

A Six-week *Origami* Physics Course

**Galen T. Pickett
Physics and Astronomy
CSU Long Beach**

● **My Students**

- **4-6th grades at A.E. Arnold Elementary, Cypress CA**
- **2004-5, 3-30 students --- HARD.**
- **2005-6, 9 GATE students, 2 adults, +2 experts --- GOOD.**
- **2006 Summer, Unitarian Universalist Church of Long Beach, 6 students --- HARD.**

● **My Course**

- ❑ **50 minutes in an after-school program**
- ❑ **Each week, one model.**
- ❑ **30 minutes to run through model once**
- ❑ **Remaining time, students work together, with diagrams.**
- ❑ **Leave with a measurement.**
- ❑ **End-of-course ... bound diagrams into a booklet.**

- **Week 1: Masu**

- **Traditional Masu**



- **Variations, height /width**



● Masu Physics

- **4-6th grade California Science Standards emphasize MEASUREMENT: Which box holds the most?**
- **4-6 th Grade: Trial and Error**
- **7th-12th Grade: Geometry of crease pattern, volume of box**
- **University: Minimize with calculus**
- **Graduate: What is the maximum volume that can be contained by a self-locking box, 1 sheet?**

- **Week 2: Tessellations**

- **Zig-Zag Tessellation.**



- **Variations ... Zig-Zig-Zag-Zag.**



● **Tessellation Physics**

- ❑ **Strong in compression ... HOW STRONG?**
- ❑ **4-6 grades ... keep stacking until you crush it.**
- ❑ **7-12th Grade ... how is strength related to scale of pattern?**
- ❑ **University ... scale of pattern, thickness of paper, dynamic thickness of paper.**
- ❑ **Graduate ... sharp creases?**
- ❑ **Research ... disordered folds, crumpling?**

- **Week 3; Rings**

- **Paper rings and chains ... polymer, membranes.**



- **Geometry.**

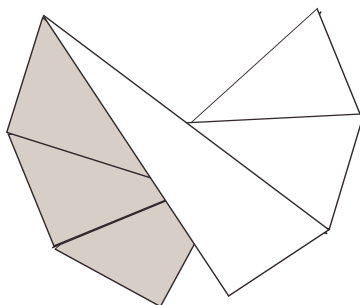
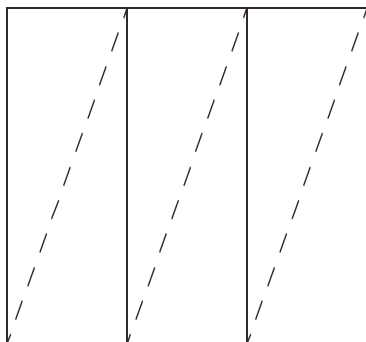


● **Ring Physics**

- **4-6 grade, how strong is a link? Chain? Parallel chains?**
- **7-12th grade, Tessellation pattern for mats, polyhedra**
- **University, mechanical properties of topological membrane.**
- **Graduate, microscopic models**
- **Research: make them.**

● Week 4: Curling Wave

□ Boaz Shuval butterfly



□ Crashing wave

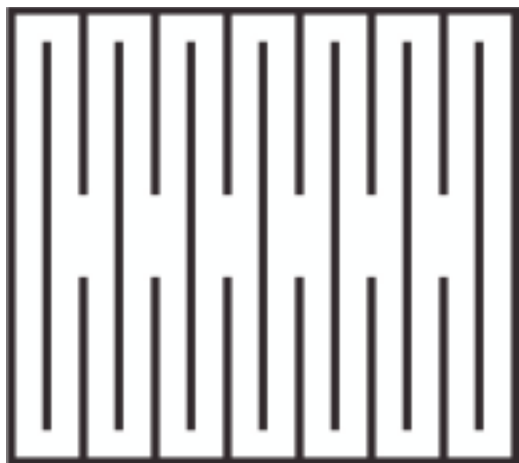


● **Wave Physics**

- ❑ **4-6 grade, what controls spiral?**
- ❑ **7-12th grade, Logarithmic spirals, self-similar growth.**
- ❑ **University, differential equation.**
- ❑ **Graduate, paper model as an analog computer.**
- ❑ **Research, what PDE's can be solved with origami?**

- **Week 5: Cut-Kites**

- **Cutting, sure, but fun:**



- **Variations:**

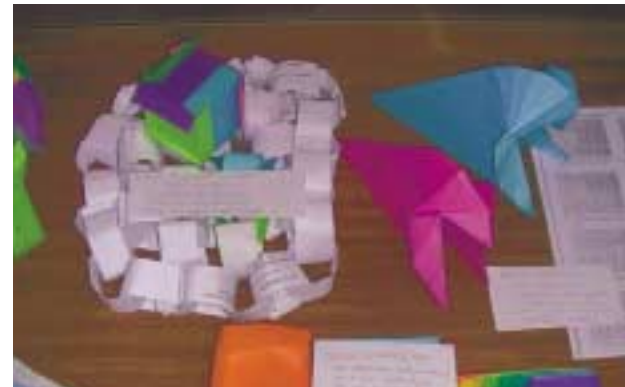


● **Cut-Kite Physics**

- **4-6th grade ... mostly just fun. But Aerodynamic ... make an airplane?**
- **7-12th grade, damped spring.**
- **University, spring constant, hanging, massive spring, motion capture.**
- **Graduate: make one on the micron scale.**
- **Research: application? propulsion?**

- **Week 6: Wrap-up and fun**

- ❑ **Booklets ... next time with experiments, datasheets, procedures, real science-fair fare.**
- ❑ **Revisit models.**
- ❑ **“Um, can’t you make an *animal* or a *flower*?”**
- ❑ **Collect samples for display.**



- **If its not fun, its not *Origami*.**

- ❑ **Small groups, maybe lots of small groups.**
- ❑ **Children can control the classroom.**
- ❑ **Open-ended questions, closed-ended questions.**
- ❑ **Art and mathematics.**
- ❑ **Fun to teach and to learn.**