Module 1: Get Things Rolling

Overview of Activities in this Module

To Learn
Activity A — Slip N Slide
Activity B — Rolling Along

To Do
Activity C — Clipmobile Design Team

To Make
Activity D — Clipmobile Build Team

Note to Leader

When two people don’t seem to get along, we say there is friction between them. What is friction? In physics, we might think of friction as a resistance to motion or movement. What affects friction? The type of surface — is it smooth or rough? Is it stationary or already moving? (If it is moving, the object has momentum.) The mass or weight of the object also can affect the amount of friction.

Try this: Rub your hands together. What do you feel? First, you only feel the surface of your palms and fingers; then they get warm. In rubbing, the surface particles change the movement or kinetic energy into thermal energy or heat that you feel in your hands.

Friction can slow down or limit the movement of objects, but friction is also a useful tool when we need traction or gripping power. What we need to find is the right amount of friction for the current use. Do we need wheels and gears that can turn freely on their axes? Do we need wheels that can grip the road to move a robot forward or up a hill? Sometimes we need to both reduce and increase friction.

Uses of friction in everyday life can be seen when we walk or ride in a car. Have you slipped in spilled water, or on ice? Have you seen a car spin around on ice because it “lost its friction”? These are examples of where we need friction.

On the other hand, friction can make it too hard to move or slide some objects. Friction also can cause a number of concerns that we should try to deal with. These include making it hard to move things by having to use more force or energy to overcome friction; losing some of our energy to heat; and ruining some objects because the heat generated by friction makes them wear out. Engineers try to make moving objects as efficient as possible; that is, they try to convert as much energy into target work as possible.

What can we do? If we need to reduce friction, we can try to use lubricants, rollers, or sliders to move objects. For more grip, we might try new tires, surfaces with grooves, rubber soles on shoes, and cushion grips on handles.
In addition to the physical constraints of friction, the design and Build Teams will also consider customer requirement constraints such as carrying capacity, cost limits, complexity, and efficiency in material usage.

**What you will need for Module 1:**

**Get Things Rolling**

- Robotics Notebook for each youth
- Trunk of Junk, see page 8
- Activity Supplies
  - Cardboard for ramp – at least one to share with the groups or one for each 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 to 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
  - Craft sticks (some with holes), about 10-15 per group
  - Toy wheels, at least four per group
  - Various kinds of tape (e.g., electrical tape, aluminum tape, duct tape, masking, and/or packing – 1 ½ to 2 inches wide, if possible)
  - Pieces of two or three different grits of sandpaper
- Toolbox
  - Scissors, a few to share with all
  - Small hacksaw (if needed)
  - Protractor to measure angles
  - Drill and bits

**Timeline for Module 1: Get Things Rolling**

**Activity A – Slip N Slide**
- Activity A will take approximately 20 minutes.
- Divide youth into small groups of two or three.
- For each team, provide a box of paper clips and cardboard ramp with various surfaces attached.

**Activity B – Rolling Along**
- Activity B will take approximately 20 minutes.
- Divide youth into small groups of two or three.
- Add to supplies from activity A: paper clips, drinking straws, coffee stirrers.

**Activity C – Clipmobile Design Team**
- Activity C will take approximately 20 minutes.
- Divide youth into groups of two or three.

**Activity D – Clipmobile Build Team**
- Activity D will take approximately 30 minutes.
- Use the same groups from Activity C, Clipmobile Design Team.
- Print play money for students to use.
Focus for Module 1: Get Things Rolling

Big Ideas

• Friction
• Underlying physical science and mathematics concepts
• Engineering Design Constraints
  – Complexity
  – Efficiency
  – Capacity
  – Cost/Budget

NSE Standards

• Form and function
• Motion and forces
• Abilities of technological design

Performance Tasks For Youth

You will explore movement and friction by testing a small box on a number of surfaces, looking at static friction and sliding friction.

You will test rolling friction by adding wheels (cylinders) or rollers as a way to overcome the overall friction of an item.

You will plan and design a vehicle to maximize its ability to coast based on considering the effects of friction. You will also consider constraints of capacity, efficiency, complexity, and costs in the design.

You will build or assemble a complex clipmobile, considering and addressing effects of friction and design constraints.

