



# Maranao Crafts and Mathematics

## Unit Summary

This Unit investigates transformations of the graph of linear, quadratic and exponential functions. It serves as an enrichment activity for students where they learn to appreciate local crafts in Lanao del Norte such as the Malong and at the same time learn about transformation concepts.

In the course of the unit, students used graphing calculators and made generalizations on the effects of parameter changes in the equation of the function to its graph. Working collaboratively in groups, students conducted information searches about famous Muslim mathematicians and their contributions to mathematics. Each group was also asked to choose a Maranao textile and analyzed the transformation concepts used in its design. As students did this, they learned to relate geometric concepts of transformation to transformations of graphs in algebra as well as relate the study of mathematics to crafts. The students also developed a variation of the design of the Maranao craft they had chosen. Students presented their work through a multimedia presentation. They also wrote journals on their learning experiences in relating mathematics to the real world. As a culminating activity, students take on the role as textile designers, where they created designs applying the transformation concepts they learned and promoted their own designs in a brochure. The students' reports in multimedia presentations and their promotional materials in brochures, were evaluated using rubrics.

### At a Glance

**Grade Level:** 10 (4th year high school)

**Subject:** Mathematics

**Time Needed:** 3 Weeks

### Things You Need

[Standards](#)

[Resources](#)

## Curriculum-Framing Questions

- **Essential Question**  
Is everything related to everything else?
- **Unit Questions**  
How are designs created?  
How does mathematics relate to craft?

- **Content Questions**

What is a function?

How do we graph functions?

What is the domain and range of the graphs?

What are the contributions of Muslim mathematicians?

What are the types of geometric transformation?

What are the geometric transformations found in a Maranao textiles?

## **Instructional Procedures**

### **Opening Activity:**

To introduce the unit, ask the class following question, *"Is everything connected to everything else?"*.

Orient them on what the unit will cover and what are expected from them as proof of their learnings.

Show a Malong to class and ask the following questions:

- *What designs can you see in this malong?*
- *Can you find any mathematical concept in this design?*
- *How was this design created?*
- *Are these designs somehow connected to the culture of the people making these designs?*

As you ask them these questions, make sure that students' answers to these questions will be processed. Inform them also that the activities they will go through in this unit will help them answer these questions.

### **Day 1-3. Discussion on Functions and Their Graphs**

Students will be given activity sheets and graphing papers in doing an activity on understanding graphs of functions. The activity also covers a discussion of the domain and range of functions using graphical representations.

To validate students answers, a discussion on graphing functions follows, where students will be guided in answering the following questions:

- *What is a function?*
- *How do we graph functions?*
- *What is the domain and range of a function?*
- *How do we identify domain and range from the graph of the function?*

### **Day 4-5. Research on a Famous Muslim Mathematician**

The students worked in groups of five. Each group researched on famous Muslim mathematicians and their contributions to mathematics.

**Expected Outputs:** (a) Accomplished Activity sheets and (b) biography of the famous Muslim Mathematician and (c) summary of his/her contributions to Mathematics.

## Day 6-10. Exploring Graphs of Functions Using a Graphing Calculator. (Connecting Mathematics Skills to Muslim Textiles)

Students will do the [activity on horizontal and vertical translation](#) (DOC 169KB). In this activity students will make a generalization on the translation of  $y = x$  that gives the graph  $y = x \pm k$ , if  $k$  is a positive real number. They will then make generalizations on the translation of  $y = x^2$  that gives the graph  $y = x^2 \pm k$ .

In addition, students also write their description on the translation of figures they will find in the various Batik patterns from Mindanao. Each group will choose a Maranao textile and investigate the mathematical concepts used in the design.

In this activity students reflect back on the answers to the questions, *How are designs created? How does mathematics relate to craft?* and also the content questions *What are the geometric transformations found in a Maranao textile?*

**Expected Outputs:** (a) Accomplished Activity Sheets and (b) Initial Results of their investigation of transformation concepts found in a design

## Day 11-12. More Activities on Exploring Graphs of Functions Using Graphics Calculator. (Connecting Mathematics Skills to Muslim Textiles)

Students will do activity on [exploring exponential function](#) (DOC 79KB), [logarithmic function and its inverse](#) (DOC 58KB) using graphics calculator. In this two activities students will make conjectures on the effect of 'P', 'a', and 'k' on the graph  $y = Pa^{kx}$ , and the effect of 'a' on the graph  $y = \log_a x$ . The concept of reflection was used on solving the inverse of a function.

During these days, each group will create their own designs. To do this, the students will further research on the concepts of transformation and consult an art teacher in making their suggested designs.

With their initial investigation on the mathematics concepts found in their chosen Maranao textile, the student will write [journals](#) (DOC 24.5KB) on *How does mathematics relate to craft?*

**Expect Output:** Journal on *How does mathematics relate to craft?*

## Day 13- 15. Creating Multimedia Presentation and Brochure.

Students will present their storyboard before they can use the computer laboratory. Their [multimedia presentations](#) (PPT 3.48MB) must have the following content.

- a. Life of their chosen Muslim Mathematician and his/her contributions to Mathematics.
- b. Analysis of the transformation concepts found in the chosen Maranao Craft.

Their [brochure](#) (PDF 147KB) on the other hand must showcase the design they created applying the transformation concepts they learned. The figure they need to transform may not necessarily be functions. Creating designs by

transforming graphs can be an activity for advanced students.

**Expected Outputs:** Multimedia presentation and brochure.

## Prerequisite Skills

The students must have prior knowledge on:

- classifying angles and polygons.
- finding relationship among angles, sides and diagonals of parallelogram.
- locating points on a coordinate plane.
- graphing functions using graphing paper.

