1-1-1992

# Just What is a Gram Anyway?

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# Just what is a gram, anyway?

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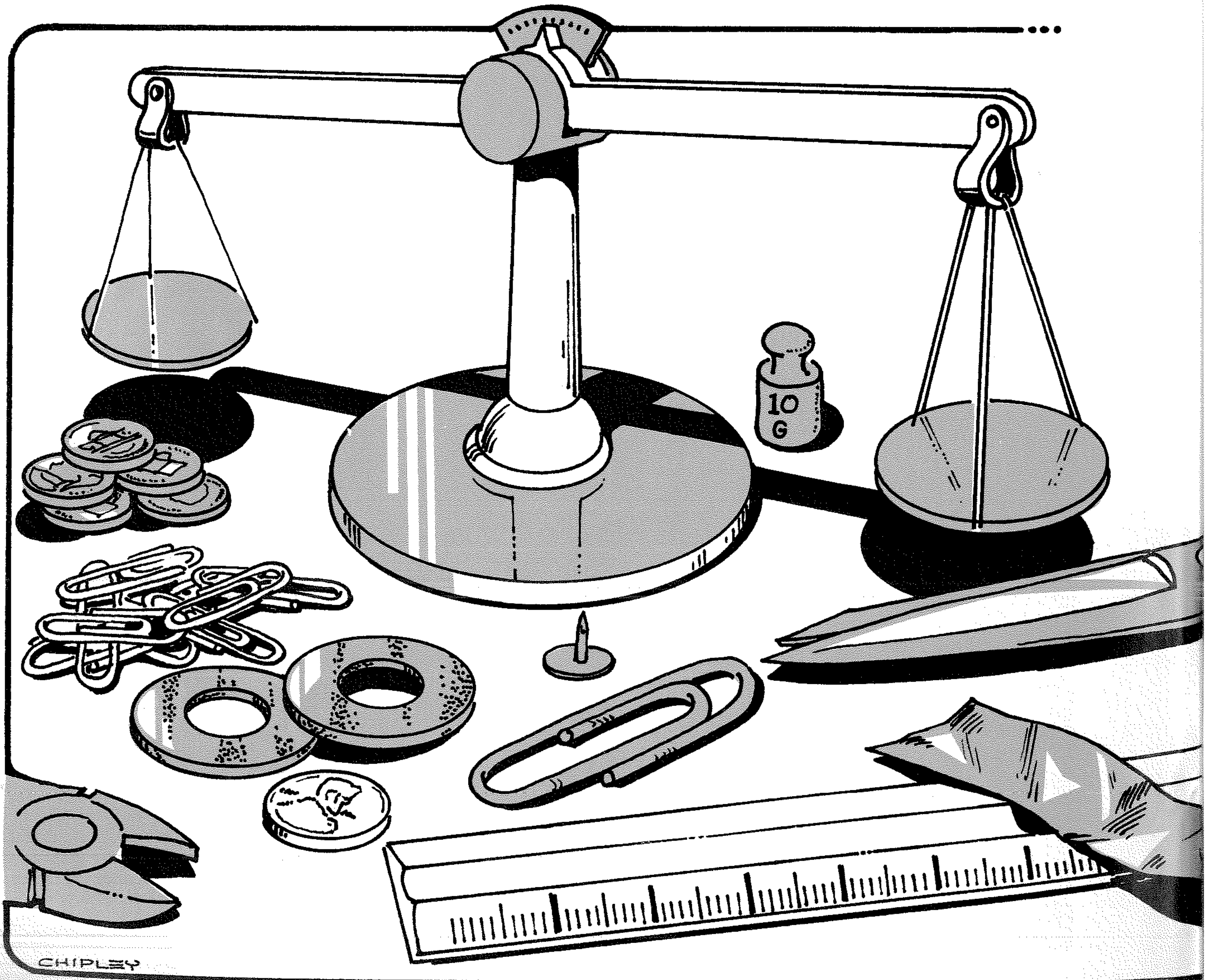

**This activity has "mass appeal" as students use paper clips, nickels, and thumbtacks to understand mass measurement.**

Art by Tom Chipley

Metersticks, graduated cylinders, balances, and spring scales cluttered the front of the classroom as we started the new unit. "You mean we have to use the metric system with these things?" groaned one student. "I hate the metric system. The meter is okay, I know it's about like a yard. We buy soft drinks in two-liter containers, so I know something about volume. But just what is a gram, anyway? It just doesn't make sense."

Whenever my class studies the metric system, mass is always the most troublesome part. Many students have difficulty conceptualizing mass measurement in terms of grams and kilograms. The English system of measurement just doesn't have any familiar comparisons for mass like it does for length and volume. Furthermore, the instruments commonly used in the science classroom to measure mass aggravate the problem further. Electronic balances and unequal-arm balances, such as the triple-beam balance, make it very difficult for students to understand the nature of mass measurement (the comparison of an unknown mass to a known mass).

