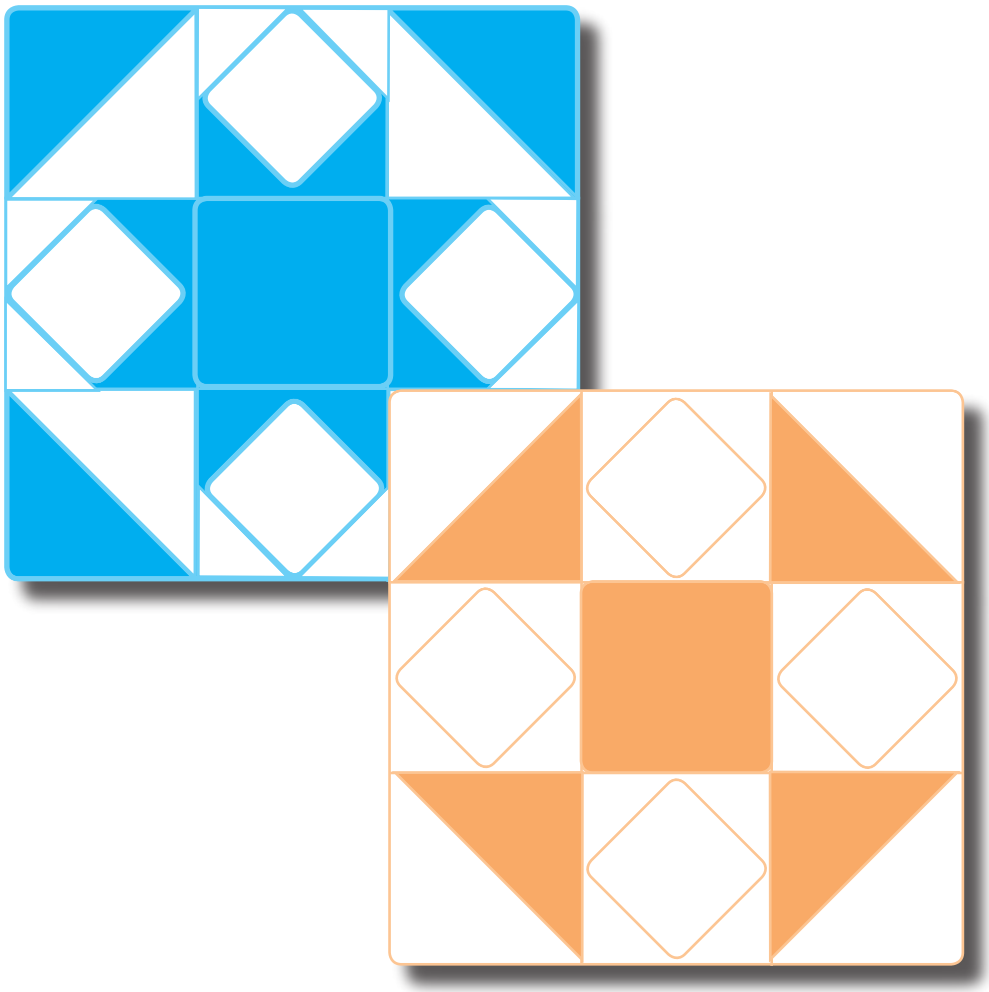
Styles in Tiles



Developing Spacial Sense

Outcomes

- To experience a rich task that integrates mathematical strands and provides an opportunity for various ways of thinking.
- To provide an opportunity for parents to explore spatial relationships with their children.
- To explore the issues of gender equity in careers.

Overview

Spatial sense and gender equity are related because spatial sense is something that we often teach our sons, but might not teach our daughters. Spatial sense is encouraged through the toys and chores we give our children. Boys often get to experience sandboxes, building materials like Legos and Erector Sets, and opportunities to figure out spaces by packing equipment and putting kits together. Girls often have less opportunity to explore spatial relationships.

