would help to counteract some of the fear and aversion to science and math that is regrettably common in non-science majors. The proposed project is thus highly innovative in its approach to teaching science, and relevant to the needs of KCC students. Furthermore, it is clearly interdisciplinary, in that it recalls the world view of the earliest natural philosophers and thus reunites science, mathematics and art.

Expected Outcomes of Course:

- Student will learn geometric properties of and relationships between the regular polygons and polyhedra.
- Student will learn the meaning and use of basic trigonometric functions (sine and cosine).
- Student will become adept at geometric derivations.
- Student will learn the basic elements of point-group symmetry (rotation axes, mirror planes, inversion centers) and learn to identify such symmetries in both geometric and real-world objects.
- Student will learn the basic techniques of Japanese paper folding (origami).
- Students will learn to use Adobe Photoshop and Microsoft Powerpoint to create geometric designs.
- Student will learn to recognize basic geometric forms in the natural and man-made world.
- Student will become familiar with diverse areas of science.
- Student will construct a set of geometric models (see cover page) from self-designed and printed paper.