## Technology-related Skills:

Students must know how to

- use a graphing calculator;
- use an encyclopedia on CD ROM or surf for information using the Internet;
- scan, edit, and save images;
- use presentation or publication software in coming up with a multimedia presentation or website; and
- use a word processing application.

## Differentiated Instruction

### Resource Student

- Resource students can focus more on identifying transformation concepts in Maranao crafts. As soon as they master to do this, they can then be allowed to develop their own designs using transformation concepts.

### Gifted Student

- The students can investigate further on the use of arithmetic sequence, fibonacci and geometric sequence on arts. Students can explore functions and make designs by transforming graphs of functions.

## Student Assessment

To evaluate technology-based outputs of students, the teacher will use the following rubrics:

- [multimedia presentation evaluation tool](#) (DOC 41.5KB) and
- [brochure evaluation tool](#) (DOC 33KB).

## Key Word Search

- Functions
- Inverse function
- Translation
- Reflection

*Note: The hyperlinked support documents are not part of the PDF. They can be downloaded and printed individually.*

# Designing Effective Projects: Maranao Crafts and Mathematics

## Content Standards and Objectives

### Targeted Philippine Basic Education Curriculum Competencies High School Mathematics IV: Advanced Algebra, Trigonometry, and Statistics

#### Linear Functions

1. Define the linear function  $f(x) = mx + b$ ; given a linear function  $Ax + By = C$ , rewrite in the form  $f(x) = mx + b$  and vice versa.
2. Draw the graph of a linear function given the following:
  - any two points
  - slope and one point
  - slope and the y-intercept
  - x and y intercepts

#### Quadratic Functions

1. Define a quadratic function  $f(x) = ax^2 + bx + c$ ; identify quadratic functions.
2. Rewrite a quadratic function  $ax^2 + bx + c$  in the form  $f(x) = a(x-h)^2 + k$  and vice versa.
3. Given a quadratic function, determine:
  - highest or lowest point (vertex)
  - axis of symmetry
  - direction of opening of the graph
4. Draw the graph of a quadratic function using the vertex, axis of symmetry, and assignment of points.
5. Analyze the effects on the graph of changes in 'a', 'h' and 'k' in  $f(x) = a(x-h)^2 + k$

#### Exponential and Logarithmic Functions

1. Define the exponential function  $f(x) = a^x$  and differentiate it from other functions studied earlier; given a table of ordered pairs, state whether the trend is exponential or not.
2. Draw the graph of an exponential function  $f(x) = a^x$  and describe some properties of the function or its graph.
  - $a > 1$
  - $0 < a < 1$
3. State the domain, range, intercepts and trend (increasing and decreasing) of a given exponential function based on its graph.

## Student Objectives/Learning Outcomes

At the end of the unit, students will be able to:

1. graph functions and give their domain and range;
2. research about a famous Muslim mathematicians and his/her contributions to mathematics and report it using a multimedia presentation;
3. make conjectures on the effect of
  - 'k' on linear function  $y = x \pm k$  and on quadratic function  $y = x^2 \pm k$ .
  - 'P', 'a', and 'k' on the graph  $y = Pa^{kx}$ .
  - 'a' on the graph  $y = \log_a x$ .
4. find the inverse of a function using reflection of graphs;
5. investigate transformation concepts used in Muslim textiles;
6. create designs using transformations
  - identify the different functions and their graphs
  - graph functions using translation;
7. promote their designs using a brochure;
8. value one's cultural heritage; and
9. appreciate mathematics in designs and crafts.

# Designing Effective Projects: Maranao Crafts and Mathematics Resources

## Materials and Resources

### Printed Materials

- Bass Laurie, Hall BR, et. al. Geometry Tools for a Changing World, Prentice Hall, Needham Massachusetts, New Jersey.
- Smith Stanley, Charles Randall, Dossey John A, et. al. Algebra 2 with Trigonometry, Prentice Hall, Needham Massachusetts, New Jersey.
- Worksheets
- Journals templates

### Supplies

- Activity sheets

### Internet Resources

- The Math Forum @Drexel MathTools, 2003-2004, June 3, 2003.  
[http://mathforum.org/mathtools/tool.html?&new\\_id=479](http://mathforum.org/mathtools/tool.html?&new_id=479)\*
- Donna Roberts, Working with Translation May 28, 2003.  
<http://regentsprep.org/Regents/math/trans/tranwork.htm>\*
- Sydney Academy Grass Roots Project, June 2,2003.  
<http://sacademy.cbv.ns.ca/grsrts/design11/parabola5.htm>\*
- Ingrid Daubechies\*, Math Alive, June 4, 2003.  
<http://www.math.princeton.edu/matalive/Geometry/GeometryLab1/Linear.html>\*
- Mu-hsuen Chen , Math in Arts, June 1, 2003.  
<http://employees.oxy.edu/jquinn/Math105/society/mathinarts.html>\*
- Wikipedia Encyclopedia, Al-Khwarizmi May 20, 2003.  
<http://en.wikipedia.org/wiki/Talk:Al-Khwarizmi>\*
- Christine F. Godinez-Ortega, KASAMA Vol. 16 No. 3 / July–August–September 2002 June 4, 2003.  
<http://www.cpcabrisbane.org/>\*

**Others**

- Art teacher as expert in designs

**Technology – Hardware**

- Digital Camera
- Internet Connection
- Scanner

**Technology – Software**

- Image Processing
- Encyclopedia on CD ROM
- Word Processing
- Web Browser
- Desktop Publishing