The module starts out with a discussion of tiles and how they are used in homes and businesses. This transition into the topic of the module's investigation gives participants a chance to get settled into the task. It sets the stage for the problem posed in "Styles in Tiles".

After the discussion, the main problem is introduced. The problem is read by all and discussed so that there are not as many misunderstandings about the problem. The problem is to design a 20" by 22" tabletop out of tiles. There are 3 sizes of tiles: 3" by 3", 3" by 4", and 4" by 4". The sizes were chosen so participants cannot use all the same size of tiles without doing some cutting. Participants are to design what they think would be the best table. The tiles can be different colors and they can be cut to form interesting patterns. Each cut costs an extra 50 cents. Many beautiful designs come out of this activity. Time is provided to share the designs and costs, and what elements are important in the design. The mathematics that was used to design and analyze the cost of the table is discussed.

After enjoying all of the designs, the participants explore the idea of gender equity. Some time is spent brainstorming the careers that are seen as male-oriented or female-oriented. The purpose of their discussion is to open participants' thoughts to limitations that they may be placing on their children and their career choices.

The facilitator then makes connections between the topics of the workshop and the district curriculum. There could be a discussion about what opportunities the district provides for discovery of careers and the necessary steps to prepare for them.

There are several activities to take home and enjoy as a family.

Mathematics Background

The mathematical focus of this module is:
- Geometric Design
- Cost Analysis

The equity focus of this module is:
Gender and Career Issues

Geometric Design
The basic problem of this module is to design a table out of tiles. The tiles and tables have dimensions that make it necessary to use different sizes of tiles in order to cover the table. The designs of the tables are limited only by one's imagination. Much of the mathematics in the problem is done intuitively. How did participants decide which tiles to use? They probably used their knowledge of factors. Since 3 does not divide evenly into 20, but 4 does, most participants start with the 4x4 or 4x3 tiles. What divides evenly into 22? Neither 3 nor 4. So participants have to take away a row of 4x4 tiles and put in another size. The problem is accessible to all learners because everyone can make a design of some sort, and yet can be very challenging to the participant who strives to find just the right design.

Cost Analysis
The cheapest table is built with 20 4x4 tiles and 10 4x3 tiles. This configuration is cheaper because there are no cuts. The cost is 20 x $3 + 10 x $2.50 = $60 + $25 = $85. If the 4x4 tiles are used throughout, it is then necessary to buy 8 more 4x tiles and to cut 3 of them in half. Thus the cost is $60 + 8 x $3 + 3 x $.50 = $60 + $24 + $1.50 = $85.50. If the last piece (1/2 of a 4x4) can be sold or used else where, it would be a more cost effective way to tile the table. Is there a most expensive table? Tables can always get more expensive by using more cuts.

Which tile is the cheapest? In order to compute this, participants need to find a common unit for comparison. The easiest is 1 square inch. The 3x3 tile covers 9 sq. inches, so $2.00 divided by 9 = $.22 per sq. inch. The 3x4 tile covers 12 sq. inches, so $2.50 divided by 12 = $.21 (rounded from .2083). The 4x4 tile covers 16 sq. inches, so $3.00 divided by 16 = $.19 (rounded from .1875). Thus the 4x4 tiles are the cheapest.

Gender and Career Issues
Boys and girls tend to do equally well in mathematics through about the 7th or 8th grade. At that time, there starts to be a sex-related difference in mathematics achievement. Some of it has been attributed to spatial sense (Fennema and Sherman), and some of it has been attributed to the preference that girls have for learning through group interaction. The resource section lists several articles on the relationship between mathematics achievement and spatial visualization. Also, doing a search for mathematics and girls provides interesting reading on the internet.

