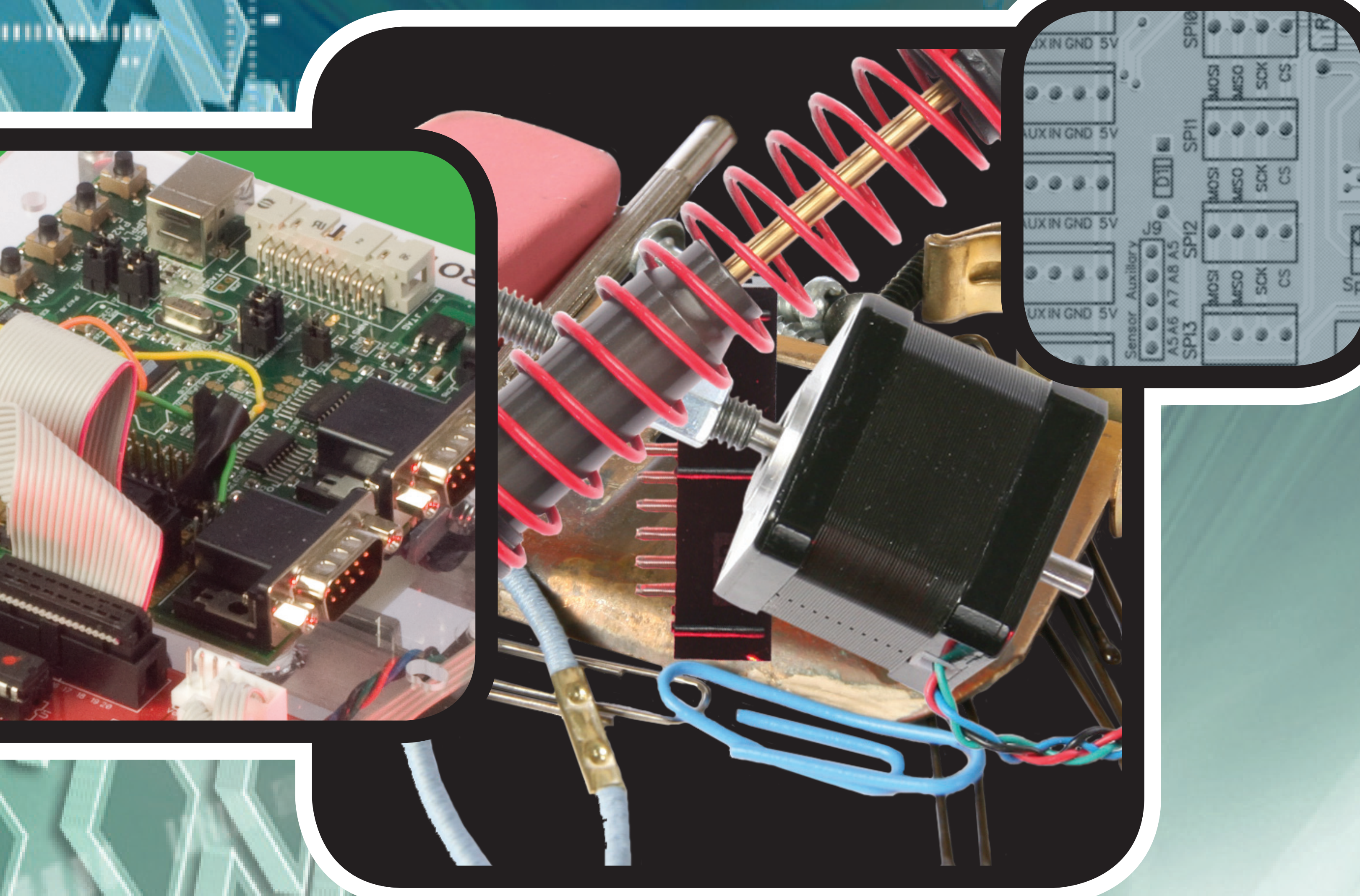
REVIEWED & RECOMMENDED
National 4-H Curriculum

