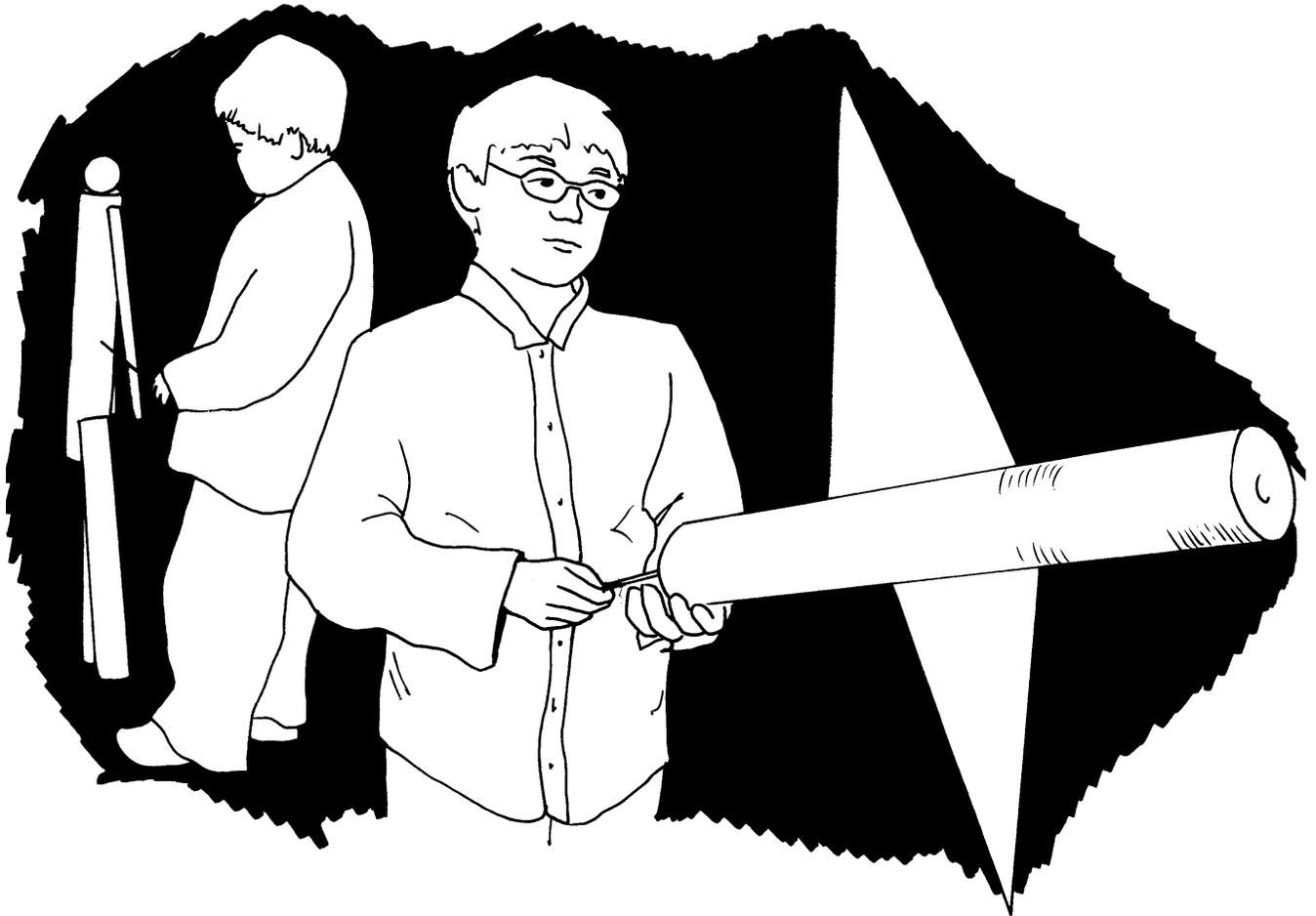


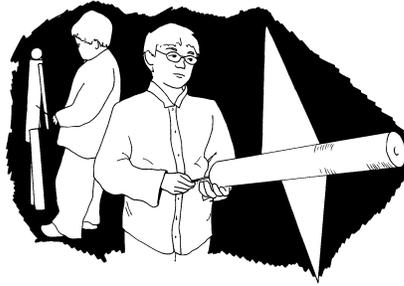
Explore It!

