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UA94/6/2/14 Science Notebook

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THE
ATLAS SCIENCE TABLET
FOR
Laboratory Notes and Drawings

School
Year
Pupil
Room
Instructor

ARRANGED BY EMANUEL R. BOYER.
Teacher of Sciences, Chicago High Schools.
(Revised Edition)

Manufactured and Published by
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1024-1026 VAN BUREN ST.
CHICAGO
TO THE INSTRUCTOR.

The experience of most science teachers has revealed the fact that as a rule beginners in attempting to give an accurate account of their own observations in writing or drawing, are in a large measure helpless for want of a definite aim or an understanding of what is required of them and how to do it.

While it is recognized that science teachers naturally differ in the method of carrying out the details of their work, yet it is believed that it will be helpful to the pupil—an economy of his time and effort—it the features which characterize scientific description and drawing in general, be clearly pointed out and impressed at the beginning. It is believed that the following suggestions to pupils can be indorsed by most teachers of Biology and that these suggestions will aid the inexperienced science pupil.

SUGGESTIONS TO PUPILS.

Concerning Notes:
1. The laboratory notes or descriptions should embody only such facts as have been gathered from your own observation and study of the object. Any collateral notes written up from lectures or reading should not be mingled with those of your own observation, but should be kept distinct and under separate headings.
2. The facts observed in the laboratory or field may first be gathered on "scratch paper" as temporary notes and subsequently be written on the Note Tablet in permanent form; but such temporary notes should be promptly written up and not be allowed to accumulate.
3. The permanent notes or descriptions should be an original account of your own observation. The statements should be scrupulously accurate and free from figurative expression and rhetorical embellishment; the style should be simple, clear and concise.
4. Frequent reference should be made to the drawings and diagrams which accompany the study so that these and the notes may be mutually helpful.
5. The ability to give a clear and accurate account of one's own observations and conclusions is an essential in scientific work, and is also of much value in practical life.

Concerning Drawings and Diagrams:
1. A drawing is intended to show the size and shape of the object, and the proportions and relations of its parts. In case the drawing is to be smaller or larger than the object, the size of the object may be indicated by symbols, as for example "X 1/4" or "X 4," the former signifying that the drawing is reduced to one-fourth and the latter that it is enlarged to four times the actual size of the object.
2. A diagram is intended to show only the relation of the parts of the object, and does not pretend to represent their size, shape or structure.
3. In making either drawing or diagram, do not aim at anything ornamental or artistic in effect. Let your aim be to represent clearly and distinctly certain facts of your observation.
4. First carefully examine the object and have definitely in mind what you wish to show in your diagram or drawing and omit everything else.
5. Decide in advance what view of the object you wish to represent and the size of your drawing. If the object be an animal or a plant, represent it, whenever practicable, in its most natural position.
6. With a fine-pointed hard pencil,* make a very faint outline of the object, step by step comparing the drawing with the object, and omitting at first all details. See that the proportions are correct, revising your drawing if necessary, by substituting new lines and ignoring or erasing old ones.
7. The details may now be worked. Avoid much shading and omit it altogether whenever possible. If the drawing is merely an outline it may be improved by tracing its lines and the effect of shading may be produced by tracing more heavily those lines which are opposite the direction of the light.
8. In diagrams no shading is needed, but in many cases the use of flat tints, produced with colored pencils or preferably water colors, is very helpful.
9. All drawings and diagrams should be accurately and intelligibly labeled. Generally it is also desirable that the parts of the drawing, especially the parts of a diagram, be designated in a way that is convenient of reference.

E. R. B.

*The grade of pencil should be determined by the kind of finish or surface of the drawing paper, but in general for science work, the harder grades of lead, say from 4H to 6H are preferable.
TWENTY YEARS AGO
[A NEW VERSION]

(Written by A. C. Burton and Dedicated to K. L. Varney.)

