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2 Building a Classroom Planetarium

- Jeff Adkins
- Deer Valley High School ESPACE Academy

3 The Plan

- Build an enclosed dome large enough to hold a normal sized class
- Project the stars on the interior of the dome
- Keep expenses low
- Create a web site to share the instructions

4 Phases of Project

- Design and build the dome
- Design and test star projector
- Write instructions for web site
- Integrate into standards, curriculum

5 Dome Design

- www.desertdomes.com
- Provides formulas and interactive calculator for geodesic domes
- Our instructions are based on these formulas

6 Dome Template

- Create two master triangles shaped like these.
- Leave a “flap” along each edge about 2 inches wide for connecting triangles
- Make 10 A-type, 30 B-type

7 How big will it be?

- Design will eventually use 10 triangle bases in a circle.
- $1.545 \text{ m} \times 10 = 15.45 \text{ m}$

- Circumference = π diameter
- diameter = $15.45/\pi$
 - = 4.92 meters
- Driven by size of cardboard
 - 4' x 8' sheets donated

8 Painting

- Paint prior to assembly
- Interior should be painted white or off-white for projection dome
- Interior should be painted black if you intend to paint the stars into place

9 Assembly

- Begin by assembling six "caps" of 5 type B triangles each
- Close the "gap"
- Binder Clips for temporary structure
- Glue/reinforcing for permanent structure

10 Arrange "caps"

- Arrange five of the "caps" in a flower arrangement (grey pentagons)
- Place A-type triangles on the floor between the pentagons (black triangles)
- Top view, not to scale

11 Connect "caps"

- Hold "caps" vertically and attach with clips
- Takes 3+ people
 - ...or lots of chairs
- Rule: You can't have too many clips

12 Make the lid

- Arrange the final "cap" with 5 B-type triangles in a starfish layout
- This becomes the "lid" which requires several people on the inside and outside to attach...

13 Base Wall

- 10 rectangular segments
- Each as wide as a triangle
- Assemble into a ring

14 It's Done!

- EXCEPT FOR
 - ...how do you get in?
 - ...what about light leaks?
 - ...how do you breathe?

15 Except for...

- ...things we figured out later
 - ...how do you get in?
 - ...what about light leaks?
 - ...how do you breathe?
 - ...safety?

16 The Projector

- Add in later when guys finish their project

17 Activity: 1-f dome

- Start with 15 circles
- Fold into equilateral triangles
- Make ONE 5-cap
- Arrange the others into an alternating row
- Connect ends of row to make a hoop
 - Decide: flaps in or out
- Attach the cap

18 Overview of site

- <http://www.cccoe.net/stars>
- This site was funded by a grant from the Dean and Margaret Lesher foundation and the Contra Costa County (CA) Office of Education
- Funds provided to develop site and disseminate information

19 Curriculum

- Teach basic astronomy concepts
- National Standards
 - Science
 - Math
- Service and Outreach

20 Basic Astronomy

- Basic astronomy lessons for a classroom planetarium
 - Stars rise in the east and set in the west.
 - Circumpolar constellations never set.
 - The position of sunrise changes throughout the year.
 - Altitude and Azimuthal coordinates.
 - Moon phases and planetary retrograde loops.
 - The ecliptic and the zodiac.
 - Effect of changing latitude.
 - The seasons are caused by the earth's tilt.

21 More Astronomy

- Scale of the Solar System
- Constellation names, legends
- The analemma and the design of sundials
- Eclipses of the sun and moon

- Astronomy from another planet (such as Mars)
- Star magnitudes (apparent and absolute)
- Star colors -- Star temperatures -- Stellar Evolution
- ...the possibilities are endless!

22 National Standards

- Science
 - Origin and Evolution of the earth system
 - Origin and evolution of the universe
 - Nature of Science
- Math
 - Properties of three dimensional shapes
 - Apply transformations and use symmetry
 - Measurement and scaling

23 Outreach

- Students produce and conduct planetarium shows at elementary schools
 - Manage a schedule and “business”
 - Organize transportation and timing
 - Represent school and program
- Public shows at open house and special events
- Provide role models for younger students
- Generate future excitement for the program
- Recruit students for the ESPACE Academy

24 Next steps for us

- Permanent 15-foot fiberglass dome with digital projector
- Funded by Specialized Secondary Program Grant
- See my next session for details

25 Resources/Links

- AstronomyTeacher.com
<http://www.AstronomyTeacher./com>
- Desert Domes–provided original plans this site's design for a planetarium is based on.
<http://www.desertdomes.com>
- Deer Valley High School's Planetarium Production Class
<http://homepage.mac.com/astronomyteacher/dvhs/planetarium.html>
- Planetarium Activities for Student Success
This is the basis for the curriculum used at Deer Valley High School's Planetarium Production class.
<http://www.lhs.berkeley.edu/pass>
- Planetarium.net hosts the Dome–L mailing list for planetarium workers, and maintains this site as a resource for planetariums of all sizes.
<http://www.planetarium.net/>
- Astro–Tec manufactures small domes for school planetariums
<http://www.astro-tec.com>
- Elumenati corporation sells the most inexpensive spherical digital projector on the market.
<http://www.elumenati.com/main.htm>
- MMI Corporation sells planetarium projectors and domes, observatories, and much more. Also has a link list and free image downloads.
<http://www.mmicorporation.com/>
- So you Want to Build a Planetarium?
<http://www.ibiblio.org/ips/sywtbap3.html>
- Planetarium suppliers from projectors to domes to shows.
<http://www.lochness.com/pltref/pltre.html>

26 Credits

- Dome design – Jeff Adkins (based on a design from www.desertdomes.com, adapted from a similar project by Dr. Louis Finsand)
 - Scale model of 5 m dome – Matt Epperson and Michelle Medina
 - Web page construction – Jeff Adkins and Cheryl Domenichelli
 - Dome measurement and construction – James McDougall, Jovina Chagas, Daniel Wasson, John Busutil, Ramon Hannon--also the first team to do a planetarium show in a cardboard dome...
 - Dome Assembly Team – Angelica Domenichelli, Melanie Maher, Alisha Dawson, Vanessa Domenichelli, Carrie Hurtado
- ...and many thanks to Kirsten DeNoyelles and the original crew that built the first prototype of this project around 1990 in Lexington, Kentucky when attending Henry Clay High School.

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- The Contra Costa County Office of Education (CA)
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- Gaylord Manufacturing (provided cardboard--plant has since closed)

28 Want more?

- Next session
- "A Project-oriented Space Academy at Deer Valley High School"
- Explains academy structure, many references for projects