

Investigations list



LIST OF PRACTICAL ACTIVITIES IN CHEMISTRY IN THE EARTH SYSTEM

IS1: COMBUSTION AND ENERGY TRANSFER

- INVESTIGATION 1.1 Reading a meniscus.
- INVESTIGATION 1.2 Heating iced water.
- INVESTIGATION 1.3 Heat of fusion of ice.
- INVESTIGATION 1.4 Reacting HCl and NaHCO₃
- INVESTIGATION 1.5 Conservation of mass.
- INVESTIGATION 1.6 Heating cooking oil.

IS2: HEAT AND ENERGY IN THE EARTH SYSTEM

- INVESTIGATION 2.1 Measuring conductivity of different metals.
- INVESTIGATION 2.2 Measuring heat transfer.
- INVESTIGATION 2.3 Mixing water of different temperatures.
- INVESTIGATION 2.4 Temperature and diffusion rate.
- INVESTIGATION 2.5 Observing Brownian motion.
- INVESTIGATION 2.6 Exploring conduction using Energy2D.
- INVESTIGATION 2.7 Exploring convection using Energy2D.
- INVESTIGATION 2.8 The Zeroth law of thermodynamics.
- INVESTIGATION 2.9 Determining density of rocks.

IS3: ATOMS, ELEMENTS, AND MOLECULES

- INVESTIGATION 3.1 Comparing one mole of various substances.
- INVESTIGATION 3.2 Determining the molecular formula of magnesium oxide.
- INVESTIGATION 3.3 Determining the ratio of water to copper sulfate in hydrated copper sulfate.
- INVESTIGATION 3.4 The cycling of copper ions through a series of reactions.
- INVESTIGATION 3.5 Making a primary standard (Na₂CO₃).
- INVESTIGATION 3.6 Volumetric analysis of HCl.
- INVESTIGATION 3.7 Volumetric analysis of NaOH.
- INVESTIGATION 3.8 Volumetric analysis of vinegar.

IS4: CHEMICAL REACTIONS

- INVESTIGATION 4.1 Modeling bond orientations with balloons.
- INVESTIGATION 4.2 Investigating properties of matter.
- INVESTIGATION 4.3 Observing the polarity of water and cyclohexane.
- INVESTIGATION 4.4 Determining the energy content of alcohols.
- INVESTIGATION 4.5 Exothermic and endothermic reactions.
- INVESTIGATION 4.6 Measuring enthalpy change in copper sulfate.
- INVESTIGATION 4.7 Concentration and reaction rate.
- INVESTIGATION 4.8 Temperature and reaction rate.

IS5: CHEMISTRY OF CLIMATE CHANGE

Modeling activities replace standard practicals in this chapter

IS6: REACTION DYNAMICS AND OCEAN ACIDIFICATION

- INVESTIGATION 6.1 Reversible reactions with red and blue litmus.
- INVESTIGATION 6.2 Modeling equilibrium reactions.
- INVESTIGATION 6.3 Testing the pH of various substances.
- INVESTIGATION 6.4 The effect of temperature on the solubility of carbon dioxide.
- INVESTIGATION 6.5 The effect of salinity on the solubility of carbon dioxide.

Equipment list



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

IS 1: Combustion and Energy Transfer

INVESTIGATION 1.1

100 mL measuring cylinder

INVESTIGATION 1.2

100 mL beaker
Balance
Thermometer
Tripod
Stopwatch
Bunsen burner

Crushed ice

INVESTIGATION 1.3

Polystyrene cup
Bunsen burner
Thermometer
Stirring rod
Balance

Ice cubes

INVESTIGATION 1.4

50 mL measuring cylinder
100 mL conical flask
Thermometer
Filter paper (any will do)
Balance

50 mL 1.0 M HCl solution
2 g sodium hydrogen carbonate (NaHCO₃)

INVESTIGATION 1.5

50 mL measuring cylinder
100 mL conical flask
Balloon
Balance

50 mL 1.0 M HCl solution
2 g Sodium bicarbonate

INVESTIGATION 1.6

100 mL beaker
Heating plate (hot plate) or Bunsen burner
Tripod
Thermometer
Stopwatch

50 mL vegetable oil

IS 2: Heat and Energy Transfer in the Earth System

INVESTIGATION 2.1

Moldable wax
Clamp stand and clamp
Bunsen burner
Steel rod
Copper rod
Aluminium rod
Stopwatch

INVESTIGATION 2.2

Large beaker (~250 mL)
Small beaker (~50 mL)
Thermometer
Insulated box or insulation

50 mL cooking oil

INVESTIGATION 2.3

2 x 500 mL beakers
Thermometer

INVESTIGATION 2.4

2 x 250 mL beakers

A few crystals of potassium permanganate (KMnO₄) or food coloring

INVESTIGATION 2.5

Needle
Micropipette and tip
Coverslip
Light microscope

Milk or oil

INVESTIGATION 2.6–2.8

Computers and online access to Energy 2D software
<http://energy.concord.org/energy2d/index.html>

INVESTIGATION 2.9

Balance
Large graduated cylinder

Selection of rocks (e.g. volcanic, sedimentary)

IS3:

Atoms, Elements and Molecules

INVESTIGATION 3.1

6 x petri dishes or
6 x filter paper (any will do)
Balance

Sodium chloride (NaCl)
Sulfur (S)
Copper chloride (CuCl₂·2H₂O)
Iron oxide (FeO)
Carbon (C)
Glucose (C₆H₁₂O₆)

