

EQUIPMENT BUILD PLAN SOUND & WAVES

F.A.K.E.D. Resonance Pendulums

Four golf-ball pendulums of different lengths hang from a single stick. By moving the stick in tiny motions that match the period of one chosen pendulum, you can make that one swing widely while the others stay nearly still. Bruce calls it the Frequency Amplified Kinesthetic Energy Demonstration (F.A.K.E.D.): a playful, low-cost way to introduce resonance, and anyone can master it with about a minute of practice.

Written from Bruce's original workshop handout. Bruce's final review of this plan is in progress.

What it shows

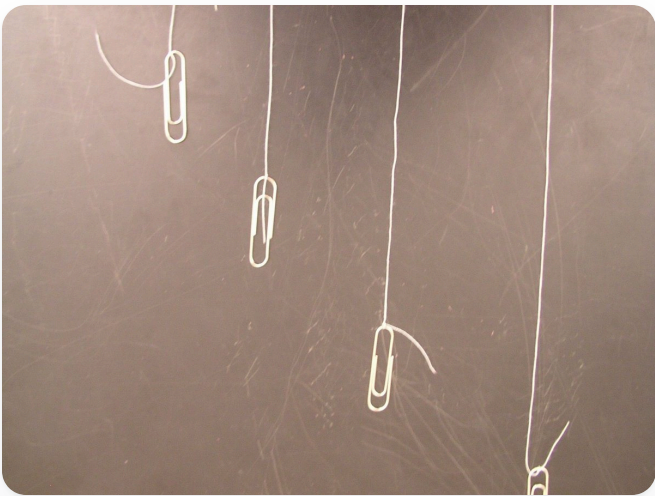
Ask the class to move just the orange ball with their minds, and watch it swing while the other three hang nearly still.

Key ideas: resonance, natural frequency, pendulum period, driven oscillation, energy transfer

Safety (Everyday care). An adult should drill the golf balls; hold each ball in a ring (such as a roll of tape) so it cannot spin or roll while drilling.

CONSTRUCTION

Build it



DIFFICULTY	BUILD TIME
Beginner	30 minutes
COST	SAFETY
About \$5	Everyday care
GOOD FOR	
Teachers, Families, Makers	

Materials

- ☐ **Golf balls** · 4
Paint or use one colored ball so it stands out; any small heavy bob will do
- ☐ **Nylon string** · About 10 ft
- ☐ **Wooden dowel** · 1, about 2-3 ft
A longer stick works better than a short one
- ☐ **Roll of electrical tape** · 1
Holds the ball steady while drilling

Tools

Drill with 3/16 in bit

Hole punch, small screwdriver or a large nail with the point cut off

Scissors

1

Steady the ball

Set a golf ball on a roll of tape so it cannot roll around.



2

Drill the hole

Drill a 3/16 in hole straight into the center of the ball.



3

Knot the string

Tie a knot in the end of a length of nylon string.

4

Push the knot in

Push the knot down into the hole with a hole punch, small screwdriver or blunted nail. The rubbery core of the ball grips the knot and holds the string.



5

Repeat

Prepare all four balls the same way. Make one a different color so the audience has a target.

6

Hang them at different lengths

Tie the strings along the dowel, spaced so the balls cannot collide. No particular lengths are needed, but make them clearly different from each other so their periods are well separated.

7

Practice

Hold the dowel level and make tiny back-and-forth movements in time with the colored ball's natural swing. Within a minute you will feel the rhythm that makes only that ball grow.

THE PHYSICS**How it works**

Every pendulum has a natural period that depends on its length, not on how heavy it is. Longer pendulums swing more slowly.

When you move the stick very slightly in time with one pendulum's period, each small push arrives at just the right moment and adds a little energy, like pushing a child on a swing. The swing grows larger and larger. That build-up is resonance.

Using it

- Tell the students to concentrate on the colored ball while you make tiny, nearly invisible motions. Then reveal the secret.
- Let students try to make each ball swing in turn and describe what they had to change.

The other pendulums have different periods, so the same pushes arrive at the wrong times for them. Some pushes add energy and others take it away, and the effects cancel out, so those pendulums stay nearly still.

- Ask why all four do not respond to the same rhythm.
- Have students time each pendulum's period and compare it with the hand rhythm that worked.
- Connect to other examples of resonance: swings, tuning forks, a singer and a wine glass, radios tuning to a station.

GO FURTHER

Variations

- Quick version: hang paper clips on threads of different lengths from a pencil or straw. It works, but a longer stick with heavier bobs is easier to control and to see.
- Bruce's first set used lead fishing sinkers as bobs; golf balls are easier for a large group to see. If you substitute sinkers, choose lead-free ones.

IF IT DOESN'T WORK

Troubleshooting

IF THIS HAPPENS

Two balls swing together

TRY THIS

Their lengths are too similar. Make the lengths more clearly different.

IF THIS HAPPENS

Everything jiggles

TRY THIS

Your hand movements are too large or too fast. Keep them tiny and match the target's slow rhythm.

IF THIS HAPPENS

String pulls out of the ball

TRY THIS

Tie a bigger knot (or a double knot) and push it deeper into the hole.

and supervise children.