SCIENCE INVESTIGATIONS
IN OUT-OF-SCHOOL PROGRAMS



Balancing Toys

EDC
CENTER FOR *Science Education*



Balancing Toys

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DESIGNING AND CREATING A MOBILE

EXPLORATION 6

Discovery Question

Can you design a mobile with the materials provided?

WHAT TO DO

Think of ways that you can hang pieces from the sticks and have the whole arrangement hang from one string attached to the ceiling. See examples on the Discovery Sheet.

WHAT TO THINK ABOUT

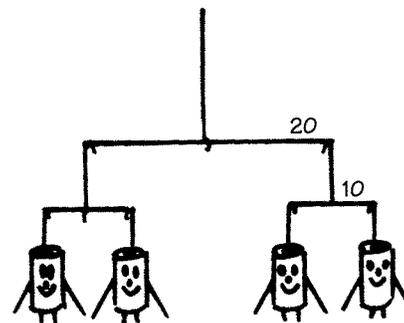
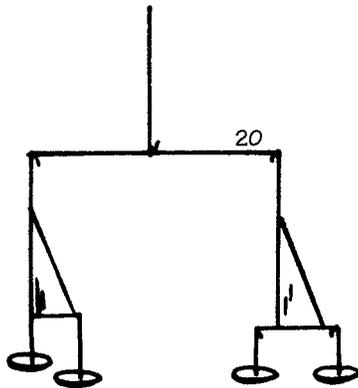
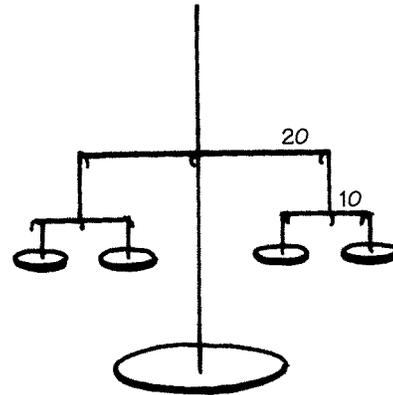
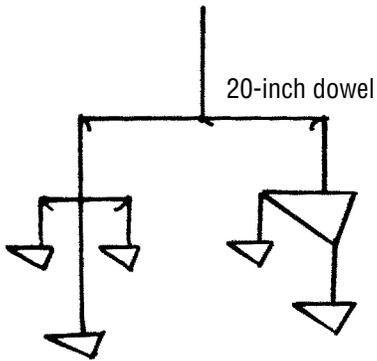
Can you have many objects hang from a stick and still have the stick remain horizontal?

DESIGNING AND CREATING A MOBILE

EXPLORATION 6

EXPLORERS' SHEET 6

DISCOVERY SHEET



DESIGNING AND CREATING A MOBILE

EXPLORATION 6

In this exploration, which is more of an arts-and-crafts activity, each child can create his or her own mobile, or a team of two or three children can create one together.

MATERIALS

For Each Team

- 1 dowel* (20 inches long)
- 2 dowels (10 inches long)
- 4 dowels (5 inches long)
- 1 scissors
- 1 Explorers' Sheet, including the Discovery Sheet

Shared

- pieces of plastic foam (from Explorations 1–3)
- pieces of triangular cardboard* (from Exploration 3; 3 different sizes)
- circular pieces of cardboard (from Exploration 4)
- string
- plastic cable ties*
- large pieces of cardboard* (at least 10 inches on a side; children can use these to create their own shapes)
- masking tape
- finishing nails*

For the Program Leader

- 1 utility knife

Additional information is available under Special Notes About Materials (page xv) for those materials noted with an asterisk ().*

PREPARING FOR THE EXPLORATION

- If you are not familiar with mobiles, study the drawings and pictures on the Explorers' Sheet.
- Try your hand at making a mobile with some of the materials suggested in the Materials list. Get acquainted with the technique of attaching string to the dowels with plastic cable ties; this is essential in the construction of the mobile. These ties were chosen because they are inexpensive and relatively easy to use. They also adjust to the diameter of the dowel, which can vary slightly from one piece to another.
 1. Slip the flat end of the tie into the slot at the opposite end (Figure 40). Do not pull it all the way closed.