STL

• Apply the design process
• Use of technology
• Core concepts
• Transportation technologies
• Manufacturing technologies

Science, Engineering and Technology Abilities

• Collect Data
• Draw/Design
• Hypothesize
• Observe
• Predict

Life Skills

• Critical Thinking
• Keeping Records
• Sharing

Success Indicators

Youth will be able to compare and select materials based on how they may affect sliding friction.

Youth will be able to demonstrate and discuss how rolling friction requires less force than sliding friction.

Youth will design a vehicle that will roll easily and meet the constraints listed.

Youth will build a vehicle to overcome friction and other constraints to roll freely down a ramp.
Activity A – Slip N Slide

Performance Task For Youth

You will explore movement and friction by testing a small box on a number of surfaces, looking at static friction and sliding friction.

Success Indicators

Youth will be able to compare and select materials based on how they may affect sliding friction.

List of Materials Needed

- Robotics Notebook
- Trunk of Junk
- Activity Supplies
  - Cardboard ramp, about 12 inches by 36 inches – at least one to share or one per group
  - Box of paper clips (two per group)
  - Paper clips – 6-10 per group
  - Pieces of various tape (e.g., masking tape, packing tape, aluminum tape, duct tape), each piece about 10 inches long to attach to ramp
  - Sandpaper strips about 10 inches long — in fine, medium, and coarse grits — to attach to ramps
  - Protractor to measure ramp angle

Activity Timeline and Getting Ready

- Activity will take approximately 20 minutes.
- Divide youth into groups of two or three.
- Before the meeting, fasten strips of different types of tapes and/or sandpapers on the surface of the cardboard ramp so that items can slide down as the ramp is raised at one end. Depending on the size of the cardboard, you may be able to get four or five different surfaces on a ramp. On each ramp, leave a blank, uncovered strip of just the cardboard for a control run. Depending on the variety of tapes you have, you may place different types of tape or sandpapers on different cardboard ramps.
- Provide teams with a cardboard ramp, protractor, and box of paper clips.
1. Share with youth the difference in static friction of an object at rest and that of sliding friction when it starts to move. Tell youth that they will be testing some objects to see how these starting sliding friction points can be different for a number of reasons. Ask the group if they have any ideas on how to measure the angle of the ramps. Share with them that they can use the protractors and have them figure out and practice measuring the ramp angles.

2. Youth will begin by testing their control (plain cardboard). Youth will place the box at the top of the plain cardboard “track.” The youth will slowly raise the cardboard until the box begins to slide down the track. They will then record this angle and repeat the experiment two more times. This will be the control test, and the angle used for comparison. This is a good time to have the youth predict if they think certain materials will allow the box to start sliding sooner (less of an angle) or not start sliding until at a higher angle.

3. Youth will then test the different material on their cardboard ramp, comparing these angles to the angle of the control test.

### 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. Use more targeted questions as prompts to get to particular points. There is no one right answer.

• Ask each group to prepare a summary of its results and form a hypothesis about why changing the surface area had an effect on how the box would slide. Ask each group to share with everyone.

• If the data differed among the groups, discuss why that might be.

• What had the greatest effect on the sliding friction?

• What had the least effect on the sliding friction?

• Why do you think it was important to repeat the same test more than once? How many times should a test be repeated?

### Generalizing and Applying

• If you wanted to have more grip or traction (more friction), what type of tape or material could you use?

• If you wanted to reduce the friction, what type of tape or material could you use?

• Youth can apply what they have designed in Activity B.
Activity B – Rolling Along

Performance Task For Youth
You will test rolling friction by adding wheels (cylinders) or rollers as a way to overcome the overall friction of an item.

Success Indicators
Youth will be able to demonstrate and discuss how rolling friction requires less force than sliding friction.

List of Materials Needed
- Robotics Notebook
- Trunk of Junk
- Activity supplies (same as for Activity A)
  - Coffee stirrers (straws)
  - Drinking straws, different-sized diameters, if possible – two to four per group
  - Paper clips – six to eight per group
  - Cardboard ramp with different surfaces to test – one per group or some to share

Activity Timeline and Getting Ready
- Activity will take approximately 20 minutes.
- Divide youth into groups of two or three.
- Provide each team with supplies.

