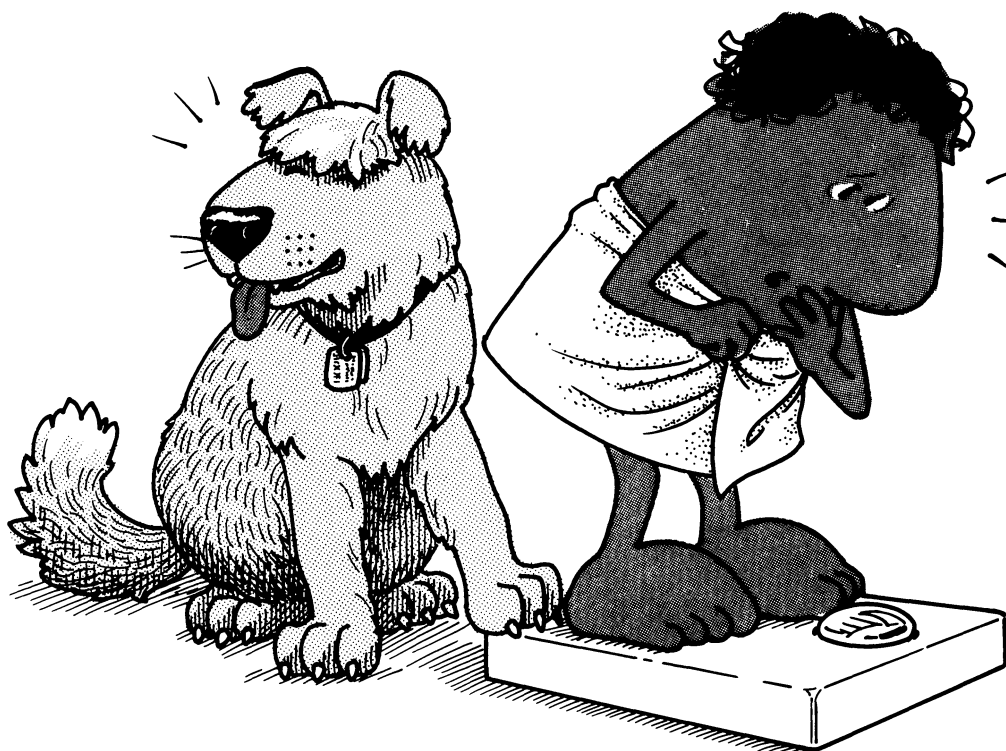


# WEIGHING



## TASK CARD SERIES

Conceived and  
written by

**Ron Marson**

Illustrated by

**Peg Marson**

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- C. Getting Ready
- D. Gathering Materials
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- F. Long Range Objectives
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## TEACHING NOTES

### CORE CURRICULUM

1. Build an Equal-Arm Balance (1)
2. Build an Equal-Arm Balance (2)
3. Build an Equal-Arm Balance (3)
4. Seeds and Paper Clips
5. A Question of Bias
6. Paper Clip Weight Standard
7. Balance Sensitivity (1)
8. Weighing Water
9. Gram Standard
10. Lightweight
11. Heavyweights
12. Spare Change
13. Balance Sensitivity (2)

### ENRICHMENT CURRICULUM

14. Coin Graph
15. Spring Scale
16. Scales and Balances
17. Going, Going, Gone
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20. Help Yourself



## REPRODUCIBLE STUDENT TASK CARDS

Task Cards 1-20  
Supplementary Pages — Balance Beams and Squares  
Graph Paper

# Gathering Materials

Listed below is everything you'll need to teach this module. Buy what you don't already have from your local supermarket, drugstore or hardware store. Ask students to bring recycled materials from home.

Keep this classification key in mind as you review what's needed.