Figure 40

DESIGNING AND CREATING A MOBILE

EXPLORATION 6

GUIDING THE EXPLORATION 6

2. Slide the loop onto a dowel and pull on the free end until it is tight but not extremely tight, as shown in Figure 41. Cut off the straight piece that sticks out from the loop.

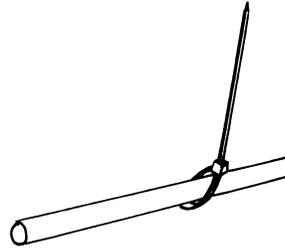


Figure 41

3. Slide the cut tie off the dowel. Cut a few inches of string and slide one end into the hole of the loop, as shown in Figure 42.

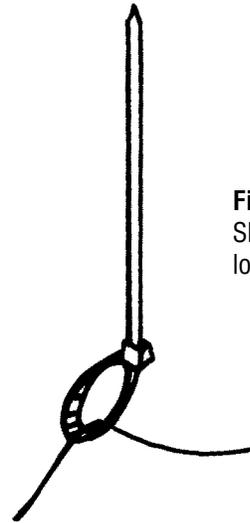


Figure 42
Slide the string through the loop of the plastic cable tie.

4. Force the loop with the string onto the 20-inch dowel. You can slide the loop along the dowel to any spot, as shown in Figure 43.

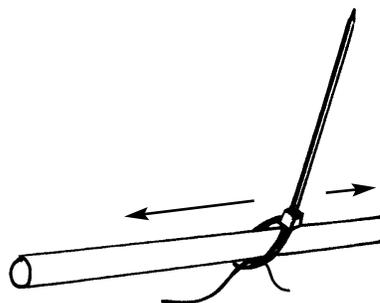


Figure 43
Make sure the string remains pulled through the loop.

DESIGNING AND CREATING A MOBILE

EXPLORATION 6

- Using the same technique, add some of the smaller pieces of dowel to the 20-inch dowel as shown in Figure 44.

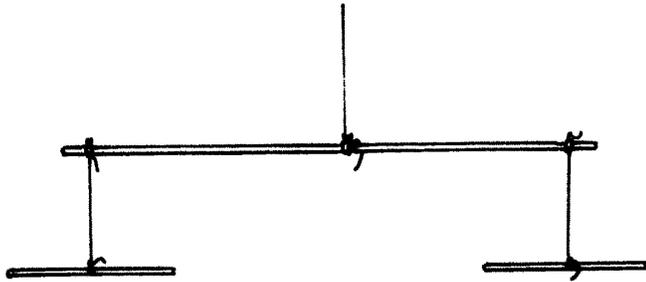


Figure 44

- Add some pieces of cardboard or other material to the dowels. You can do this by taping a piece of string to the cardboard and inserting the other end through a plastic cable tie, following the procedure just outlined. See the Discovery Sheet for some suggestions.
 - After finishing the construction, play around with it by moving the pieces into different positions. How does this change the overall configuration, or one part of the overall configuration? What happens when a nail is attached to any part of the mobile? How does this change the overall configuration?
- Decide ahead of time what will happen with the children's mobiles when they are finished. It would be useful to have them around for the next few explorations, because these will all revolve around mobile construction. Is there some ceiling space where you could hang their mobiles? It would also be nice to have their parents see their constructions.
 - Make one copy of the Explorers' Sheet for each team, including the Discovery Sheet. However, wait to pass them out until after you have explained the task at hand.

NOTE: Some of the materials used in this exploration can be recycled for use in later explorations.

INTRODUCING THE EXPLORATION

Tell the children that they will have the opportunity to design their own mobiles. Ask whether any of them have seen mobiles before.⁵

⁵ If any of the children have seen mobiles before, you could show them the listed materials and let them come up with their own designs. A whole session could be devoted to this introduction to mobiles.

DESIGNING AND CREATING A MOBILE

EXPLORATION 6

GUIDING THE EXPLORATION 6

Distribute the Explorers' Sheet to each team, including the Discovery Sheet, and have the children study the drawings of mobiles on the sheet. Explain that mobiles are sculptures that hang from above, and they usually have multiple layers, with different kinds of materials and objects hanging from these layers. The layers and objects can rotate. In some museums, there are very large mobiles that have pieces several feet across. Others are just a few feet overall. The sculptor Alexander Calder was famous for his large mobiles. He made many of them during his lifetime.