NATIONAL 4-H CURRICULUM
Product Number 08431

JUNK DRAWER ROBOTICS

LEVEL 1: GIVE ROBOTS A HAND



4-H ROBOTICS: ENGINEERING FOR TODAY AND TOMORROW

Acknowledgments – Junk Drawer Robotics

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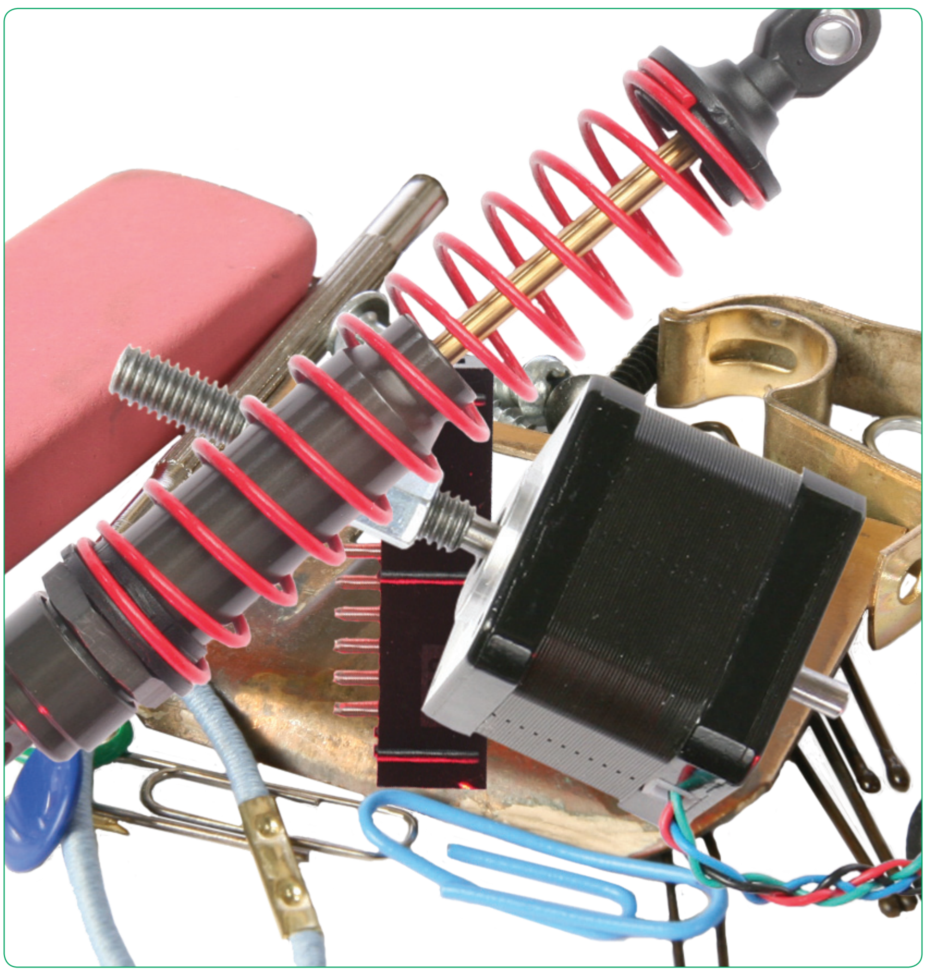
4-H Robotics: Engineering for Today and Tomorrow

Junk Drawer Robotics

Level 1

Give Robots a Hand

Presenter's Activity Guide



Junk Drawer Robotics Level 1

Give Robots a Hand

Table of Contents

Introduction to Junk Drawer Robotics

The goal of *4-H Junk Drawer Robotics* is to make science, engineering, and technology engaging and meaningful in the lives of young people. The activities do this by encouraging youth to use the processes and approaches of *science*; the planning and conceptual design of *engineering*; and the application of *technology* in their personal portfolios of skills and abilities.

The *Junk Drawer Robotics* curriculum is divided into three levels or books each around a central theme related to robotics design, use, construction, and control. Each level starts out with background information on working with youth, curriculum elements, and a focus on the concepts to be addressed.