Room Setup
- Desks or tables arranged in groups of 4
- Tables for sign-in, supplies, estimations, and snacks
- Overhead projector and screen
- Chart paper on easel
- Poster of the agenda

Materials

<table>
<tr><th>Facilitator</th><th>Transparencies</th></tr>
<tr><td>• Overhead projector
• Overhead pens
• Transparencies, blank
• Chart paper
• Chart markers
• Masking tape
• Timer (optional)
• Estimation questions (prepared by facilitator)
• Inexpensive prizes</td><td>BLM 1: Welcome
BLM 26: Styles in Tiles Problem
BLM 29: Gender-Career Connections
BLM 32: Leading Occupations
BLM 33: NCTM: Roles of Families
BLM 34.1: Designing a Table</td></tr>
<tr><th>Participant</th><th>Handouts</th></tr>
<tr><td>Individuals
• Paper
• Pencil
• Reflection
• Scissors
Groups
• Chart paper
• Chart markers
• Pattern Blocks (tub of at least 200)</td><td>One per participant for class
BLM 26: Styles in Tiles Problem
BLM 27: Grid for Tile Design
BLM 28.1-3: Optional Tile Samples
BLM 29: Gender-Career Connections
BLM 30: Reflection Questions
BLM 31: Pay Scales
BLM 34.1-2: Designing a Table
One per participant for home (make packet for easy distribution)
BLM 35: Opposing Sides
BLM 36: Drawing Blocks
BLM 37: Rotating Letters
BLM 38: Isometric Grid</td></tr>
</table>

Timing
2 hours and 10 minutes

Preparation and Timing (2 hours and 10 minutes)

Part 1: Getting Started (10 minutes)

Set-up on tables:
Estimation activities, snacks, sign-in sheet
Display transparency from workshop one:
BLM 1: Welcome

Part 2: Setting the Stage (5 minutes)

No handouts or transparencies

Part 3: Styles in Tiles (55 minutes)

Make transparency of:
BLM 26: Styles in Tiles Problem
Make copies for each participant:
BLM 26: Styles in Tiles Problem
BLM 27: Grid for Tile Design
BLM 28.1-3: Optional Tile Samples

Part 4: Gender-Career Connections (45 minutes)

Make transparency of:
BLM 29: Gender-Career Connections
BLM 32: Leading Occupations
Make copies for each participant:
BLM 29: Gender-Career Connections
BLM 30: Reflection Questions
BLM 31: Pay Scales

Part 5: Connections (5 minutes)

Make transparency of:
BLM 33: NCTM: Roles of Families

Part 6: Take Home Applications (5 minutes)

Make transparency of:
BLM 34.1: Designing a Table
Make copies and prepare a take home packet for each participant:
BLM 34.1-2: Designing a Table
Optional:
Make copies and prepare a take home packet for each participant:
BLM 35: Opposing Sides
BLM 36: Drawing Blocks
BLM 37: Rotating Letters
BLM 38: Isometric Grid

Part 7: Closing (5 minutes)

No handouts or transparencies
Prizes and reflection / evaluations *(provided by the evaluation team)*

Facilitator Resources

Books

Standards 2000 Project, *Principles and Standards for School Mathematics*, The National Council of Teachers of Mathematics, Inc (NCTM), 2000, P. 378, ISBN 0-87353-480-8, www.nctm.org

Space Visualization, Addison-Wesley Publishing Co. 1986.

Mathematics and Gender. NY Teachers College Press. 1990, *Changing Perspectives*. Leder, G p. 149-168.

Articles

Fennema, E and Sherman, J. *Sex-related Differences in Mathematics Achievement, Spatial Visualization and Affective Factors, Research Journal*. Vol 14 p. 51-71.

Internet Connections

Women's Pay Issue Websites (site addresses updated 5/28/03):
Equal Pay Is an Issue for All Working Women. AFL-CIO
http://www.aflcio.org/yourjobeconomy/women/equalpay/

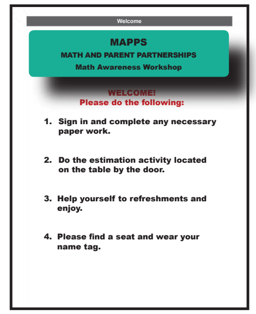
20 Leading Occupations of Employed Women 2001 Annual Averages. U.S. Department of Labor, Bureau of Labor Statistics. Women's Bureau. March 2002.
http://www.dol.gov/wb/wb_pubs/20lead2001.htm