Experiencing
1. Share with the group that in the last activity they were exploring sliding friction, and in this activity they will be looking at rolling friction. Ask if anyone can describe what the difference might be. There are no right or wrong answers — have the youth discover through active discussion. Generally, rolling friction is with wheels or cylinders and with spheres or balls. Each of these items will have much smaller touch areas between the surfaces and that — in part — plus other factors will reduce the friction. Share that in the next tests they will be using rollers to try to get the box to move more freely down the ramp.

2. Preparation – Members will create axles and cylinder wheels using paper clips and pieces of drinking straws and/or coffee stirrer straws. The members will bend the paper clips so part of the paper clips can be mounted to the box with tape and part can hang down for an axle. Using short pieces of straws, slide them onto the paper clip axles. If there are different sizes of straws, youth might want to try each one or try putting one straw inside another. They can try one or more axles.

3. Youth will test the effect of rollers and wheels. Youth will place the box of paper clips on the control (plain — no tape or sandpaper) part of the cardboard, and slowly raise the cardboard until the box of paper clips begins to roll down. They will then measure the angle at which the box of paper clips begins to move.
4. Youth will then test the rollers and wheels on different types of surfaces, repeating the same steps as above.

5. Youth should repeat each test three times making sure their readings are accurate.

**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. Use more targeted questions as prompts to get to particular points. There is no one right answer.

- Ask the groups to prepare a summary of their results and form a hypothesis about why they rolled better or worse than in the first activity without the rollers. Ask each group to share with everyone.
- How did rolling make a difference on the different surfaces versus sliding on the surfaces?
- Share your experience in making axles and wheels (cylinders).
- What do you think would improve the axles and wheels?

**Generalizing and Applying**

- Where have you seen or heard about using rollers to move heavy loads?
- Youth can apply what they have learned in Activity C.
Activity C – Clipmobile Design Team

Performance Task For Youth
You will plan and design a vehicle to maximize its ability to coast, based on considering the effects of friction. You also will consider constraints of capacity, efficiency, complexity, and costs in the design.

Success Indicator
Youth will design a vehicle that will roll easily and meet the constraints listed.

List of Materials Needed
• Robotics Notebook
• Activity Supplies
  – A bag of “start-up” sample supplies for each Design Team. One each of the following is suggested:
    • One regular craft stick, one jumbo craft stick, one craft stick with holes
    • One regular paper clip, one large paper clip
    • One 1-inch paper brad, one 1 ½-inch paper brad
    • One binder clip
    • One drinking straw
    • One coffee stirrer (straw type)
    • One rubber band
    • One toy wheel
    • One wood skewer (dull or remove the sharp, pointed end; may cut or break in half for packing in bag)
  • Play money
  • Optional materials could include whiteboard, poster pad, or newsprint.

Activity Timeline and Getting Ready
• Activity will take approximately 20 minutes.
• Divide youth into groups of two or three.
• Print some fake paper money for students to use.
• If not using the Robotics Notebook, make copies of the Clipmobile Challenge, the Junk Drawer Supply Company sheet, and the Materials Order Form.
• Assemble packs of start-up materials for each group.
  – Fill a re-sealable bag with some materials that can be used in building the Clipmobile — one bag for each group.
  – Each bag should include some of each type of supplies available to the groups, but the bag should not include enough supplies to complete a full Clipmobile.
1. Explain to youth about the budget. They will have $45.00 to spend on materials that they will “purchase” from the materials supplier (you). Youth must learn the importance of staying on budget. For every dollar ($1) under budget, they get extra points. For every dollar ($1) over budget, they must subtract two points. In determining budget, youth cannot return any materials purchased, but get dollar points for supplies in inventory at half the value of new ones. Materials broken or unusable will not have any credit value.

2. Review with the groups the concepts of design and manufacturing elements, and of form and function (from Level 1 activities).

3. Highlight that engineers work at solving problems based on constraints in the task’s requirements. Some of those constraints will be listed in the Clipmobile activity.

4. Give limited instructions on the design task and customer requirements (constraints).
   a. Provide each team with their start-up funds ($45.00 play money).
   b. Ask each team to review the Clipmobile Challenge and the Junk Drawer Supply Company procedures (found in the Robotics Notebook or make copies to hand out to each team or a poster to share).
   c. Clipmobile Challenge (customer requirements):
      i. Design a vehicle that will roll freely down a ramp and will travel (coast) a long distance (overcome friction).
      ii. It must be able to hold (carry) a box of paper clips (capacity).
      iii. It must contain at least five different types of parts (complexity).
      iv. But it must use the least total number of all parts (efficiency).
      v. Cost target: under $35 of play money for all the parts and materials used to build one of their clipmobiles as designed.