- In Book 1, the theme is robotic arms, hands, and grippers.
- In Book 2, the theme is moving, power transfer, and locomotion.
- In Book 3, the theme is the connection between mechanical and electronic elements.

Modules within each book target major concepts of the theme. The modules each contain five or more activities that help the members develop an understanding of the concepts, create solutions to challenges, and develop skills in constructing alternatives.

Your role as a presenter in this curriculum is different from the normal role of the teacher that we may know from a school setting. It is not about mere transfer of knowledge from teacher to student. It is about assisting learners in developing their own knowledge and Problem solving skills. This is done by bringing together a scientific inquiry and engineering design approach to learning. Youth will learn about a topic by exploration. When given a problem, they will design a solution. Then, using what they have learned and designed, they will build or construct a working model.

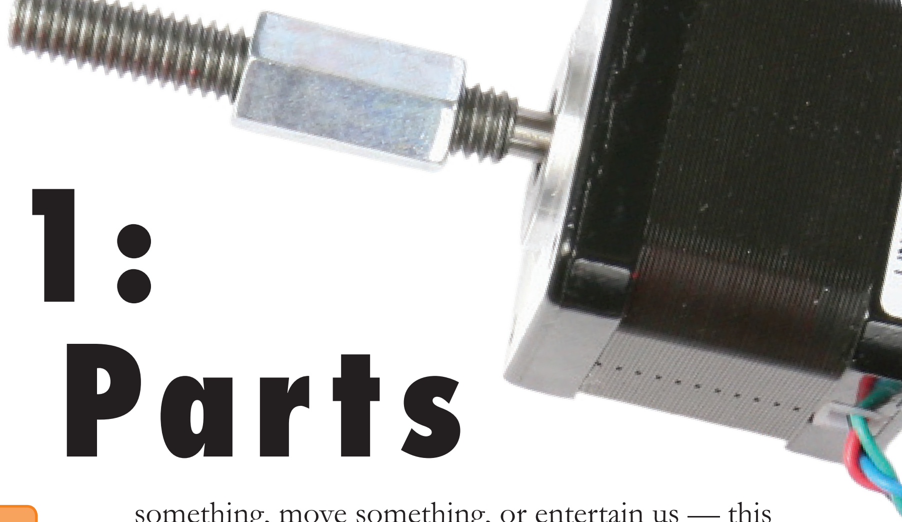
The presenters of this curriculum may be teachers, after-school staff, or volunteers, including teens working with younger youth. In the case of teens, an adult coach or mentor could provide support, training, and guidance to teams of two or three teens who present the activities together. As a presenter, you will assist the youth in understanding the processes of science, engineering, and technology by how you ask questions and have them share their ideas, designs, and results.

The robotics curriculum is designed around three themes of science, engineering, and technology. Each module has activities in each of these three areas. As a framework, *4-H Junk Drawer Robotics* uses these simple definitions developed by Anne Mahacek, former 4-H teen member who is now a mechanical engineer and grad student in mechatronics.

To Learn: **Science** is finding out how things work.

To Do: **Engineering** is using what you found out to design something to work.

To Make: **Technology** is using tools and processes to make something work.



Module 1: Parts Is Parts

Overview of Activities in this Module

To Learn

Activity A – Think Like a Scientist
Activity B – Communicate Like an Engineer
Activity C – Build Like a Technician

To Do

Activity D – Marshmallow Catapult Design Team

To Make

Activity E – Marshmallow Catapult Build Team

Note to Leader

When we look at how things are made, we come across many words that relate to the making of things. Items can be made, constructed, built, manufactured, produced, or fabricated.

The two primary aspects of how things are made are the design elements and the manufacturing elements. Design elements include the geometric shape/size (round, square, long, wheels) of the item's parts. We can find many basic shapes in items, such as arcs, triangles, and columns. Manufacturing elements include the sequence of processing steps (forged, drilled, cast, cut, fabricated), and how the raw materials were used, modified, or changed in the assembly of the items.