<p><b>general on-the-shelf materials:</b> Normal type suggests that these materials are common. Keep these basics on shelves or in drawers that are accessible to your students. The next TOPS module you teach will likely utilize many of these same materials.</p>	<p><i>special in-a-box materials:</i> Italic type suggests that these materials are unusual. Keep these specialty items in a separate box. After you finish teaching this module, label the box for storage and put it away, ready to use again.</p>
<p><b>(substituted materials):</b> Parentheses enclosing any item suggests a ready substitute. These alternatives may work just as well as the original. Don't be afraid to improvise, to make do with what you have.</p>	<p><b>*optional materials:</b> An asterisk sets these items apart. They are nice to have, but you can easily live without them. They are probably not worth an extra trip to the store, unless you are gathering other materials as well.</p>

Everything is listed in order of first use. Start gathering at the top of this list and work down. (The teaching notes may occasionally suggest additional *Extensions*. Supplies for these optional experiments are listed neither here nor under *Materials*. Read the extension itself to determine what new items, if any, are required.)

Quantities depend on how many students you have, how you organize them into activity groups, and how you teach. Decide which of these 3 estimates best applies to you, then adjust quantities up or down as necessary:

**Q<sub>1</sub> / Q<sub>2</sub> / Q<sub>3</sub>**

- ├── **Single Student:** Enough for 1 student to do all the experiments.
- ├── **Individualized Approach:** Enough for 30 students informally working in pairs, all self-paced.
- └── **Traditional Approach:** Enough for 30 students, organized into pairs, all doing the same lesson.

<b>KEY:</b>	general on-the-shelf materials (substituted materials)	<i>special in-a-box materials</i> *optional materials
	<b>Q<sub>1</sub>/Q<sub>2</sub>/Q<sub>3</sub></b> (These quantities assume that every student will construct a balance.)	
	1/15/15 scissors — heavy-duty enough to cut corrugated cardboard	100 coins of each kind: pennies, nickels and dimes; students may be able to supply from pocket change, or you can substitute rice, popcorn and pinto beans already in use — see activity 14
	1/5/5 bottles white glue	.1/.5/1 cups oil-based clay — 1 cup = 1/2 lb
	4/100/100 lined index cards — 4 x 6 inch or other sizes	1/2/2 pkgs notebook paper
	1/2/2 <i>corrugated cardboard boxes at least 30 cm tall</i>	1/10/10 metric rulers
	2/40/50 straight pins — extra long work best; steel pins have wide application in magnetism modules	1/5/10 graduated cylinders — 10 ml capacity
	1/3/3 boxes paper clips — one brand only	1/1/1 source of water
	2/60/60 wooden clothespins	1/5/10 *hand calculators
	1/30/30 medium-sized tin cans	1/5/5 <i>cups clean dry gravel</i>
	1/3/3 rolls masking tape	1/5/10 size D batteries, dead or alive
	1/3/3 paper punch tools	1/10/10 meter sticks or yard sticks
	3/80/80 <i>small paper drinking cups with flat bottoms</i>	1/30/30 birthday candles
	10/150/150 light-duty rubber bands	1/5/10 pkgs matches
	1/30/30 heavy-duty rubber bands	2/60/60 <i>envelopes — legal or personal size</i>
	1/2/2 pkgs uncooked long-grained white rice	1/1/1 misc materials — see second item listed in task 19
	1/1/1 pkgs unpopped popcorn seeds	
	1/1/110/100/ pkgs pinto beans	1/1/1 <i>large bowl</i>