5. Design Teams may purchase a sample bag of materials at the reduced cost of $10.00 for planning and design.

6. Allow Design Team discussion and design on how to make the vehicle. Teams may use start-up supplies during design, but this is not a build time so no tools or building during this time.

7. Have each Design Team use the Robotics Notebook to plan and draw their ideas. Groups should make sketches of their plans.

8. Based on their design plan, each team will create a Materials Order Form (MOF) of all the supplies they wish to order (purchase) for building their Clipmobile.
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. Use more targeted questions as prompts to get to particular points. There is no one right answer.

- Ask Design Teams to discuss the vehicles they have designed with the entire group.
- How do you think friction will affect this vehicle?
- How did you use axles or bearings in the vehicle?
- Based on the design criteria, which part of the vehicle design is most important?
- What design criteria has to be included?
- How did you address all of the constraints of the customer requirements?
- What other parts or supplies might make it easier to design this vehicle?

Generalizing and Applying

- Where might manufacturers have to be concerned about friction when they design a car?
- How about in designing a farm tractor or plow?
- Select an item either in the room or one commonly found and discuss constraints that might have been used during its design.
- Youth can apply what they have designed in Activity D.
Career Connection 3: Constraints

There are many elements for engineers to consider when approaching a problem. Oftentimes, there are constraints that impact the engineering design process, especially in the type of design that can realistically be built. Engineers use their creativity and resources to overcome these obstacles.

Engineers must take time into account when devising a solution, because they often work on a deadline. “Time to market” is used to describe the time needed to plan, create, test, produce, and release a new product. The timely delivery of products to people is critical for companies to profit. To minimize their “time to market,” engineers work in teams, sometimes assigned to specialized components of the overall product.

Money is another constraint that engineers face. Engineers constantly search for less expensive materials that perform similarly to their expensive counterparts. Along with the expense of resources, engineers also must consider the availability of these materials. Certain supplies are sometimes unavailable, so engineers must find replacements and alternative equipment.

The physical elements of components also pose a challenge. Engineers must use physics and mathematics to ensure that the dimensions of their device will allow it to function correctly. They must find materials with properties that best suit the design.

- What are some constraints that you face in daily life? What are some ways you have found to work within those constraints?
- What do you think are some of the constraints in building a robot? Why?
Clipmobile Challenge
Using what you have learned by exploring friction and movement, see how you can apply your knowledge for this design challenge.

Customer Requirements for a Clipmobile
- Design a vehicle that will overcome friction and roll freely down a ramp, and travel a long distance (performance).
- It must be able to hold (carry) a box of paper clips (capacity).
- It must contain at least five different types of parts (complexity).
- But it must use the least total number of all parts (efficiency).
- Cost target is to be no more than $40.00 of play money, including start-up supplies in inventory bag (budget).

Manufacturing Selection Criteria
Criteria to select the team that will be chosen to mass produce the Clipmobile:

Meeting Design Criteria (constraints)

**Capacity** – carry a box of paper clips: (Yes) 10 points; (No) 0 points

**Performance** – roll down ramp and coast: +1 point per inch – maximum 24 points

**Complexity** – various types of parts used: +2 points for each type of part

**Efficiency** – least overall number of parts: -1 point for each part used

**Budget / cost** – cost of production: +1 point for each dollar under $35.00

-2 points for each dollar over $35.00

Team Business Strength

**Capital** – dollars left from $45.00: +1 point for each dollar still in cash

**Inventory value** – value of supplies in inventory: +1 point for each dollar of value

Overall Team Score
Junk Drawer Supply Company

JDSC is the official supplier of all materials for Clipmobile design, development, and manufacturing. Thank you for using JDSC.