I've wandered to the country Tom, I've sat beneath the tree,
Upon the schoolhouse playground that sheltered you and me;
But none were left to greet me Tom, and the old farms just so,
Alive with briars and sassafras as twenty years ago.

The grass is not so green Tom, the gullies wider grown,
Are washing all the soil away and the better boys have flown;
The master sleeps upon the hill where many briars do grow,
They're thicker Tom, and larger too than twenty years ago.

The old school house has not changed much the benches are replaced,
But patent desks are cut and scarred as those we once defaced.
The same old bricks are in the wall the bell swings to and fro,
To call a smaller, younger crowd than twenty years ago.

The boys were sitting on a rock beneath the same old tree,
It seems the love of play has died since you played there with me;
The larger children go to town, the school improves too slow,
The old school spirit is not there of twenty years ago.

They do not test the seed corn Tom, they plant no cover crops,
Tobacco is their hope for cash and when the market drops
The children have no Santa Claus, the tenants stand no show,
And how they need the cheap wild game of twenty years ago.

The women look so worn, dear Tom, they struggle up the hill,
And carry water from the spring the washing tubs to fill;
Of course the men could build a ram and pump it from below,
But they just take it out in talk as twenty years ago.

The old graveyard upon the hill is growing, growing on,
So many boys of our old class are long since dead and gone;
The people do not clean their teeth, they sleep with windows low,
And drink those worthless patent cures as twenty years ago.

You know the trees around the spring, they're all in cross-ties now,
The children scarce could find a place to swing beneath a bough;
The stables are too small Tom, to give the cows a show,
And scrub hens roost in old peach trees as twenty years ago.

But Tom, they say that up the creek, affairs are moving some,
They're learning how to lime, and feed, and make the money come;
They build good roads and put out trees and vines along to grow,
And people do not treat their dead as twenty years ago.

And now I hope our neighborhood will catch the new soul fire,
And clean up all the country and kill out every briar;
For when the end of time shall come on that resurrection day,
I'd hate to rise to meet my Lord in the briar patch o'er the way.
Ex. 1

**Purpose:** To determine the laws of vibrating strings.

**Materials:** Piano wire, boards, pulley, bucket, water and three tuning forks.

**Drawing:**

1. Adjust bridge until note given by wire was in tune with C fork.
2. Set the same with C fork.
3. Use two wires and by adding water to one bucket, found the same notes, the other wire being only half as long.

Data: Length of C wire = 48 cm.

... C = 24 ...

... G = 49 ...

Conclusion: The ratio of lengths is 1 to 2.

Ex. II.

Purpose: To find wave length of a note of a tuning fork.

Materials: Large and small glass tubes, rubber tubing, beaker, and water.
Operation: Sounds folk over large tube while raising and lowering breaker until the right sound found.

Data: 1st resonant length = 6 cm
      2nd ... = 82 ...

Conclusion: Wave length = 72 x 2 = 144
Ex. III.

Purpose: To find magnetic fields of bar magnet.

Materials: Board with a groove, paper, bar magnet, pencil and iron filings.

Drawings:
Operation: Pin a piece of paper over your bar magnet, sift iron filings over the paper but not too thick. Tape the paper gently and the filings will be found to have arranged themselves in lines running in symmetric curves from one pole around to the other. Hold a compass needle in a number of positions over the board. It will be found that the compass points in opposite direction to lines of filings.
b. Reverse the knitting needle so that the second end occupies exactly the position originally occupied by the first. We found the S pole 1° stronger than the N pole.

c. Stroke the needle once more with the magnet precisely as at first and again bring it to the same position. The deflection increased 3°.

d. Continue to stroke the magnet in the same way until it is saturated. It was saturated at 300
Part II of No III.

Purpose: To find magnetic field about certain combinations of horse shoe magnets placed in various ways, filings and paper.

Materials: Board with magnets

Drawings

No I
No. IV.

Ex. IV.

Purpose: To find molecular nature of magnetism

Materials: Knitting needle, magnet and iron filings, steel rod.

