WHEN BARBIE GOES TO A MATH CLASS

Oregon Standards recommendation:

- Numbers: Apply proportions to solve problems (Grade 8)
- Geometry: Use proportional reasoning, drawings, models or technology to demonstrate similarity and congruence of polygons with an emphasis on triangles. (Grade 8)
- Geometry: Use proportional reasoning, drawings, models, or technology to demonstrate congruence and similarity of polygons with an emphasis on quadrilaterals. (Grade 7)

Curriculum Focal Points (NCTM, 2006)

Number and Operations and *Algebra* and *Geometry:*

- Develop an understanding of and applying proportionality, including similarity (Grade 7)
- Understand and use ratios and proportions to represent quantitative relationships. (Grades 6 and 7)
- Develop, analyze, and explain methods for solving problems involving proportions, such as scaling and finding equivalent ratios. (Grades 6, 7 and 8)

The following section is written as a middle school lesson plan.
Goal: The purpose of these lessons is to develop, analyze, explain, and use methods for solving proportions while solving relevant problems.

Objectives:
(1) The students will measure dimensions of a common object (Barbie dolls) to create a scaled up version of it.
(2) The students will use the relationship for scaling factor f = b/a, where a is the actual measure of the object (doll), b is the same measure for the target (actual person).
(3) The students will draw the scaled up version of the object (Barbie and/or action figure). The students will superpose the drawings of the scaled-up dolls on the drawings of contour of the actual person.
(4) The students in small groups will conduct research and present their findings on topics such as (i) self worth and body image, (ii) eating disorder, (iii) consumerism.

Pre-requisite knowledge and skills:
(1) Ability to measure using a tape measure;
(2) Ability to multiply and divide non-whole numbers;
(3) Ability to round a number;
(4) Ability to conduct research on the Internet.

Materials: Barbie dolls, tailor's tape measures, ball of string, newsprint long enough for a person to lie on, markers in two colors.
Video: Killing us softly 3 (Jean Killbourne, 1999)
http://video.google.com/videoplay?docid=-1993368502337678412
http://www.youtube.com/watch?v=_FpyGwP3yzE
[If restricted for time, the teacher is advised to select clips for viewing]

Procedure: Students, working in small groups (4-5), will receive one doll, measuring tape. They also will have at their disposal two markers of different colors and newsprint.

Day 1: Measuring the cast
[Prepare worksheet 1]

Begin with the question – "What would Barbie look like if she is as big as you?"
This activity is similar to drawing a map of a country on paper (scaling down), drawing a magnified insect's eyes for scientific illustration (scaling up).

Each group has to find their group average. How does one find an average of a group? What does average mean?
Barbie will be as tall as the average person.

[Although this is a nice juncture to have a discussion to compare and contrast the term average in mathematical and social sense, one may by-pass this step and just ask for a volunteer from each group, who then serves as the model for human size Barbie.]

Distribute worksheet 1 to record measurement data.

Worksheet 1

Monitor as the students figure out the scaling factor, and measure Barbie body parts.

Day 2: Drawing – What does she look like?
On a newsprint/butcher paper, the group representative person lies down so that the team members can draw the body contour with a marker.

The team members draw* the human-size Barbie by superposing it on the contour of their peer with a different colored marker pen.
Ask each group to write down their procedure and findings so that they can share with the rest of the class. [Could be a structured writing for the students]

* Drawing the human-size Barbie is an approximation process. The two-dimensional rendition of three-dimensional measures (for example, waist as a circumference) as estimation is worth a discussion.

Have each group display their drawings.
Discussions: Facilitate whole class discussion broadly based on questions such as: What surprised you the most? Is there anything that you can do about it?

Worksheet 1

$$\text{Scaling factor, } = \frac{\text{Height of person}}{\text{Height of Barbie}}$$

Body Measurements

	Barbie a	Barbie scaled a*F	Real person b
Bust			
Waist			
Hips			
Legs			
Arms			
Feet			
Head			
Neck			

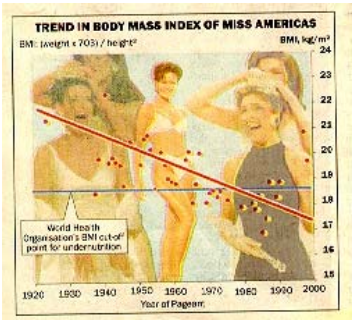
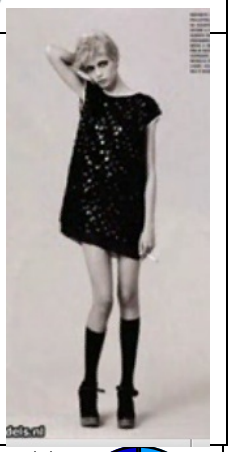
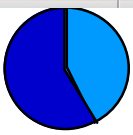
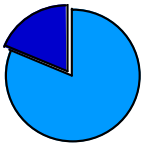
Points to ponder:

The average American woman is **5'4"** tall and weighs **140** pounds; she wears a size 12. She has **37"** bust, a **29"** waist, and **40"** hips.