How to get parts and supplies:
1. The Junk Drawer Supply Company will provide each Design Team with a Materials Order Form (MOF) and a sample of the different items for sale. This sample pack of supplies will only cost $10.00 for the whole bag of supplies (over a $25.00 value of supplies — what a bargain!). These items can be used in your design process and in your building activity.
2. During the Design, complete the MOF, listing the total number of each part or item you plan to use.
3. Calculate the cost for each type of part you have ordered.
4. Add up all the costs for parts to get the total dollar amount needed to purchase all the items.
5. During the Build activity, have one of your team members take the completed MOF to the Junk Drawer Supply Company area to pay for and pick up the materials ordered.
6. The Junk Drawer Supply Company has limited operating hours and will close after all the teams have filled their orders. Make sure to order enough to build your Clipmobile, but try not to have too many extras as leftover inventory is only worth half of its cost new.
7. The Junk Drawer Supply Company is very picky and will not accept any returned parts or items.

Junk Drawer Supply Company
Clipmobile Materials Order Form (MOF)

<table>
<thead>
<tr>
<th>Item Code #</th>
<th>Item/Part Description</th>
<th>Price per Item</th>
<th>Number Ordered</th>
<th>Total Cost (Price X Number)</th>
</tr>
</thead>
<tbody>
<tr>
<td>101</td>
<td>Craft Stick – Large or small</td>
<td>$3.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>102</td>
<td>Craft Stick w/ hole – Large or small</td>
<td>$4.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>203</td>
<td>Paper Clip – Large or small</td>
<td>$1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>304</td>
<td>Brass Paper Brad – Various sizes</td>
<td>$1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>405</td>
<td>Binder Clip – Various sizes</td>
<td>$2.00</td>
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<tr>
<td>506</td>
<td>Drinking Straw – Various sizes</td>
<td>$2.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>507</td>
<td>Coffee Stirrer Straw</td>
<td>$1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>608</td>
<td>Rubber Band – Various sizes</td>
<td>$1.00</td>
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<td></td>
</tr>
<tr>
<td>709</td>
<td>Wheel – Various sizes</td>
<td>$3.00</td>
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<td></td>
</tr>
<tr>
<td>810</td>
<td>Wood Skewer – Various sizes</td>
<td>$2.00</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Thanks for using Junk Drawer Supply Company. See us first for all your robot supplies!

Grand Total:
Activity D – Clipmobile Build Team

Performance Task For Youth
You will build or assemble a complex Clipmobile, considering and addressing effects of friction and design constraints.

Success Indicator
Youth will be able to build a vehicle to overcome friction and other constraints to roll freely down a ramp.

List of Materials Needed
• Robotics Notebook
• Activity Supplies
  – Collection of parts or materials that can be used in creating the Clipmobile
  – Different sizes of paper clips, binder clips, paper brads, and clothespins
  – Craft, paint, or wood sticks
  – Various sizes of coffee stirrers and drinking straws (axles and bearings)
  – Variety of other items, including toy wheels or disks, at least four per group
  – Cardboard for ramp – about 12 inches by 36 inches in size; one or more ramps can be shared for test runs.
• Toolbox
  – No tape or glue to be used in making the Clipmobile
  – Hand drill and bits
  – Hacksaw
  – Pliers, scissors, punches, if needed

Activity Timeline and Getting Ready
• Activity will take approximately 30 minutes.
• Use the same teams from Activity C.

Experiencing
1. Review design challenge and customer requirements for the Build Teams.
   a. Build a vehicle that will roll freely down a ramp and will travel (coast) a long distance (overcome friction).
   b. It must be able to hold (carry) a box of paper clips (capacity).
   c. It must contain at least five different types of parts (complexity).
   d. But it must use the least total number of all parts (efficiency).
   e. Cost target is to be less than $40.00 of play money, including start-up supplies in inventory bag (budget).
2. Build Teams will start with the following from the Design Team activity:
   a. Start-up bag of sample supplies used in design activity
   b. $35.00 of play money start-up funds (dollars left after purchase of start-up supply bag)
   c. Materials Order Form completed in the design activity
   d. Clipmobile plans created in the design activity
3. Allow each team to go to the Junk Drawer Supply Company (JDSC) with their MOF (Materials Order Form) and play money to purchase supplies.
   a. The materials for the Build Teams will need to be organized for “sale” to the teams.
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. Use more targeted questions as prompts to get to particular points. There is no one right answer.

- What design shapes worked well?
- What design shapes did not work well?
- What are some ways these vehicles overcame or used friction to help in their design?
- What seemed to work well for axles?
- What would have to be changed to haul heavier loads?
- How did the customer constraints affect the building of the Clipmobiles?