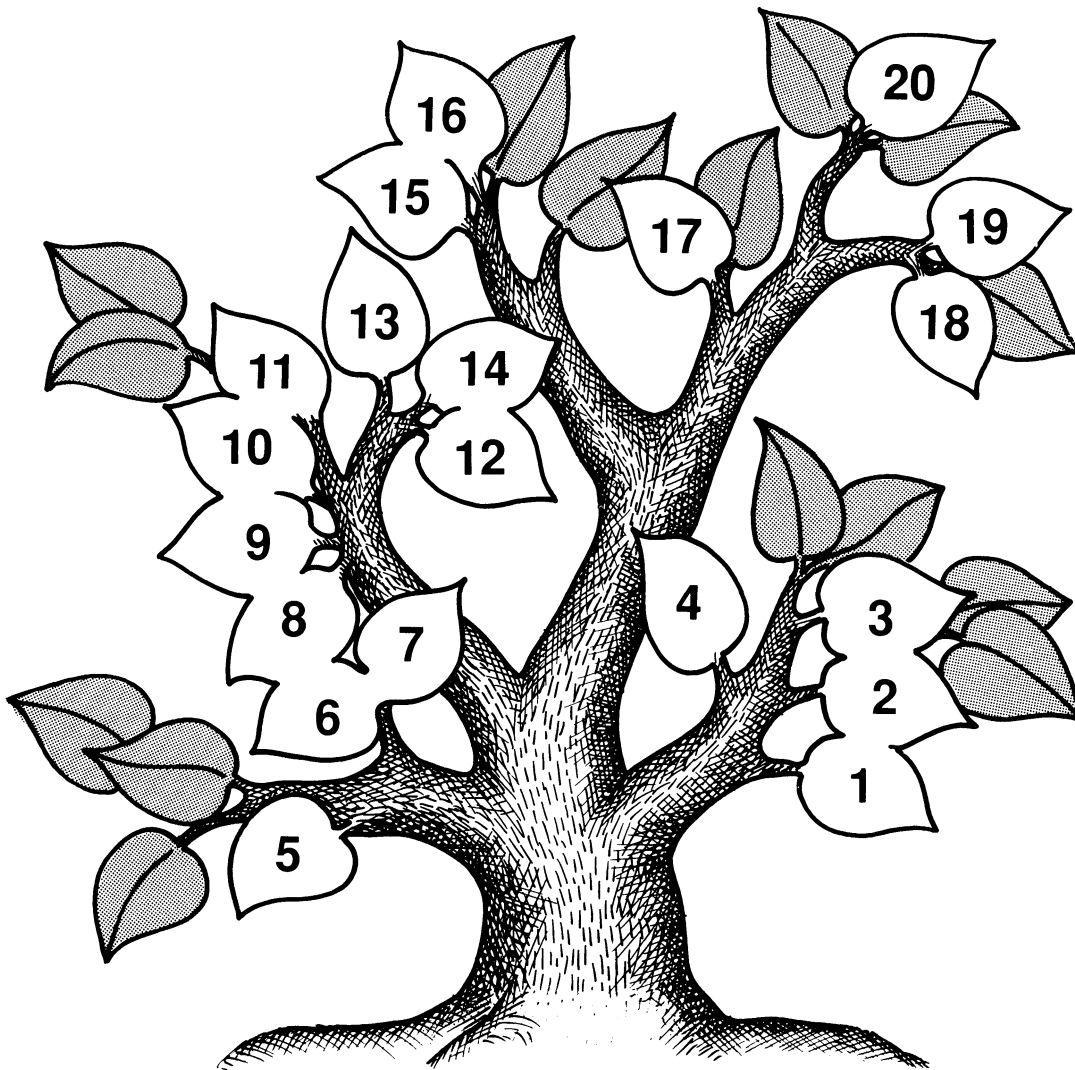
## Sequencing Task Cards

This logic tree shows how all the activities in this module tie together. In general, students begin at the trunk of the tree and work up through the related branches. Lower level activities support the ones above.

You may, at your discretion, omit certain task cards or change their sequence to meet specific class needs. However, when leaves open *vertically* into each other, those below logically precede those above, and cannot be omitted.

When possible, students should complete task cards in the same sequence as numbered. If time is short, however, or certain students need to catch up, you can use this logic tree to identify concept-related *horizontal* activities. Some of these might be omitted since they serve to reinforce learned concepts rather than introduce new ones.

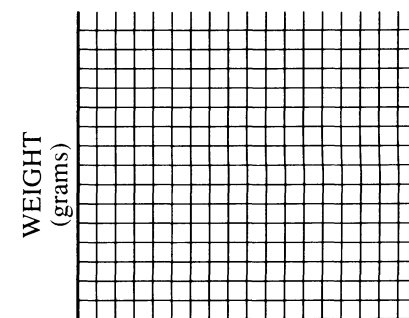
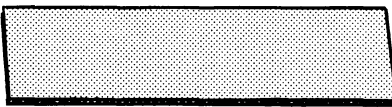
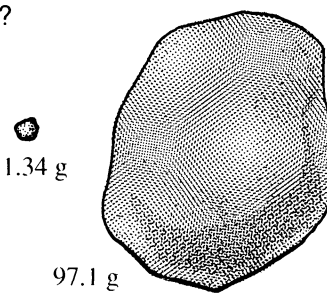
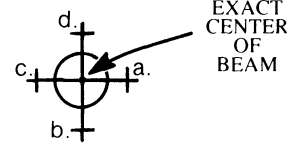
For whatever reason, when you wish to make sequence changes, you'll find this logic tree a valuable reference. Parentheses in the upper right corner of each task card allow you total flexibility. They are blank so you can pencil in sequence numbers of your own choosing.