Similar to the design and manufacturing of an item is the concept of form and function. Form is how something looks or feels. An item may be made a certain way so it looks good, has a great color, or is pleasing to hold — this is part of its form. The function is how something works or accomplishes a desired task. An item may be made to hold something, move something, or entertain us — this is part of its function.

There are different ways of thinking about the relationship between form and function. One viewpoint is based on Louis Sullivan's famous axiom, "Form follows function." This basic rule for design means that if an object has to perform a specific function, its design must first support that function. An example of this is the top-down design process, based on a challenge, need, or problem to be solved.

Another point of view is from the artist, who looks first at form and second at the item's function. This point of view gives rise to a bottom-up design process, given specific tools, materials, or supplies to accomplish the task. Both views can come into play in good design.

The architect Frank Lloyd Wright made this statement regarding form and function: "Form follows function — that has been misunderstood. Form and function should be one."

Raymond Loewy, referred to as the Father of Industrial Design, explained form and function this way: "I once said that the most difficult things to design are the simplest. For instance, to improve the form of a scalpel or a needle is extremely difficult, if not impossible. To improve the appearance of a threshing machine is easy. There are so many components on which one can work."

And, he said, "It would seem that more than function itself, simplicity is the deciding factor in the aesthetic equation. One might call the process, beauty through function and simplification."

When beginning to design, form and function must be considered. Both are necessary for good products; how they are achieved is up to the designer.

What you will need for Module 1: Parts Is Parts

- Robotics Notebook for each youth
- Trunk of Junk, see page 8
- Activity Supplies
  - Cardboard or pegboard work base; rectangle about 6 inches by 12 inches, at least one per group
  - Paper clips, binder clips in different sizes, about 10-15 per group
  - Full boxes of paper clips (at least one per group)
  - Paper brads, about 5-10 per group
  - Clothespins or other fasteners about 5-10 per group
  - Coffee stirrers, about 10-15 per group
  - Straws, about two to six per participant
  - Paint sticks (some with holes), about 5-10 per group
  - Craft sticks (some with holes), about 10-15 per group
  - Washers, about 5-10 per group
- Posters, Handouts, and other items (Note: Most of these elements are in the Robotics Notebook, but you may choose to create an additional poster or handout especially if youth do not have a copy of the Robotics Notebook.)
  - Optional: Copies of tables and graphs on pages 19-20
  - Optional: Poster/Handout of Manufacturing Processes on page 27
  - Optional: Poster/Handout of Design Shapes on page 28
  - Optional: Poster/Handout of Marshmallow Catapult Challenge on page 32
- Toolbox
  - Glue
  - Tape
  - Scissors, 1 or 2 per group
  - Low-temperature glue gun (two or three to share)
  - Hand drill with bits
  - Small hacksaw (to cut dowels and small boards)

Timeline for Module 1: Parts Is Parts

Activity A – Think Like a Scientist

- Activity will take approximately 20 minutes.
- Divide youth into small groups of two or three.
- For each team, arrange a random selection of parts on a table or work space.

Activity B – Communicate Like an Engineer

- Activity will take approximately 20 minutes.
- Divide youth into groups of four.

Activity C – Build Like a Technician

- Activity will take approximately 20 minutes.
- Divide youth into teams of two or three.

Activity D – Marshmallow Catapult Design Team

- Activity will take approximately 20 minutes.
- Divide youth into groups of two or three.

Activity E – Marshmallow Catapult Build Team

- Activity will take approximately 30 minutes.
- Use the same groups from Activity D, Marshmallow Catapult Design Team.
- The Marshmallow Catapult can be adapted into a balance beam scale to be used in Activity F, Sense of Balance.

Focus for Module 1: Parts Is Parts

Big Ideas

- Science habits of mind
- Form and function
- Engineering design process

NSE Standards

- Systems, order, and organization
- Form and function

STL

- Core concepts of technology
- Relationships and connections
- Attributes of design
- Manufacturing technologies

SET Abilities

- Categorize/Order/Classify
- Compare/Contrast
- Communicate/Demonstrate
- Draw/Design
- Build/Construct

Performance Tasks For Youth

You will learn the importance of identification as you make observations and sort materials based on selected attributes. You also will record data into charts and graphs.