U. S. Department of Labor. Women's Bureau.
http://www.dol.gov/wb/

The Facts About Pay Equity. Employment Policy Foundation. March 1999, Volume V, No. 3.
http://www.epf.org/ff/ff990315.htm

What is Pay Equity? Virginia National Organization for Women. October 1997.
http://www.now-va.org/pay_equity.html

Activities

Preparation of Classroom	Notes
1. Arrange desks or tables in groups of 4-6. Set up a table with a sign-in sheet, name tags, and snacks. On another table set up estimation activities. 2. Have pattern blocks at the participant tables. Ask the participants to use the pattern blocks to make interesting patterns. These can be used as a lead into the discussion on tiles. 3. Display the transparency of **BLM 1: Welcome!**. 4. Prepare and display a poster with the agenda and purpose of the session.	BLM 1: Transparency 
Part 1: Getting Started (10 minutes) - with children	
Introductions 1. Introduce yourselves and then have the participants introduce themselves. 2. Briefly explain the MAPPS program. Have participants who are involved in the program share their experiences. 3. Go over the agenda and purpose for the session.	
Part 2: Setting the Stage (20 minutes)	
Patterns 1. Begin a discussion on tiles by asking who has a pattern with the pattern blocks that turned out nicely. Have them share their pattern and then ask what qualities make an attractive pattern. Then ask where tiles are used in homes. Discuss designs made from tiles. The discussion should include that tiles come in a variety of shapes, colors, and sizes. These are often mixed to create a design. Have a few examples of decorative items done in tile. (These can be found in magazines.) Ask: *If you are going to design a table top of tile, what are some things that you need to know or be able to do?* 2. Some important ideas that need to be shared are: a) Using different colors b) Cutting tiles to fit c) Covering the entire surface, without any gaps If these ideas are not shared, ask questions that encourage participants to think of these things.	

Activities

Part 3: Styles in Tiles (55 minutes)

Understanding the problem: (5 minutes)

1. The problem that you are about to assign is for the participants to design a table top in tile (see BLM 24). The table top is 20" by 22". Tiles come in three sizes and can be cut to enhance the design. The project is best done alone or with one partner, as it gives the participants more time to think. Begin by saying:

   Tonight you are going to have the opportunity to design a tiled table top.

2. Distribute **BLM 26: Styles in Tiles Problem**. Have participants volunteer to read the instructions aloud, then review the important facts as a group, recording them on chart paper.

Important facts include:

   a) The dimensions of the table (20" x 22")
   b) The three sizes of tiles
   c) The cost of each size
   d) The fact that each cut costs fifty cents

Refer to the list developed in Part 2, step 1 to see if there are other important ideas to remember. Ask if anyone has an idea of how they might start this project.

Working the problem: (40 minutes)

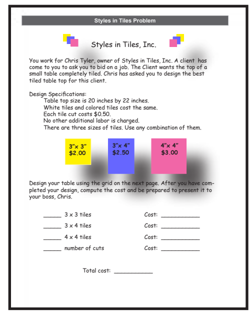
1. Give participants several sheets of **BLM 27: Grid for Tile Design** and optional manipulatives of tiles cut from **BLM-28.1-3: Optional Tile Samples** for their work. Give participants about 30 minutes to design their table top.

2. Walk around the room, helping participants as needed. Questions for participants that are stuck:
   - *What do you know about the problem?*
   - *What have you tried?*
   - *What else could you have tried?*
   - *What size of tile did you try?*
   - *What worked / didn't work with that?*
   - *Where did you get stuck?*

3. Another strategy for helping participants is snooping. If they are comfortable, have them "snoop "(go around and look at what others are doing and ask them questions;) and then come back and work.

Notes

BLM 26: Transparency /Handout



Styles in Tiles Problem

Styles in Tiles, Inc.

You work for Chris Tyler, owner of Styles in Tiles, Inc. A client has come to you to ask you to bid on a job. The Client wants the top of a small table completely tiled. Chris has asked you to design the best tiled table top for this client.