### WEIGHING 05


# Review / Test Questions

Photocopy the questions below. On a separate sheet of blank paper, cut and paste those boxes you want to use as test questions. Include questions of your own design, as well. Crowd all these questions onto a single page for students to answer on another paper, or leave space for student responses after each question, as you wish. Duplicate a class set and your custom-made test is ready to use. Use leftover questions as a review in preparation for the final exam.

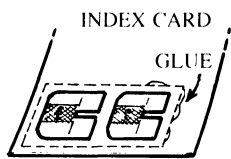
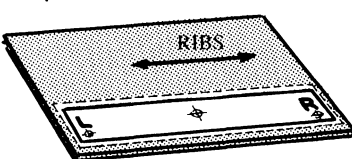
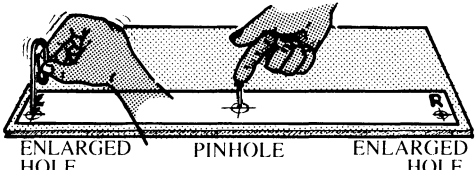
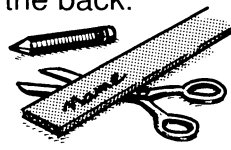
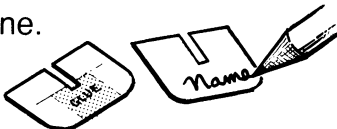
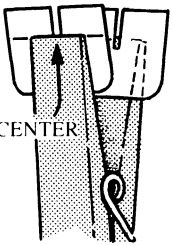
<p><b>task 1, 5</b></p> <p>When building an equal-arm balance, why is it important to punch the pivot pin through the exact center of the middle bull's-eye?</p>	<p><b>task 8-9</b></p> <p>Exactly 190 Brand-X paper clips balance 100 ml of water poured from a graduated cylinder.</p> <p>a. How much does 100 ml of water weigh in grams?</p> <p>b. How many Brand-X paper clips weigh exactly 1 gram?</p> <p>c. How many grams equal exactly 1 Brand-X paper clip?</p> <p>d. Which is a better standard of measure, the gram or Brand-X paper clip? Explain.</p>	<p><b>task 14</b></p> <p>Brand-X paper clips weigh 1.90 g each. Plot a graph that shows how the total weight of these clips increases with number.</p> 
<p><b>task 2</b></p> <p>When building an equal-arm balance, why is it important to identify the right and left cups with an "R" and an "L"?</p>	<p><b>task 10-11</b></p> <p>This much cardboard weighs exactly 1 gram.</p>  <p>a. How would you use this cardboard and a balance to fashion a lump of clay that weighed exactly 7 grams?</p> <p>b. How would you cut this cardboard to get a piece that weighed 0.15 g?</p>	<p><b>task 15</b></p> <p>Two fishermen are having an argument over who caught the heaviest fish. Explain how you might settle this argument using a rubber band.</p>
<p><b>task 3, 8</b></p> <p>How do you center your equal-arm balance? Why is this important?</p>	<p><b>task 11-12</b></p> <p>A pencil weighs 3.87 g. List the gram weights you would add to your balance to equal this weight.</p>	<p><b>task 16</b></p> <p>On Earth, a 200 gram rock weighs about 2 Newtons.</p> <p>a. What is the weight of this rock? What is its mass?</p> <p>b. How would you change the weight of this rock without changing its mass?</p> <p>c. How would you change the mass of this rock?</p>
<p><b>task 4</b></p> <p>Two paper clips balance 11 lentil seeds. What is the weight of each lentil to the nearest hundredth paper clip (.01 pc)? Show your math.</p>	<p><b>task 12</b></p> <p><i>(You need your balance and gram masses to complete this task.)</i></p> <p>Weigh a sheet of notebook paper to the nearest .01 g.</p>	<p><b>task 17</b></p> <p>Can you completely whiten your blackboard with only 1 piece of chalk? Explain how you might answer this question, using your balance and gram weights, without covering the entire board with chalk.</p>
<p><b>task 5</b></p> <p>A penny weighs 7 paper clips when placed in the left pan, but only 5 paper clips when placed in the right pan. What is wrong with this balance, and how can you fix it?</p>	<p><b>task 13</b></p> <p>A large rock weighs 97.1 g, and a tiny pebble weighs 1.34 g. Which stone was weighed with greater accuracy? Why?</p> 	<p><b>task 18</b></p> <p>How would you use a strong, flat board and a brick to determine the lightest person in class?</p>
<p><b>task 6</b></p> <p>You are given an equal-arm balance, a single paper clip, plus paper and scissors. Explain how you would use these items, and these alone, to cut a piece of paper that weighed exactly .75 pc.</p>		<p><b>task 19</b></p> <p>Invent a weight standard using string. Explain how it works.</p>
<p><b>task 5, 7</b></p> <p>This balance beam is pinned at its exact center. Suppose you now move its pivot pin first to position a, then b, then c, and finally d. In each case explain how this affects the characteristics of your balance.</p>	<p><b>task 20</b></p> <p>Hikers divide up trail mix by the handful. Is this a good standard of measure? Explain.</p>	