Operation: And Conclusion:

Low stroke knitting needle with magnet

Using the north pole and found that it repelled the north pole of compass needle
II. Effect of iron on a saturated magnet.
   a. Drop needle on the floor and again test its strength. It lost 10°.
   b. Strike the needle a number of sharp blows against the knob and test again and found it had lost 10°.
   c. When magnetized consists in a particular arrangement of the molecules of the needle, the effect of an external force would displace them.

III. Effect of breaking a magnetized needle.
   a. Magnetize a darnin...
needle, then dip it into a box of iron filings and no appreciable magnetism is found in middle b. Broke in two and test by means of a compass and then by means of iron filings. The results are the same as before.

c. These experiments lead us to believe that a magnet consists of rows of molecular magnets arranged end to end

IV. Effects of heating a magnet

a. Heat damaging
after being magnetized and it will lose its magnetism.

Heat at again to redness and then transfer to a position between the poles of a magnet. Let it remain until cool and then test and it will be found to be deflected 20°.

V. a. Hold a piece of an unmagnetized needle between the poles of a horseshoe magnet and have it vigorous ly without allowing it to touch the magnet. It becomes magnetized.
Turn it end for end. Replace it between the poles of the horse shoe magnet and tap again. The poles will change.

c. Remove the steel rod from a tripod and hold it nearly vertical in a north and south plane. Strike the upper end three or four short blows with a hammer and then test the two ends of the rod for magnetism. The same end is the N pole.

d. Repeat with the ends of rod reversed.
the same end is also the N. pole.

Drawing: From all of the above experiments one can see the following picture regarding the operation which goes on within a bar of iron when it is magnetized.
**Purpose**: To find action of dilute sulphuric acid on copper and zinc strips.

**Materials**: Strip of copper and zinc, sulphuric acid, copper wire, no. 31 German silver wire, tumbler, water, and vanescope, copper and zinc sulphate.

**Drawing**
Operation and Conclusion:

Fill tumbler with very dilute sulphuric acid. Introduce a strip of zinc and bubbles form, which are hydrogen. Repeat the ex with copper and a very slight action was observed. Press strips together and bubbles of hydrogen will form on copper.

III. Fasten strips in clamps. Connect with galvanoscope which had been placed in north and south plains. Dip the metal in acid and the needle...
b. Disconnect the wire from the galvanoscope and touch them to your tongue. They were found warm.

iv. Take a fresh and dry copper. Put it in a clamp and connect to the 25-turn coil of galvanoscope. Insert about a cm. of No. 3½ German silver wire. Immerse the copper in acid. The needle of compass was deflected 80°. Short circuit the cell for half a minute by holding a short strip of copper in contact with...
with both the copper
and zinc plates. Re-
move the copper strip
and the compass
needle did not re-
turn to its old val-
ue. This is polariza-
tion.

VDried copper plate
filled tumbler half
full of saturated
solution of copper
sulphate and poured
zinc sulphate into
a small porous tsp.
which was then
placed in the tum-
blet placed in the liquids. The zinc
going into the zinc
sulphate and the
copper into the copper sulphate. The need be deflected 22°. After being short circuit ed it returns to its former value. The Daniell cell is non polarizing.

VI. Replaced the Daniell with a dry cell. The current sent through three feet of No. 36 German silver wire did not weaken in twelve minutes. After being short circuit ed it did not return to its old value. It is a polarizing cell. After the cell has rested a few
a few minutes it returns to its former deflection. I tried the same in permanent with a simple cell. There was a difference of 12° in the deflection. This is due to the fact that there is nothing to remove the hydrogen bubbles.

Ex VI

Purpose: To observe the magnetic effect of a current.

Materials: Dry cell and commutator.

Operation and conclusion
(1) Connected a dry cell with commutator so that current flowed from south to north over needle. All wires were copper, 10 ft. long. Needle was deflected 30° W.