Students can best come to understand mass measurement using an equal-arm (double-pan) balance, which places a known mass on one pan and an unknown mass on the other and then compares them. Since the user can actually see the comparison of these masses, the concept of mass measurement is made clearer. Unfortunately, for those who are unfamiliar with the various quantities of mass, using an equal-arm balance alone cannot solve the problem. For the unfamiliar, there still remains a resistance to learning the metric system.(1) One way to address this resistance is by directly experiencing metric mass measurement.

*Mass appeal* can help students develop concepts in mass measurement. Many students typically find this activity to be a challenging, if not frustrating, experience. One of the ways to reduce some of the frustration is to place the students in cooperative learning groups. Students exhibit many different strengths—in mechanical manipulation, mathematical calculation, and reasoning ability—as they work toward a solution. Also, groups seem to naturally exhibit division of labor. All of these benefits, when combined, make the solution to complex problems possible and fun.(2)

Students begin the activity by developing their own personal systems of mass measurement by comparing the mass of common items to standard mass units. Next, they determine the masses of several common objects using their personal mass systems. The masses determined can then be compared to those of different groups to show the accuracy (or inaccuracy) of the groups' systems. Comparisons can also be made by using standard mass sets to determine the masses of the same objects.

Again, even bright students typically consider this activity a real challenge. A hidden advantage of using this activity is that if you are short of standard mass sets, students can make their own. Sometimes, when later given a choice between using the standard masses and their own system of measurement, many students prefer their own systems. By using common materials for masses, students are able to gain a true feeling for various quantities of mass, and can then visualize length and volume. When students develop their own systems of measurement or their own measuring devices, they create valuable tools for later experiences.(3)


## References

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3. Shaw, J.M. (1983). Student-made Measuring Tools. *Arithmetic Teacher, 31*(3), 12–15.



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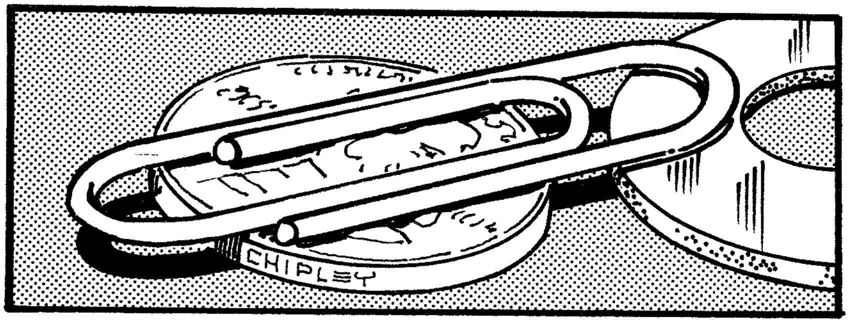
# Mass appeal



**Materials**

*(For each group)*

- Five nickels
- Ten #1 paper clips
- Two large washers
- Thumbtack
- Jumbo paper clip
- Penny
- Metric ruler
- 20 staples
- Small, 5cm-wide strip of aluminum foil
- Wire cutters (one pair for the class)
- Scissors
- Equal-arm balance
- 10g standard mass

**Procedure**

1. Using the equal-arm balance, place the 10g standard mass on one pan. By placing nickels on the other pan, find out how many nickels are needed to balance the 10g mass. Calculate the mass of the nickel. This is your new standard of measurement, so you can return the 10g mass to your teacher.
2. Determine the mass of a #1 paper clip by placing a nickel on one side of the balance and paper clips on the other side. Calculate the mass of a single paper clip. Since the nickels and paper clips are now known masses, you can use them to determine the mass of the other small objects.
3. Test your system of masses by finding the masses of the following objects: staple, thumbtack, jumbo paper clip, penny, metric ruler.
4. Compare the masses you determined with those of several other groups. Is your mass system accurate?
5. Use standard mass units and the equal-arm balance to determine the mass of the same list of objects. How do these masses compare to those obtained with the personal mass system?

*Students discover several things through this activity. They find that a nickel has a mass of about 5g and the a #1 paper clip has a mass of about 0.5g. The mass of the large washers will vary, but once students determine the mass of an individual washer, it can be labeled and used for determining the mass of larger objects.*

*For most students, finding a way to measure objects to an accuracy of 0.1g is the most difficult part. There are two basic approaches to this problem. The first is to start with a #1 paper clip (with a mass of approximately 0.5g). Students have found that by determining the overall length of the clip and cutting it into five equal parts, each part will equal the required 0.1g. For the second approach, again using the paper clip as a base, students cut a sheet of aluminum foil large enough to balance out the 0.5g mass. They then cut the foil into five equal parts of 0.1g each. These individual masses can then be folded into a square or triangular shape and marked to show their mass.*