**Task Objective (TO)** begin building a sturdy, accurate equal-arm balance to use in all experiments that require weight measure.

### BUILD AN EQUAL-ARM BALANCE (1)



### Weighing ( )

1. Get paper patterns for 2 pivots and a beam from your teacher...  
 ...Glue 2 pivots to a piece of index card...  

- ...Glue 1 beam to some corrugated cardboard, parallel to the "ribs."  

2. Push a pin *straight* through the *exact* center of the 3 bull's-eyes. Force the end of a paper clip through both *outside* pin holes. Leave the center pin hole small.  

3. Cut out this beam and write your name on the back.  

4. Cut out the small squares, then cut out the long narrow slot in each one. Write your name on the back of one.  

5. Glue where marked. Fix to the *inside* of clothespin wings with the slots centered.  


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### Answers / Notes

1. *It is important to place this rectangle parallel to the corrugations. Beams cut with perpendicular ribs are not as strong.*



2. *This step is crucial to building an accurate balance. Make sure that each pinhole is poked exactly on the bull's-eye; that the pin is pushed straight through from an upright perpendicular position. If your students lack good eye-hand coordination, do this step for them.*

*An easier way to enlarge the end pin holes is to drill them front and back with a sharp pencil. If your students use this method, make sure they don't get carried away and enlarge the hole too much. The paper clip should easily fit the hole, but not wobble excessively.*

5. *Students may proceed directly to the next task card. The glue will dry by the time they need to use their clothespins.*

*The unfinished balance so far looks like this:*

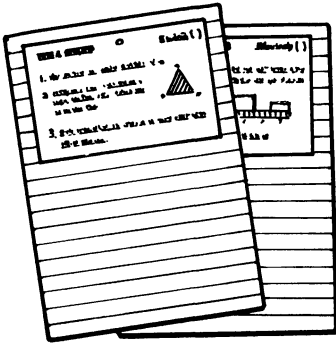


### Materials

- Cut-out patterns. Photocopy the last page in this book. The multiple patterns serve up to 5 students per page. Copy an extra page to accommodate students who spoil their patterns and need to start over.
- Scissors. These should be sharp enough and heavy-duty enough to cut through corrugated cardboard.
- A bottle of white paper glue or wood glue.
- An index card. One 4x6 card will serve 4 to 8 students.
- Corrugated cardboard. Cut cardboard boxes into strips that are somewhat larger than the 3 cm x 25 cm beam pattern itself. Remember to cut the longest dimension of each piece *parallel* to its corrugations.
- A straight pin. Extra long pins work best.
- A paper clip.