INVESTIGATION 3.2

Crucible and lid
Balance
Tripod
Clay triangle
Bunsen burner
Tongs

Magnesium ribbon (10 cm)

INVESTIGATION 3.3

Crucible and lid
Balance
Tripod
Clay triangle

Bunsen burner
Tongs

6 g hydrated copper sulphate

INVESTIGATION 3.4

Filter paper (any will do)
Balance
2 x test tubes
Rubber cork
Delivery tube
Clamp stand and clamp
Glass beaker (big enough to fit the test tube)
Bunsen burner
100 mL beaker
Glass stirring rod
Steel wool or sandpaper
Large iron nail
Buchner funnel
Drying oven (optional)

2 g copper II carbonate (CuCO₃)
Limewater
80 mL 1 mol/L sulfuric acid solution

INVESTIGATION 3.5

Small beaker
250 mL volumetric flask
Glass funnel
Dropper

1.3 g anhydrous Na₂CO₃
Distilled water

INVESTIGATION 3.6

100 mL beaker
25 mL pipette
250 mL volumetric flask
50 mL burette
Clamp stand and clamps
4 x 100 mL conical flasks

50 mL 1 mol/L HCl solution
Na₂CO₃ solution (prepared in investigation 3.5)
Methyl orange indicator
Distilled water

INVESTIGATION 3.7

100 mL beaker
250 mL volumetric flask
25 mL pipette
Balance
50 mL burette
20 mL pipette
Clamp stand and clamps
4 x 100 mL conical flask

50 mL 1 mol/L NaOH solution or 1 g NaOH
80 mL standardized HCl solution
Phenolphthalein indicator

INVESTIGATION 3.8

50 mL burette
Clamp stand and clamps
25 mL pipette
100 mL volumetric flask
4 x 100 mL conical flask

50 mL standardized NaOH solution
25 mL vinegar (any will do)
Phenolphthalein indicator

IS4: Chemical Reactions

INVESTIGATION 4.1

4 x balloons
Marker pen

INVESTIGATION 4.2

11 x watch glasses
11 x 50 mL beakers
Conductivity meter
Stirring rod
Test tube
2 x deflagrating spoon
Bunsen burner
Small heat resistant pad or glass plate
Glass jar

1 g sodium chloride (NaCl),
1 g magnesium (Mg)
1 g magnesium sulfate ($MgSO_4$)
1 g sulfur (S)
1 g iron (Fe)
1 g copper (Cu)
1 g copper sulfate ($CuSO_4$)
Distilled water
Ice
1 mL cyclohexane (C_6H_{12})
1 g quartz or glass (SiO_2)

INVESTIGATION 4.3

2 x 50 mL burettes
100 mL beaker
Glass rod
Silk cloth or polyester towel

50 mL distilled water
50 mL cyclohexane

INVESTIGATION 4.4

Balance
Alcohol burner
Soda can (empty)
Thermometer
Ring stand
Wire gauze or clamp stand
Ring clamp and clamp
Stopwatch

Methanol (CH_3OH)
Ethanol (CH_3CH_2OH)
Propan-1-ol ($CH_3CH_2CH_2OH$)
Distilled water

INVESTIGATION 4.5

3 x 25 mL beakers
Watch glass
Thermometer

Sodium hydroxide (solid)
Ammonium chloride (solid)
1 M HCl solution
1 M NaOH solution
Ammonium thiocyanate (solid)
Barium hydroxide (solid)
Distilled water

INVESTIGATION 4.6

Styrofoam cup
100 mL measuring cylinder
Thermometer
100 mL 0.1 mol/L copper sulfate solution
Zinc powder

INVESTIGATION 4.7

5 x 50 mL measuring cylinders
5 x test tubes
Colorimeter
Stopwatch

Bleach (sodium hypochlorite, NaClO)
Food coloring

INVESTIGATION 4.8

3 x boiling tubes
Ice bath
Water bath (50°C)
3 x 250 mL beakers
Thermometer
Stopwatch

45 mL 0.1 mol/L potassium permanganate solution
45 mL 0.5 mol/L oxalic acid
90 mL 4 mol/L sulfuric acid
Distilled water

IS6:

Reaction Dynamics and Ocean Acidification

INVESTIGATION 6.1

2 x test tubes
Red litmus paper
Blue litmus paper

0.1 M HCl
0.1 M NaOH

INVESTIGATION 6.2

2 x 1 L minimum beaker or basin
100 mL beaker
50 mL beaker

INVESTIGATION 6.3

Watch glasses (or spotting tile)

0.1 mol/L hydrochloric acid (HCl)
0.1 mol/L nitric acid (HNO_3)
0.1 mol/L ethanoic acid (CH_3COOH)
0.1 mol/L citric acid ($C_6H_8O_7$)
0.1 mol/L sodium hydroxide (NaOH)
0.1 mol/L ammonia solution (NH_3)
0.1 mol/L sodium carbonate (Na_2CO_3)
0.1 mol/L sodium hydrogen carbonate ($NaHCO_3$)

Distilled water
pH paper

INVESTIGATION 6.4

Water bath or basin
Measuring cylinder
Clamp stand
Funnel
Alka Seltzer tablets (or similar effervescent tablets)

Cold water / warm water (~45°C)