Generalizing and Applying

- How would you get a bicycle to coast farther without peddling?
- Where on a bicycle would you want to have friction? Or less friction?
- Have groups review the data they have gathered in their Robotics Notebook from the previous activities. Ask them to develop a hypothesis about friction – what are the properties of friction?
- What are some additional constraints that you think could be placed on this build?
- Youth can apply what they have learned in Module 2, Watt’s Up.
Build Team

Clipmobile Reports

How to figure Cost of Production of a Clipmobile:

1. Take your completed Clipmobile and evaluate all the components and parts used.
2. Use the COP (Cost of Production) sheet and fill in the information.
   • List the number of each type of part used; how many wheels, how many brads, etc.
   • Calculate the cost of each type of part used in the Clipmobile.
   • Check the last column for the types of parts you used in building the Clipmobile.
3. At the bottom of the COP, calculate the totals for:
   • The total number of parts
   • The total cost of the parts used to build your Clipmobile
   • The total of the different types of parts used

You may have some parts that you did not use or parts that you cut or bent, or that broke when working on them. Sort these extra leftover parts into two stacks: one stack is good parts that could be used on a different activity, and a second stack is the broken, bent, or used parts that are not like new. Since the first stack is good as new, take an inventory (count) of them and record it on the Materials Inventory Sheet (MIS).

How to determine Supply Inventory on hand after building the Clipmobile:

1. Take the stack of good unused parts:
   • Group them by their type of part.
   • Count how many of each type and record the number or the MIS (Materials Inventory Sheet) in the “number on hand” column.
   • Calculate the value of each type of part. (Notice that those which are “used,” have value less than “new” parts.)
2. On the bottom, add up the totals for:
   • Total number of parts on hand (in inventory)
   • Total value of parts in inventory
3. Have a representative of JDSC (facilitator or leader) verify your inventory stock and your MIS sheet.
### Clipmobile Report – Cost of Production (COP)

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<th>Item Code</th>
<th>Item/Part Description</th>
<th>Price Per Item</th>
<th>Number Used in Vehicle*</th>
<th>Total Cost (Price X Number)</th>
<th>Check Items Used in This Build</th>
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<tbody>
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<td>101</td>
<td>Craft Stick – Large or small</td>
<td>$3.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>102</td>
<td>Craft Stick w/holes – Large or small</td>
<td>$4.00</td>
<td></td>
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<td>Paper Clip – Large or small</td>
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<td>304</td>
<td>Brass Paper Brad – Various sizes</td>
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</tr>
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<td>405</td>
<td>Binder Clip – Various sizes</td>
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<td>Wood Skewer – Various sizes</td>
<td>$2.00</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*include full value even if only part of an item was used, cut in half, taken apart, etc.

### Totals

<table>
<thead>
<tr>
<th>Total Parts Used</th>
<th>Total Cost of Production</th>
<th>Total Parts Used</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Clipmobile Report – Materials Inventory Sheet

<table>
<thead>
<tr>
<th>Item Code</th>
<th>Item/Part Description</th>
<th>Used Value Per Item</th>
<th>Number of Good Items Still on Hand*</th>
<th>Total Value (Price X Number)</th>
<th>Verification of Inventory on Hand</th>
</tr>
</thead>
<tbody>
<tr>
<td>101</td>
<td>Craft Stick – Large or small</td>
<td>$1.50</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>102</td>
<td>Craft Stick w/holes – Large or small</td>
<td>$2.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>203</td>
<td>Paper Clip – Large or small</td>
<td>$0.50</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>304</td>
<td>Brass Paper Brad – Various sizes</td>
<td>$0.50</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>405</td>
<td>Binder Clip – Various sizes</td>
<td>$1.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>506</td>
<td>Drinking Straw – Various sizes</td>
<td>$1.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>507</td>
<td>Coffee Stirrer Straw</td>
<td>$0.50</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>608</td>
<td>Rubber Band – Various sizes</td>
<td>$0.50</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>709</td>
<td>Wheel – Various sizes</td>
<td>$1.50</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>810</td>
<td>Wood Skewer – Various sizes</td>
<td>$1.00</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*only include complete items in good usable condition; not those cut, drilled, bent, taken apart, etc.

### Totals

<table>
<thead>
<tr>
<th>Total Parts Not Used</th>
<th>Total Value of Parts on Hand (Inventory)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>