You will describe an object by drawing and writing a description of it. You also will have to determine items that others have described.

You will use the engineering design process to complete a building challenge that involves using manufacturing processes and design shapes.

You will plan and design a swinging arm trebuchet-style catapult to launch marshmallows.

You will assemble parts, use simple tools, make modifications, and record information in your Robotics Notebook as you build a catapult.

Life Skills

- Keeping Records
- Critical Thinking
- Communication

Success Indicators

Youth will be able to select and categorize items based on observation and comparison of common attributes. Youth will be able to create their own charts and graphs based on data gathered.

Youth will be able to utilize communication skills to describe an object using sketching and drawing techniques as well as written and verbal descriptions.

Youth will be able to use the engineering design process in completing a challenge that includes using basic design shapes and tools.

Youth will be able to record thoughts, ideas, and design plans for a trebuchet-type catapult.

Youth will be able to use tools and parts to build a catapult of their design.

Activity A – Think Like a Scientist

Performance Task For Youth

You will learn the importance of identification as you make observations and sort materials based on selected attributes. You also will record data into charts and graphs.

Success Indicators

Youth will be able to select and categorize items based on observation and comparison of common attributes. Youth will be able to create their own charts and graph based on data gathered.

List of Materials Needed

- Robotics Notebook
- Collection of parts – Each team should have 15 to 30 items to sort. Teams do not have to have the same number of items, just a selection of different items to sort. Try to have different sizes and colors of paper clips; binder clips; clothespins; craft, paint, or wood sticks; paper brads; coffee stirrers; and drinking straws. If you can, try to use items that you already have available and that you'll be using in the builds.
- Optional: Copies of tables and graphs on pages 19-20

Activity Timeline and Getting Ready

- Activity will take approximately 20 minutes.
- Divide youth into groups of two or three.
- For each team, arrange a random selection of parts on a table or work area.

Experiencing

Sorting 1

1. Ask participants to look at and observe the items. Then ask the youth to sort the objects by color and shape, e.g., blue circle, red rectangle. Youth will then fill out the chart and graph in their notebook. In the notebook, youth should keep count of the different categories they've created and used.
2. Discuss with the youth the importance of keeping data in their notebooks, and how important it is to use charts and graphs. The youth should understand that their notebooks should be neat and easy for anyone to read and to understand what will happen during the experiment. For this activity, it means that anyone reading the notebook will be able to gather the same materials and have similar categories and groupings.

Sorting 2

3. Next, ask the participants to think about other ways they could group or sort the items. Have others sort the items into new groups using a different sorting criterion. Let the youth determine how they will sort the items, such as big/little, round/not round, flat/raised, rough/smooth, size, shape, or material. Have the youth sort the items, but not tell the other members of the entire group how they sorted. Have those who are not members of the group try to guess or predict how the items are sorted by observing the sorted items.
4. Youth should count the number of items in each new sorted grouping. Then they should

create their own chart and graph headings in their notebooks and record the numbers in their notebook.

5. Discussion: After the members have guessed the grouping, ask the participants to share other ideas on ways to sort the parts or materials.
6. Then use the *Note to Leader* information on page 13 to share about form and function.

Sorting 3

7. After the discussion, again ask youth to observe the parts carefully. Encourage them to notice how the parts are designed and how they are to be used.
8. Ask participants to sort the parts (items) according to:
   a. The item's use (**the function** — hold things, provide shelter, move stuff, etc.)
   b. The item's shape, appearance, or configuration (**the form** — the look of the items, colors, shapes, etc.)
9. Discussion: Have youth record their findings in their Robotics Notebook. Youth should create a chart that lists the item, the function of the item, and the form of the item.
10. Have the youth share their ideas for form and function with the rest of the group. There are different possibilities for form and function; people use different objects in different ways. There are no wrong answers, only different opinions.