Design Specifications:
Table top size is 20 inches by 22 inches.
White tiles and colored tiles cost the same.
Each tile cut costs $0.50.
No other additional labor is charged.
There are three sizes of tiles. Use any combination of them.

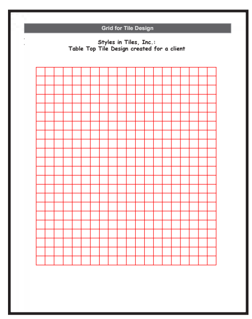
3"x 3" $2.00
3"x 4" $2.50
4"x 4" $3.00

Design your table using the grid on the next page. After you have completed your design, compute the cost and be prepared to present it to your boss, Chris.

_____ 3 x 3 tiles Cost: _________
_____ 3 x 4 tiles Cost: _________
_____ 4 x 4 tiles Cost: _________
_____ number of cuts Cost: _________

Total cost: _________

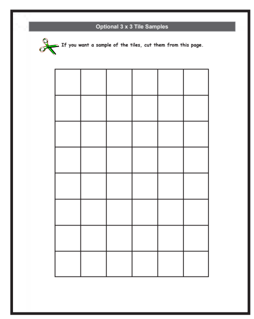
BLM 27: Handout



Grid for Tile Design

Styles in Tiles, Inc.:
Table Top Tile Design created for a client

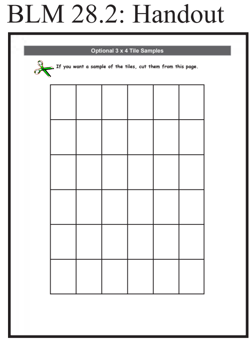
BLM 28.1: Handout



Optional 3 x 3 Tile Samples

If you want a sample of the tiles, cut them from this page.

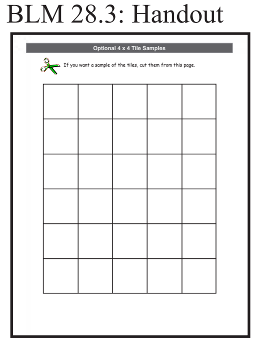
BLM 28.2: Handout



Optional 3 x 4 Tile Samples

If you want a sample of the tiles, cut them from this page.

BLM 28.3: Handout



Optional 4 x 4 Tile Samples

If you want a sample of the tiles, cut them from this page.

Activities

Part 3: Styles in Tiles (continued)	Notes
4. Some strategies for the participants that finish early: • *How else might you design this tabletop?* • *What criteria did you use to define "best?"* • *What if you used a different criteria, how would your design change?* After 30 minutes, tell them that they have 10 minutes left to figure the total cost. **Processing the problem: (10 minutes)** 1. Have participants share their designs and costs in groups of six to eight participants. Have groups choose one design to present to Chris, listing cost and reasons for choosing that design. As groups report out, have them post their design for all to see, while you record their cost and reasons on chart paper. 2. Ask: • *What qualities make up the best designs?* (Make a list of the qualities that the participants share.) • *What mathematics did you do in this problem?* **See Note A.** (Make a list of the mathematics that participants share.) 3. Say: *Today there is an emphasis in mathematics classes on making connections between mathematical ideas: multiplication, decimals and geometry all being part of the same problem.* • *How many different answers did we get here?* • *Is there one correct answer?* *This is another concept in mathematics today. In life, there is not always just one solution. A student can justify why his/her answer has validity. This activity is considered a rich mathematical task because:* *a) It makes connections between strands of mathematics* *b) It has multiple solutions or strategies* *c) It is accessible (doable) to everyone*	**A. NOTE** Mathematics for processing the problem: 1. Computing price 2. Manipulating geometric shapes 3. Performing slides (transformations) and turns (rotations) 4. Investigating spatial relationship 5. Using fractional pieces 6. Exploring area
Part 4: Gender-Career Connections (45 minutes)	
Transition 1. Start by asking: • *The tile shop owner's name was Chris in the problem that you just did. In your mind, did you assume Chris was a male or a female?*	

Activities

Part 4: Gender-Career Connections (continued)

After a pause, ask for a show of hands when you ask:

- *How many thought of Chris as male? Female?*
- *Why would some of us think male or female?*

2. Say:

    Lots of things influence our lives, such as family, nationality, race and religion. We want to explore one of the most powerful influences: gender. Let's look at the impact that gender has on the kinds of jobs and careers we choose.