A Barbie doll constructed to 5'4" tall, has a waist 16". Her feet are 5.6" long.

Day 3 onwards

Discussion topics (not limited to)

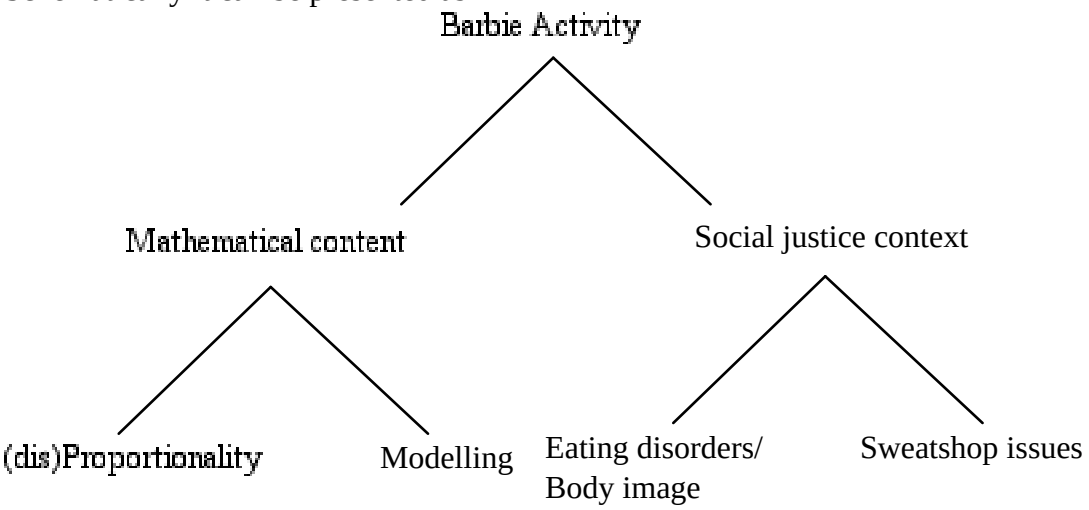
Media manipulation (Killing Us Softly 3 - Kilbourne)	 Jeroen Kramer/Getty Images, for The New York Times
Self worth, self image, multiculturalism What is body mass index? **Body mass index:** A key index for relating a person's body weight to their height. The body mass index (BMI) is a person's weight in kilograms (kg) divided by their height in meters (m) squared. In US units, BMI = 703*weight (lb)/height^2 (inch^2) Calculate BMI for adults and children. http://www.cdc.gov/nccdphp/dnpa/bmi/	 
Eating disorders In the United States, conservative estimates indicate that after puberty, **5-10 million** girls and women and **1 million** boys and men are struggling with eating disorders including anorexia, bulimia, binge eating disorder, or borderline conditions. http://www.nationaleatingdisorders.org/p.asp?WebPage_ID=320&Profile_ID=41138	**42%** of 1st-3rd grade girls want to be thinner (Collins, 1991).  **81%** of 10 year ols are afraid of being fat.(Mellin et al. 1991)  **51%** of 9 and 10 year-old girls feel better about themselves if they are on a diet (Mellin et al., 1991). **25%** of American men and **45%** of American women are on a diet on any given day (Smolak, 1996).

Consumerism 	
Sweatshop - labor issues The Maquila Solidarity Network is asking people to write to Mattel, the producers of Barbie dolls, to tell them to enforce their own code of conduct for labor so that Barbies are not made in sweatshops Citing wages as low as $3 (US) a day, strict factory rules and arbitrary fines, work up to 11 hours per day and six days per week, with high quotas and no over-time pay, as well as hot, stifling factories, the network says that though Mattel has a code of conduct, it only "gives the workers rights on paper, not on the shop floor."	 

Assessment
In this project-based approach, the daily assignments and culminating projects could be a wide variety of things.
Using the first two days activities as a launching point, student teachers have done different products. Media analysis (Dove commercial), contextually complex (multi-step) word problems appropriate for grades 5 -6, curriculum design (who is your hero?), intergenerational interview, etc., are just a few examples. To augment the mathematical thinking, I will recommend supplemental exercises (Comparing with ratio- Tenth Planet), textbook, etc.
I also encourage the participants to fill up a self-evaluation sheet [addressing mathematical knowledge, writing and research ability, ability to work with others, sense of agency and effort]

This activity (and its isomorphs) are exercises in modeling. This particular one is interesting because the way it creates space for interrogating many ideas of our contemporary world that needs critical examination.

Schematically it can be presented as



Follow-up activities:
Stretching and Shrinking (e.g., design a logo for your team. Design a business card using the logo, make a mouse-pad, etc.)

Logo	Business card