Show them the materials they will work with. Refer children to the Discovery Question on the Explorers' Sheet, and have them talk about how they think they could make their own mobiles.

Then show them the technique of using the plastic cable ties and how the string is placed in the loop of the tie, which is then slid onto the dowel.

They can work either in teams or as individuals. Before starting to work on the materials, they should first think about an overall design and make a drawing. Tell them they should try to make a mobile with at least three hanging layers.



SAFETY: When working with a mobile, children should keep it away from their own and others' faces, so that no one gets poked in the eye. It is best if they hang the mobile below the edge of the table when they are working with it.

LEADING THE EXPLORATION

First check in with each child or team to see what materials they think they will use and what kind of overall design they think they will try. Then survey the whole group to see who may be having problems mastering the technique of using the plastic cable ties and placing them on the dowels. Some children may have some initial difficulty forcing the loop onto the dowel. Show them how to do this.

If children want to cut their own cardboard into unique shapes, have them outline the shapes on the cardboard. For safety reasons, you can cut the shape for them using a utility knife.

Some children may become dissatisfied with their mobiles as they are assembling them. Take some time to talk to them about what they think the Discovery Question is asking. Do they need to start all over again, or just make some adjustments?

They will learn more about balancing and end up with a more interesting mobile if they have multiple layers instead of hanging all their pieces from the one long main piece. So, as you visit each person or team, encourage them to add several layers to their constructions. At this point every layer does not have to be perfectly horizontal. The goal is to assemble something that looks interesting and moves freely.

DESIGNING AND CREATING A MOBILE

EXPLORATION 6

As children finish their mobiles, encourage them to play around with their arrangements.

- What happens when the plastic cable tie is moved along one of the dowels? Does it change the arrangement of just that part of the mobile, or does it change the whole mobile?
- What happens if a nail is taped to one part of the mobile? How does this affect the whole arrangement?

After all the children have completed their constructions, you can hang them from the ceiling. If that is not possible, have them rest the mobiles on the tables.

LEADING THE DISCUSSION

First let each child or team show off their construction. They can explain how they started out and whether they made changes along the way. Ask them what kind of adjustments they made to each piece to get its layer to be horizontal.

Exploratory Demonstration

1. To perform some tests, choose a mobile that has three horizontal layers.
2. Tape the whole mobile to the wall or whiteboard so that it hangs freely and the lower layers can move. Pick one place on the mobile where one of the plastic cable ties can be moved. Ask:
 - What will happen if you move this tie to the left or to the right?
 - What will happen to this layer?
 - What will happen to the whole mobile?
3. After the children have made guesses and given reasons, move the tie and see what happens. Do this at several places, following the same procedure.
4. Then you can try the same procedure using nails. Tape a nail or two to one part of the mobile. How will this change the configuration?

DESIGNING AND CREATING A MOBILE

EXPLORATION 6

RATIONALE

Mobiles are popular with people of all ages. They have a special appeal because of their movement and shapes. And constructing them is an exercise in balancing. Therefore, they build on children's experiences in the previous explorations. As children assemble their mobiles, they have to think about how to get each piece to balance horizontally. They can apply some of their findings from the previous explorations. Children also have the opportunity to perform an analysis after construction and learn more about how complicated arrangements are balanced.

SCIENCE/TECHNOLOGY BACKGROUND

Children may think in a confused way about what happens when adjustments are made to the different layers. Some may think that moving a piece on the lowest layer will affect the whole arrangement. Some do not realize that adding a weight such as a nail to one side of the mobile, no matter to which layer, affects the position of the top layer as well as the one to which the nail has been added.

Doing these tests and making predictions is good practice in taking a system apart and thinking about how the parts relate to one another. Children will also see that a weight's location in relation to the balancing point determines whether that section is horizontal or not. This will be dealt with more explicitly in the next explorations.

FURTHER EXPLORATION

All kinds of materials can be hung on mobiles, and mobiles can be made into a variety of configurations. Some children may want to continue to make other kinds of mobiles. Encourage them to use other materials found around your venue or have them bring materials from home to make other kinds of mobiles.