(2) Turned the top of commutator through 90°. This reversed the current. The deflection of compass needle was reversed to 30° E.

(3) Place the compass above the wire. Needle was deflected to 60° W. Reversed current
and deflection of needle changed to 30°E.
(2) Hold the wire so that the current flows vertically downward just in front of N pole of compass, then cause the current to flow upward past the same pole.
Needle reversed 15°E.
(3) Hold the wire so that the current flows from west to east over the middle of the needle. It has no effect on the needle.
III As iron passed a
current from a cell over the compass from south to north keeping the wire as close to the face of the compass as possible. Needle was deflected 15° E. Passed wire beneath compass. Reflection is increased to 70° E. Because the magnetic lines were going in the same direction.

Placed both sides of loop above compass. It had no effect on the needle, because the magnetic lines were going
in opposite direction
o) hooped the wire
several times around
the compass so the
plane of the coil was
north and south.
Deflection increased
with each turn
until it reaches 70°
then it ceased to in-
crease.
Ex VII

Purpose: To find magnetic properties of coils carrying currents.

Materials: Dry cell, helix, nail, V wire commutator and magnet.

Drawings:

helix.
Operation and conclusion:

Having current arranged as in last experiment, formed a close helix. By use of a magnet, found...
the helix to be a magnet.

b) By means of commutator reversed the direction of the current and the poles of the helix were reversed. If put a nail thru the helix and found poles to be much stronger.

c) Reversed the current and the poles were reversed.

e) Wound wire carrying current around V wire in such a way that marked end was N pole. It repelled
north pole of compass and attracted south pole.

Ex. VIII.

Purpose: To observe principle of the O'Arsonval galvanometer.

Material: Cell, commutator, O'Arsonval and galvanometer.

Operation and conclusion:

Hung a coil of about 115 turns of No 32 copper wire between the poles of a horse shoe magnet, so that coil is parallel to the line joining the poles. Passed current from cell.
Ex. IX

Purpose: To observe electromotive forces of various metals.

Materials: Simple cell with zinc lead, copper, carbon, and aluminium, galvanoscope, water, sulphuric acid, and a solution of sodium chlorate, sodium carbonate.
Operation and conclusion.

1. To one of the terminals of the 100 turn coil of the galvanoscope connect small coil of German silver wire, the resistance of which is about 50 ohms. Completed the circuit and
found needle to be de
lected to little plate
almost out of liquid
and there was a
very slight change
changed plates for
narrower and moved
them as far apart
as possible, then
move them together
there was no change.
The distance apart
has no effect but the
greater the area the
greater the effect.
This replace the copper
plate of with a lead
plate, also used zinc
with carbon and
zinc and aluminium
with copper with
The following results were obtained:
gold - copper + deflected 13
... carbon ... 5
... lead ... 15
... aluminium ... 10°

When placed gold by a lead plate:
lead + copper + deflected 0
... aluminium ...
... carbon ...

Gold and copper have the highest E.M.F.

Used the same apparatus but changed liquids
I found the deflection in dilute sulphuric acid to be 0°E. in common salt, 10°E, sodium carbonate 7°E, and in water 3°E.
The EMF is affected in magnitude by the electrolyte.

IV (a) Connect the high resistance circuit to the terminals of a single cell and the deflection was 10°.

(b) Connected the two similar cells in series and the deflection was 10°. The deflection is greater when connected in series than in parallel.

V. Used a Daniel cell and moved compass away from cell until
its needle deflected 10°. Replaced it with dry cells and deflection was 25°.

Ex. X.

Purpose: To prove Ohm's law.

Material: Dry cell, galvanoscope, German silver coil, commutator and bridge.

Operation and conclusion.
1. Connected dry cell to terminals of high resistance galvanoscope coil that was 50 ohms. Silver coil. Deflection was 40° C.

2. Connected two cells in series joined to same circuit. The deflection was increased to 70°. Doubled amount of resistance. Was reduced to 50°.

