

Investigations list



LIST OF PRACTICAL ACTIVITIES IN PHYSICS OF THE UNIVERSE

IS1: Forces and Motion

- INVESTIGATION 1.1 Distance, displacement, and velocity
- INVESTIGATION 1.2 Investigating pressure
- INVESTIGATION 1.3 Investigating compressive strength
- INVESTIGATION 1.4 Shape and compressive strength
- INVESTIGATION 1.5 Building bridges
- INVESTIGATION 1.6 Investigating momentum
- INVESTIGATION 1.7 Building a lander

IS6: Stars and the Origins of the Universe

- INVESTIGATION 6.1 Measuring the diameter of the Sun
- INVESTIGATION 6.2 Modeling expansion

IS2: Forces at a Distance

- INVESTIGATION 2.1 Cavendish's experiment
- INVESTIGATION 2.2 Parallax
- INVESTIGATION 2.3 Orbits
- INVESTIGATION 2.4 Computational models of orbits
- INVESTIGATION 2.5 Balloon electrostatics
- INVESTIGATION 2.6 Threading the needle
- INVESTIGATION 2.7 Observing the inverse square law
- INVESTIGATION 2.8 Polarity
- INVESTIGATION 2.9 What is affected by magnets?
- INVESTIGATION 2.10 Charges and magnets
- INVESTIGATION 2.11 Magnetic fields
- INVESTIGATION 2.12 Strength of a magnetic field
- INVESTIGATION 2.13 Making a magnet
- INVESTIGATION 2.14 Patterns in materials
- INVESTIGATION 2.15 What is used where

IS3: Energy Conversion and Renewable Energy

- INVESTIGATION 3.1 A simple power plant
- INVESTIGATION 3.2 Electricity affects a compass part 1
- INVESTIGATION 3.3 Electricity affects a compass part 2
- INVESTIGATION 3.4 Electricity affects a compass part 3
- INVESTIGATION 3.5 Electricity from magnets

IS4: Nuclear Processes and Earth History

- INVESTIGATION 4.1 Modeling the strong nuclear force
- INVESTIGATION 4.2 Making a cloud chamber
- INVESTIGATION 4.3 Half lives 1
- INVESTIGATION 4.4 Half lives 2

IS5: Waves and Electromagnetic Radiation

- INVESTIGATION 5.1 Modeling the stadium wave
- INVESTIGATION 5.2 Water waves
- INVESTIGATION 5.3 Slinky springs
- INVESTIGATION 5.4 The speed of sound in air
- INVESTIGATION 5.5 Amplitude
- INVESTIGATION 5.6 Modeling an earthquake
- INVESTIGATION 5.7 Damping a building
- INVESTIGATION 5.8 Your own double slit experiment
- INVESTIGATION 5.9 Investigating two properties unique to waves

Equipment list



The equipment list provides the material and equipment needed per group.

IS 1: Forces and Motion

INVESTIGATION 1.1:

Distance, displacement, and velocity
Per class

Measuring tape (at least 10 m)
Flag or bright fabric as starter signal
12 stop watches (watches/cell phones)

INVESTIGATION 1.2:

Investigating pressure

Per student/pair/group

High heel/stiletto shoes
Flat boots or shoes
Area of sand, mud, uncompacted soil,
or lawn

INVESTIGATION 1.3:

Investigating compressive strength

Per student/pair/group

Cardboard tube (e.g. toilet tissue roll)
Empty aluminum can
Paper cup
Styrofoam cup
Empty "tin" food can, 300–400 mL
Thick card or very thin board
Masses (range 200 g to 1 kg)

INVESTIGATION 1.4:

Shape and compressive strength

Per student/pair/group

Thin card or cartridge paper, roughly
200–300 gsm
Thick card as support for masses
Scissors
Ruler
Tape
Masses (range 10–200 g)

INVESTIGATION 1.5:

Building bridges

Per student/pair/group

18 plastic drinking straws or 36 dry
spaghetti straws
1 g Blu Tack or similar adhesive putty
30 cm string
4 x 1- g masses
1/2 sheet US letter or A4 copy paper
Computer/device and access to internet

INVESTIGATION 1.6:

Investigating momentum

Per student/pair/group

Marble and ball bearing of similar size
but different mass
Ramp
Tape measure
Carpeted area for run

INVESTIGATION 1.7:

Building a lander

Per student/pair/group

1 egg
1 plastic egg (for testing)
Tape
5 medium sized rubber bands

1 small garbage or plastic bag
10 paper clips
String
20 plastic or paper straws
Equipment can be modified with
equivalent replacements

IS 2: Forces at a Distance

INVESTIGATION 2.1: Cavendish's experiment

Per student/pair/group

2 x 1 m rulers or 1 x 2m ruler or thin
wooden rail
Tape or rubber bands
Nylon fishing line or similar
2 x large masses (5–10 kg)
2 x small masses (1 kg)
Video recorder or cell phone camera

INVESTIGATION 2.2:

Parallax

Per group of four

Protractor (a 180° is easiest to use)
Corkboard or thick card
Tape
Push pins
Plastic straw
Measuring tape

INVESTIGATION 2.3:

Orbits

Per student/pair

String (15 cm)
Two thumbtacks
Pencil
Corkboard or card

INVESTIGATION 2.4:

Computational models of orbits

Per student/pair

Computer
Spreadsheet application such as
Microsoft Excel

INVESTIGATION 2.5:

Balloon electrostatics

Per student/pair

Two balloons
Fabric (wool or synthetic)
Nylon thread or fishing line

INVESTIGATION 2.6:

Threading the needle

Per student

Sewing needle
Nylon thread and cotton thread of
same gauge

INVESTIGATION 2.7:

Observing the inverse square law

Per student/pair

Black marker pen
Balloon (not black)

INVESTIGATION 2.8:

Polarity

Per student/pair

50 mL burette
Clamp
Distilled water
Cyclohexane
100 mL beaker
Glass rod
Silk or polyester fabric or towel

INVESTIGATION 2.9:

What is affected by magnets?