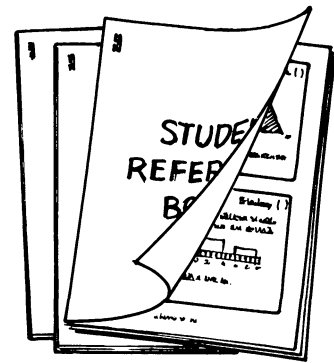
# Task Cards Options

Here are 3 management options to consider before you photocopy:

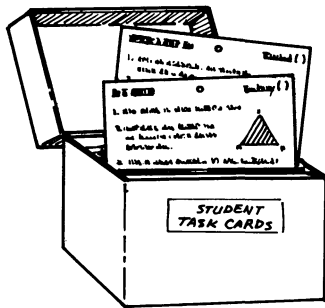


**1. Consumable Worksheets:** Copy 1 complete set of task card pages. Cut out each card and fix it to a separate sheet of boldly lined paper. Duplicate a class set of each worksheet master you have made, 1 per student. Direct students to follow the task card instructions at the top of each page, then respond to questions in the lined space underneath.

**2. Nonconsumable Reference Booklets:** Copy and collate the 2-up task card pages in sequence. Make perhaps half as many sets as the students who will use them. Staple each set in the upper left corner, both front and back to prevent the outside pages from working loose. Tell students that these task card booklets are for reference only. They should use them as they would any textbook, responding to questions on their own papers, returning them unmarked and in good shape at the end of the module.



**3. Nonconsumable Task Cards:** Copy several sets of task card pages. Laminate them, if you wish, for extra durability, then cut out each card to display in your room. You might pin cards to bulletin boards; or punch out the holes and hang them from wall hooks (you can fashion hooks from paper clips and tape these to the wall); or fix cards to cereal boxes with paper fasteners, 4 to a box; or keep cards on designated reference tables. The important thing is to provide enough task card reference points about your classroom to avoid a jam of too many students at any one location. Two or 3 task card sets should accommodate everyone, since different students will use different cards at different times.





## BUILD AN EQUAL-ARM BALANCE (1)



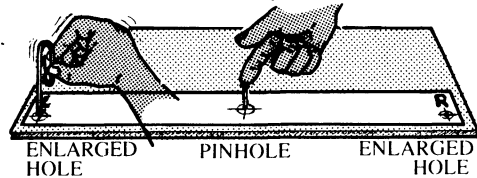
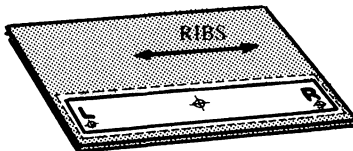
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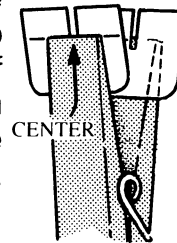
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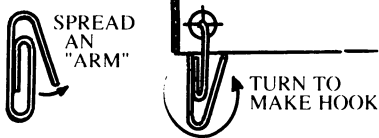
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## BUILD AN EQUAL-ARM BALANCE (2)

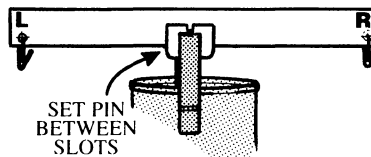


Weighing ( )

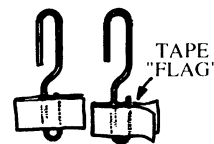
1. Pull out the "arms" of 2 paper clips just a little. Push these arms through the end holes, then rotate each clip to make a hook.



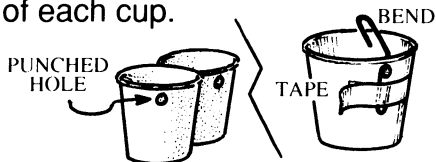
2. Stick a straight pin through the center hole. Clip your clothespin to a can and balance your beam so the pin rests between the slots.



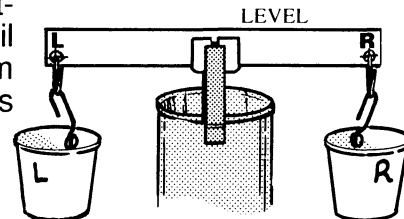
3. Unbend 2 paper clips like these. Flag the small end with masking tape.



4. Paper-punch a hole below the lip of 2 drinking cups. Push your clips through, taping each flagged end. Bend the free ends toward the center of each cup.



5. Hook each cup on the beam. Label them "L" and "R". Add tape to the bottom of the lightest cup until the beam balances level.



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