Next pass current from a Daniell cell through the commutator high resistance balance coil of galvanoscope and 50 ohms german silver coil.
Deflection was 10°E.
Reversed current by means of commutator. Deflection was 10°E.
Doubling the circuit all being joined in series. Deflection was 15°E. Current was decreased by doubling resistance.
Connected a 12-cell to ends of a meter of no. 30 gnosil silver wire mounted above a meter stick. Connected one end of the high resistance coil to winding.
Shortened the wire between the two terminals to about six. It glowed red hot, showing that energy of the electric current was transformed into heat energy.

Drawing:

```
  DRY CELL  DRY CELL
```

Ex XII

Purpose: To show principles of the arc light

Materials: Two cells and two pencils

Drawing:

[Diagram of two dry cells connected]

Operation and Conclusion:
Connect the two cells.
Insert the pencils in the circuit so that the pencil points were part of the circuit. Held them ino
the points just bare
head not touch.
The current contin-
ued to flow as was
shown by the light
given off.

Ex XIII

Purpose: To find the relative resistances of copper, iron, and German
silver by the fall of potential method.

Materials: Insulated Cu. wire No. iron wire No. 30, silver
wire No. 30, dry or dan-
ned cells, galvanoscope
and Wheatstone
bridge.

Operation

Wind up into a coil
3 m of no. 20 insulated cu. wire. Attach one end of it to binding post E. Between binding posts E and H stretch about 20 cm of no. 20 enameled wire. Connect terminals male of cell B to points G and D. Then join terminals of high resistance coil of potentiometer to indicator, indicating the fall of potential through copper coil C. Read deflection of galvanometer.
scope needle.

b. Connect to E the end of the galvane
scope terminal which
was below at (a) and
move the other ter-
minal along your
wire toward H until
the P.D between E
and the point touch-
ed is the same as
that between (a) and
E or until deflection
is same as at first
find how many


times the resisting
force iron wire ex-
ceeds that of the wire
of the same length
and diameter.
Data:

- A boxwaxoscope needle deflects 65° E.
- The length of iron wire = 40 cm
- Silver = 9

Part II

Purpose:
To measure an unknown resistance by means of Wheatstone bridge.

Operation:
- Stretch no. 30 silver wire between A and C as in Fig. 5.
- Place a meter stick beneath it and...
Then connect a simple or dry cell to the terminals a and b. Between the binding posts a and b, insert some known resistances. Between b and c, insert the same coil of 30 cm wire. Connect binding post at m one terminal of a D'Arsonval galvanometer. Touch the free terminal of the galvanometer at a number of points along the wire a c until you find that point at which galvanometer...
shows no deflection.
In some way measure
and the resistance of
exactly 30
iron wire and calculate
from the result the
resistance of 30
of such a wire 3 m
long.
(c) In same way measure
the resistance of
exactly 30 cm. no 30
German silver wire
and compute from
the results the re-
sistance of such a
wire 3 m long. Record
the percent of dif-
ference between this re-
sult and that found
in no 1
Drawing:

Data Part II

Conclusion: The results of 13 cm of iron wire and 6 cm of German silver wire = 3 cm wire resistance of copper to new silver = 1.1.87

Ex. XIV.

Purpose: To determine the resistance of a galvanic cell.

Materials: Cell and voltmeter
Operation: Connected a cell with a single line of heavy copper wire and to a middle binding post of the galvanoscope.

Data:

Deflection 10°

Distilt water out of acid gradually.

Deflection 10°

Conclusion: The size of plates does not affect the EMF.

Part II: Push the compass away from the single turn until deflection is 10°.

Data: Make as second cell.
and record its strength.