Example 1. All the items in the photo below are used to hold or fasten items together – they all have the same function. But some are pointed, some springy, some wrap around – they have different forms.

Example 2. Is the color (red) part of the item's *form* or *function*? Some might say red is just the *form*. The item can perform its function (hold paper together) if it is red, green, yellow, or a different color. But others may say that red is a *function* that might be used to help sort or group things based on the color. Files on robots are red, files on cars are yellow, files on gardens are green, etc.

Is it form or is it function?

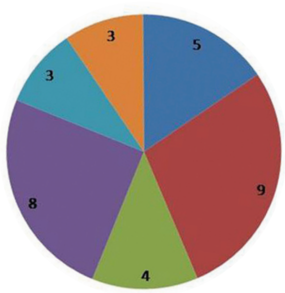
Sharing and Processing

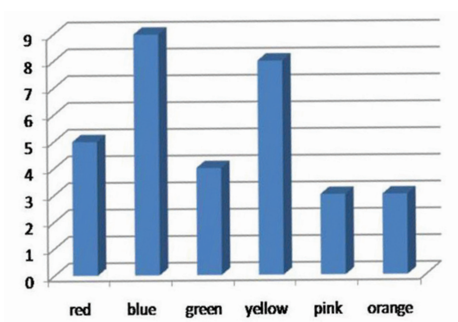
As the facilitator, help guide youth as they question, share, and compare their observations. Before they share with the group, have youth reflect on the activity in their Robotics Notebook. You may choose one of the questions below as a prompt. If necessary, use more targeted questions as prompts to get to particular points. Remember these questions are not about getting one right answer.

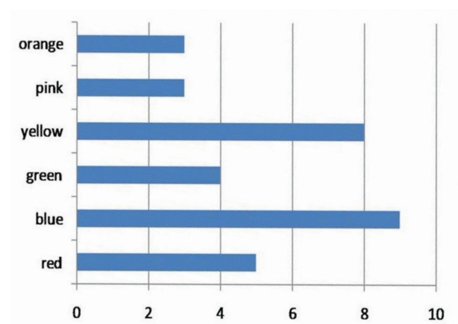
- How did you select your sorting method?
- What knowledge did you need in this sorting exercise?
- Why could it be important to sort and classify parts?
- Why are the items we sorted made the way they are made? (Is it for the function of the part or is it the look and feel of the part?)
- How does classifying help determine how parts are made or used?

Generalizing and Applying

- What are some other things that are grouped or classified in science?
- What are the form and function of some other items?
- Youth can be asked to apply sorting to things in their room or other rooms in their home, at school, or in other locations. They can share their experience with the group.
- Ask the youth to determine the form and function of other items they have at home or see around town.
- Youth also can apply what they have learned in Activity B.







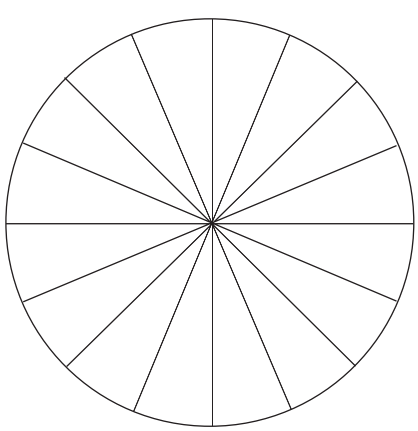
Sample graphs

Sorting 1 – Color and Shapes

Shape / Color	Square	Triangle	Circle	Rectangle	________	________	Total
Red							
Blue							
Green							
Yellow							
____________							
____________							

Graph 1 – Number by Color

Red										
Blue										
Green										
Yellow										
____________										
____________										
color / number	1	2	3	4	5	6	7	8	9	10



Pie Graph 1A - By Color

Sorting 2 – ______________________________

____ / ____	____	____	____	____	____	____	Total
____							
____							
____							
____							
____							
____							

Graph 2 – ____________________

____										
____										
____										
____										
____										
____										
____ / number	1	2	3	4	5	6	7	8	9	10

Sorting 3 – Form and Function

Item	What is its Function?	What is its Form?