Gender-Career Brainstorming

1. Distribute to each group **BLM 29: Gender-Career Connections** for them to record female-dominated careers and male-dominated careers.

2. Say:
    - *In your small groups, please choose someone who will be the recorder and write down your ideas. The recorder should have the handout called Gender-Career Connections and a pencil to record the "Female-Dominated Careers" and the"Male-Dominated Careers."*
    - *Your task is to brainstorm as many careers as you can think of that have either mostly women or mostly men in them. Try to think of at least five for each gender. You have 5 minutes to make your lists.*

(Set a timer or let the participants know when 5 minutes has ended.)

3. Have each group share one of their ideas. **See Note B.**

Generalities

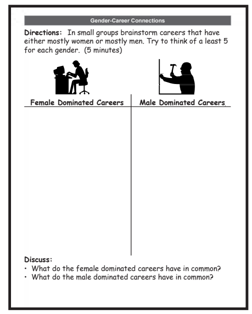
1. Have participants generalize what the female-dominated careers have in common. Then what the male-dominated careers have in common.

2. Have the groups share their ideas.

3. Display a transparency of **BLM 29: Gender-Career Connections** and record each groups ideas. **See Note C on next page.**

Notes

BLM 29: Transparency / Handout


Gender-Career Connections

Directions: In small groups brainstorm careers that have either mostly women or mostly men. Try to think of a least 5 for each gender. (5 minutes)

Female Dominated Careers	Male Dominated Careers

Discuss:
- What do the female dominated careers have in common?
- What do the male dominated careers have in common?

B. NOTE

Examples of gender-related careers:

Female-dominated careers: Nursing, secretarial work, elementary school teaching, cosmetology, waitress, and child care.

Male-dominated careers: police officer, fire fighter, doctors, engineers, construction (electrician, plumber, etc.), and political offices.

Activities

Part 4: Gender-Career Connections (continued)	Notes

Group Discussion

1. After all of the generalities have been listed, facilitate a discussion with the large group of the differences between female and male careers.

2. Distribute the handout of **BLM 30: Reflection Questions** and ask some or all of the following questions:
   - *Are there any careers on the female side that men cannot do?*
   - *Are there any careers on the male side that women cannot do?*
   - *Why do you think that women and men tend to choose different careers?*
   - *What influences do family, peers, and society play in these choices?*
   - *Who do you think generally makes more money?*

   (Men make around 33% more)

3. Discuss the factors that might contribute to the inequitable pay and list these on the board.
   Which high school classes generally lead to higher paying jobs/careers? (Math, science, computer/technology and male-oriented vocational classes. These classes often filter women out of high-paying careers. An interesting fact is that women have to go to college between 3 to 4 years to earn the same amount of money as a man who stopped his education as a high school graduate).

4. Distribute the handout of **BLM 31: Pay Scales** with the list of different pay scales for men and women in same job. Explain that this is a set of graphs showing the difference in pay, one bar represent females, and the other males.

5. Display the transparency of **BLM 32: Leading Occupations** which lists different occupations for men and women and have participants discuss what they see with a partner. Have them share their ideas.

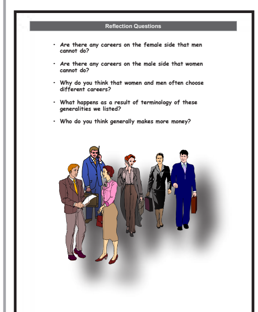
C. NOTE

Examples of generalities that have been shared:

Men's jobs tend to require more physical strength, a higher level of leadership, work that is primarily with adults, employment out of doors, management responsibility, and positions requiring travel.