2. And connect in series. Deflection was 14°.
3. Connect in par. Deflection was 10°.

Part III

Data

- Insert about a meter of no 24 copper wire and a meter of no 3 0.5 wire into the circuit of a Dan cell. The deflection was 16°.
- Insert in place of the meter of no 3 0.5, enough of some wire to reduce the deflection to its former value.
Drawing:

**H₂SO₄**

**Data:** The bubbles appeared at the cathode or minus plate.

**Conclusion:** The H₂SO₄ broke into two parts, H₂SO₄ went to the other.

**Part II**

**Electroplating**

**Purpose:** To electroplate.
Material: Cell, Cu so4, clips, and coins.

Operation: Dip into solution and hold for about 2 minutes.

Conclusion: Coins become covered with a cu plating. The Cu will collect on the cathode and the SO4 will go to the anode.

Ex XVII

Purpose: To make a storage bottom.

Material: Dry cells, simple cell, lead plates, 2 resistance boxes, 2 compasses, 2 galvanometers.
Explanation of drawing:

V = Voltmeter
A = Amperes
R + R' = Resistance boxes of 100 ohms each
M and m = Bottom of dry cell
Operation: Connect simple cell to both meters. Then resistance box. Deflection was 1 volt.
Now replace ca. and zinc plates with ph. plates no 8 M/1
seven.
Next connect the

mains of battery

with resistance

box and ammeter
to simple cell. Do

de
deflection of ammeter

30°, voltmeter 40°. Now

shot circuit resist

ance box at R. Pb

will form on plate

b. Replace the plat

es in the acid and
take away the

sheet from R. The
deflection was 45°

18. Disconnect at H

and Pb from battery.
and touch them together. I reflected the current is opposite what it was when battery was running. Both the voltmeter and ammeter will fall while the storage battery was discharging.

Conclusion: That chemical energy is stored up by placing PbO₂ on the Pb. plates.

Ex XVIII

Purpose: To prove that angles of incidence equal angles of reflection
Material: Mirror, block of wood and pins.

Operation and conclusion

Attached mirror to block of wood and set it on edge so
so that the line BC coincides with edge
set a pin at B again
at the face of the
glass. Set another
pin at P, placed up
so as to sight along
BP. Set another
pin in this line
of sight. Removed
off axis, drew perpendicular
drawn to BC and
corresponded pins.
Measured angles
of incidence and
reflection and found
them equal.
II. Drew line AC and
set pin at P. Drew
lines along straight
reflection of P. Re-
moved mirror and
prolonged lines. Found
lines met at P.
Found XP to = XP
'OK'.

Ex. XIX.

Purpose: To find ratio of the
velocities of light in
air and glass.

Materials: Plate of glass prisms,
nucleus and paper.

Drawing:
Operation and Conclusion.

The arcs \( R, R' \) show the difference in speed in air and glass which is about this ratio \( \frac{i}{i} \).

ExXX

Purpose: To show the critical angle of glass.

Material: Glass prism

Drawing
Conclusion: The critical angle of glass changed as the source of light is changed.

Ex XXI Part II

Purpose: To determine the focal length of lens.
Material: Lens.
Operation: Hold lens until a perfect image is found.

Part III

Purpose: To determine the focal length of lens, pins and mirror.

Drawing:
Conclusion: The pin is reflected the same size but is inverted.

Ex XXII.

Purpose: To find magnifying power of a simple lens.

Material: Lens and meter stick.

Drawing:

Conclusion: Magnifying power of lens is 11.9.
Ex XXIII

Purpose: To show the astronomical telescope.

Material: Lens, clamp, and reading stems.

Drawing:

Operation and conclusion:
Put two marks on a board and then look through the telescope and mark where they
appears to be. We found three inches distance between line when seen through the telescope. We also found that the magnifying power of this telescope to be 6 1/2 times.

**Ex XXW**

**Purpose:** To show the compound microscope.

**Materials:** Lens, ruler, clamp and paper tube.

**Conclusion:** Magnifying power about 34.6 times.
Ex. XXV.

Purpose: To show reflection of light.

Material: Glass prisms.

Diagram:
Conclusion: The greater the amount of glass the light passes through the greater will be the reflection.

OK

Results good.

Remind very nice.

WFA
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