Per pair/group (modify list as required)

Magnet
Aluminum foil
Pure iron
Pure copper
Paper clips
Copper penny
Nickel or dime
Stainless steel
Brass
Minerals (e.g. quartz, hematite, calcite,
pyrite)
PVC plastic
Styrofoam
Wood
Paper

INVESTIGATION 2.10:

Charges and magnets

Per student/pair

Magnet
2 x plastic rulers
Wool
Small bottle lid

INVESTIGATION 2.11:

Magnetic fields

Per student/pair

Two bar magnets
Zip lock sandwich bag
Iron filings (or powder)
Index card (or ruled card)

INVESTIGATION 2.12:

Strength of a magnetic field

Per student/pair

Sheets of copy paper
Magnet
Metal paper clip

INVESTIGATION 2.13:

Making a magnet

Per student/pair

Bar magnet
Iron object, e.g. nail or needle
Pen to mark nail center
Compass or iron objects to test

INVESTIGATION 2.14:

Patterns in materials

Per student/pair

Magnifying glass or dissecting microscope
Conductivity meter or simple circuit

Materials to test:
metal paper clip, plastic paper clip,

thin block of wood, concrete/brick, length of nylon, length of cotton, a stone, a nail, glass, natural quartz.

INVESTIGATION 2.15:

What is used where

No special equipment required

IS3: Energy Conversion and Renewable Energy

INVESTIGATION 3.1

A simple power plant

Per student/pair/group

2 x 1.5 volt electric motors

Wires

1 x galvanometer or center zero voltmeter

1 x Low voltage light bulb

Material to construct turbine blades (optional)

INVESTIGATION 3.2

Electricity affects a compass part 1

Per student/pair/group

1 x 1.5 volt AA cell

Insulated wire

Electrical tape

Cardboard

1 x compass

INVESTIGATION 3.3

Electricity affects a compass part 2

Per student/pair/group

1 x 1.5 volt AA cell

Insulated wire

Electrical tape

Cardboard

1 x compass

Clear tape

INVESTIGATION 3.4

Electricity affects a compass part 3

Per student/pair/group

1 x 1.5 volt AA cell

Insulated wire

Electrical tape

Cardboard

1 x compass

INVESTIGATION 3.5

Electricity from magnets

Per student/pair/group

Insulated wire

1 x bar magnet

1 x cardboard tube

1 x galvanometer

IS4: Nuclear Processes and Earth History

INVESTIGATION 4.1:

Modeling the strong nuclear force

Per group/class

An old click pen

2 x small neodymium magnets with central holes

NOTE: The diameter of the spring needs to be greater than the diameter of the hole in the magnets otherwise 2 washers (outer diameter bigger than hole in the magnets and inner diameter

bigger than the tube but smaller than the spring) may be needed.

INVESTIGATION 4.2:

Making a cloud chamber

Per group/class

Clear plastic cup or plastic tank

Felt to cover the base of cup/tank

Glue or other adhesive

Plasticine (if using cup)

Isopropyl alcohol (propanol)

Styrofoam tray/ice box lid

Dry ice to fill tray/ice box lid

Metal tray

Flashlight

INVESTIGATION 4.3: Half lives 1

Per student/group of two

A4 or US letter sized sheet of paper

Scissors

Ruler

INVESTIGATION 4.4: Half lives 2

Per group of two or three

30 x 6 sided dice (or up to that number as available)

IS5: Waves and Electromagnetic Radiation

INVESTIGATION 5.1

Modeling the stadium wave

Per class

1 x video recording device (e.g. phone)

Screen to play video on

INVESTIGATION 5.2

Water waves

Per student/group

1 x large plastic tray

Water

1 x plastic float (e.g. bottle cap)

1 x small piece of wood

INVESTIGATION 5.3

Slinky springs

Per pair

1 x Slinky spring

INVESTIGATION 5.4

The speed of sound in air

Per group/class

Set of tuning forks or frequency generator with speaker

1 x clamp stand and clamp

Water

1 x large beaker

1 x PVC pipe (30–60 cm)

INVESTIGATION 5.5

Amplitude

Per pair

1 x rope (at least 4 m long)

Masking tape

1 x Timer

INVESTIGATION 5.6

Modeling an earthquake

Per student/group

1 x Manila folder

1 x pair of scissors

5 x binder clips

2 x blocks of wood

Rubber bands or tape

INVESTIGATION 5.7

Damping a building

Per student/group

1 x Manila folder

1 x pair of scissors

1 x Ruler

Tape

1 x drawing compass or needle

Thread

1 x small weight (e.g. fishing sinker)

1 x block of wood

INVESTIGATION 5.8

Your own double slit experiment

Per student/group/class

1 x microscope slide painted black

1 x craft knife

1 x ruler

Plasticine or blu-tak

1 x laser pointer

INVESTIGATION 5.9

Investigating two properties unique to waves

Per pair/group

1 x square tray

1 x ruler or thin stick

Blocks of wood (3 shorter, 3 longer)

Water

IS6: Stars and the Origins of the Universe

INVESTIGATION 6.1:

Measuring the diameter of the Sun

Per student/pair

Aluminum foil

Push pin

Card (to make a frame for the foil)

Ruler

INVESTIGATION 6.2:

Modeling expansion

Per student/pair

Thick rubber band

Push pin

Different colored pens (red/blue)

Black marker