Women's jobs tend to be indoors, less strenuous physically, and more service-oriented, often working with children.

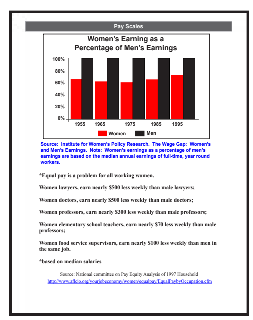
BLM 30: Handout



Reflection Questions

- Are there any careers on the female side that men cannot do?
- Are there any careers on the male side that women cannot do?
- Why do you think that women and men often choose different careers?
- What happens as a result of terminology of these generalities we listed?
- Who do you think generally makes more money?

BLM 31: Handout



Pay Scales

Women's Earning as a Percentage of Men's Earnings

Source: Institute for Women's Policy Research. The Wage Gap: Women's and Men's Earnings. Note: Women's earnings as a percentage of men's earnings are based on the median annual earnings of full-time, year round workers.

*Equal pay is a problem for all working women.

Women lawyers, earn nearly $500 less weekly than male lawyers;

Women doctors, earn nearly $500 less weekly than male doctors;

Women professors, earn nearly $300 less weekly than male professors;

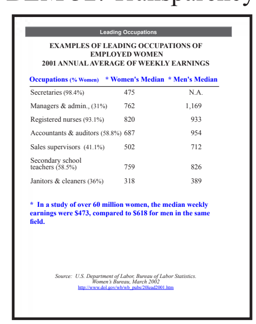
Women elementary school teachers, earn nearly $70 less weekly than male professors;

Women food service supervisors, earn nearly $100 less weekly than men in the same job.

*based on median salaries

Source: National committee on Pay Equity Analysis of 1997 Household
http://www.aflcio.org/yourjobeconomy/women/equalpay/EqualPaybyOccupation.cfm

BLM 32: Transparency



Leading Occupations

EXAMPLES OF LEADING OCCUPATIONS OF EMPLOYED WOMEN
2001 ANNUAL AVERAGE OF WEEKLY EARNINGS

Occupations (% Women)	* Women's Median	* Men's Median
Secretaries (98.4%)	475	N.A.
Managers & admin., (31%)	762	1,169
Registered nurses (93.1%)	820	933
Accountants & auditors (58.8%)	687	954
Sales supervisors (41.1%)	502	712
Secondary school teachers (58.5%)	759	826
Janitors & cleaners (36%)	318	389

* In a study of over 60 million women, the median weekly earnings were $473, compared to $618 for men in the same field.

Source: U.S. Department of Labor, Bureau of Labor Statistics. Women's Bureau, March 2002
http://www.dol.gov/wb/wb_pubs/20lead2001.htm

Activities

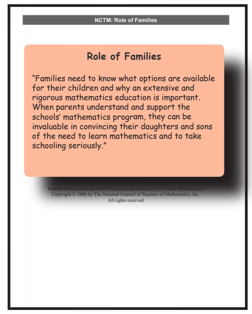
Part 5: Connections (5 minutes)

1. Say:
   One of the skills that separates the genders in school is spatial sense. The activity that we did tonight was designed to explore spatial sense. Spatial sense is used in many careers such as photographer, artist, construction workers, designers, industrial and civil engineers, and many others. As parents, we need to make sure that our children are doing all kinds of math including spatial sense to be assured that our children are not limiting their career opportunities.

2. Connect the theme of this workshop to the standards at the national, state, or local level. If connecting to the national standards, display **BLM 33: NCTM: Role of Families**. Ask participants to think about reasons that students stop taking mathematics in school, and then discuss ways that they can address those issues with their children and support them in continuing their mathematical education.

Notes

BLM 33: Transparency


NCTM: Role of Families

Role of Families

"Families need to know what options are available for their children and why an extensive and rigorous mathematics education is important. When parents understand and support the schools' mathematics program, they can be invaluable in convincing their daughters and sons of the need to learn mathematics and to take schooling seriously."

