SRC ☑

Balancing Acts

Topic **Systems (Homeostasis)**

Objectives
- Construct a model of a balanced system.
- Explore effects of changes to a system.
- Explain the center of mass of a set of objects.

Duration 30-40 minutes

Assessment Type Formative

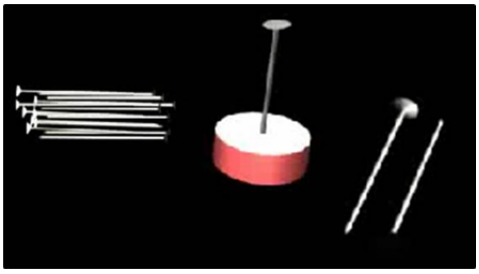
Students will operationally define center of mass by devising a balanced structure. The upright nail in the wooden base acts as a fulcrum. The complete system is comprised of many distinct, inter-related and inter-dependent, factors represented by the smaller nails. Students often overlook the fact that individual and collective, intentional and accidental, natural and catalyzed actions may change or even remove system variables. This shows how even though the model may maintain a stable form, it must respond to change to achieve overall equilibrium and that there is likely a critical limit in each case.

Set-up

In advance, prepare zip-bags of materials for distribution to each team.

Assign 2-3 students to a team.

Materials



- ☐ 1: 1-inch diameter dowel rod cut about 1 inch thick with a 16-penny nail hole in the center
- ☐ 3: 16-penny nails
- ☐ 16: 8-penny nails

Instructions

1. Make sure you have all of the necessary materials.
2. Insert one large nail into the center of the wood slice so that the nail stands upright.
3. Without using any other materials, balance all of the nails on the head of the nail in the dowel rod!
4. Sketch the arrangement of the nails when they are balanced.
5. Count how many nails can be removed (one at a time) before the structure collapses.

Notes

There are many ways to help students apply this experiential knowledge of center of mass. Using an ecosystem example, the two larger nails represent the key themes of population and sustainability. The numerous small nails represent different topics that impact on critical issues. Population is the overriding variable that most affects the system's ability to sustain itself. In the model, the larger nail serves as the base of the canopy of smaller nails to be balanced.

If you don't have stable, horizontal desks or tables, have students work on the floor to avoid accidental shaking.

Timesaver! Make sure that the vertical nail is solidly inserted in the dowel base before starting.

After one team solves the challenge, you may choose to have them demonstrate their solution so that the others have time to replicate success. Although there may be other possible solutions, the most common approach is shown here.

Discussion Questions

- Which nails were necessary for your structure to remain intact?
- Is there more than one possible solution to this challenge?
- Where was the balancing point (center of mass) in your solution?
- What real-world systems might this model represent?

Reality Check! Evaluation

- ☐ Did students 'see' a solution?
  - Was each team able to balance all 16 of the 8-penny nails on the post?
  - Did students work together to accomplish the solution?
  - Did teams appropriately share experiences (research collaboration)?
- ☐ Did students experiment with changing the structure?
  - Were they able to remove 2 or more nails from the balanced structure?
  - Did they conduct multiple trials to gain better results?
  - Did teams compare how many nails they were able to remove?
- ☐ Were students able to identify the balance point precisely?
  - Did they set up the activity properly (base nail)?
  - Did they recognize the balanced nail 'canopy' as a set?
  - Could they devise methods for removing more nails from the balanced structure?