Part 6: Take Home Applications (5 minutes)

1. Distribute handouts of **BLM 34.1-2: Designing a Table** to participants.

2. Display the transparency of **BLM 34.1** and go over directions for the home activities. Spatial sense needs to be developed. These activities can help develop that sense.

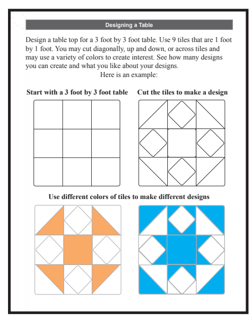
Optional

1. If you choose the option activity for the participants to take home then distribute copies of handouts (see next page):
   BLM 35: Opposing Sides
   BLM 36: Drawing Blocks
   BLM 37: Rotating Letters (see next page)
   BLM 38: Isometric Grid (see next page)

2. Tell the participants that they will need to find cubes (e.g. dice, sugar cubes, children's blocks, etc.) to do the Drawing Blocks activity. Let them know that the extra isometric grid is included for their use.

Notes

BLM 34.1: Transparency / Handout

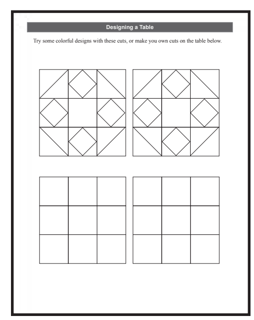

Designing a Table

Design a table top for a 3 foot by 3 foot table. Use 9 tiles that are 1 foot by 1 foot. You may cut diagonally, up and down, or across tiles and may use a variety of colors to create interest. See how many designs you can create and what you like about your designs.
Here is an example:

Start with a 3 foot by 3 foot table   Cut the tiles to make a design

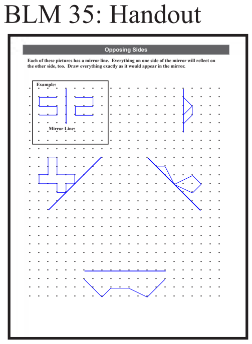
Use different colors of tiles to make different designs

BLM 34.2: Handout


Designing a Table

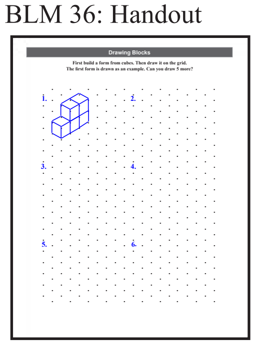
Try some colorful designs with these cuts, or make you own cuts on the table below.

BLM 35: Handout


Opposing Sides

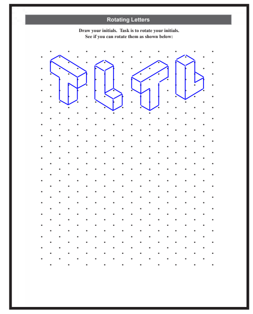
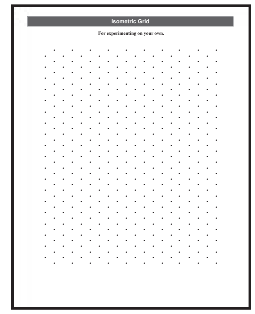
Each of these pictures has a mirror line. Everything on one side of the mirror will reflect on the other side, too. Draw everything exactly as it would appear in the mirror.

BLM 36: Handout


Drawing Blocks

First build a form from cubes. Then draw it on the grid. The first form is drawn as an example. Can you draw 5 more?

Activities

Part 6: Take Home Applications (continued)	Notes
	BLM 37: Handout  BLM 38: Handout 
Part 7: Closing (5 minutes)	
1. Distribute any prizes from estimations or drawings. 2. If your district does not have an evaluation form to use, you may want to use a reflection similar to: *As a result of tonight's activities, I understand more about...?* or have them answer on of the following questions: • *What did you learn tonight?* • *What will you do with your son/daughter as a result of this session?*	