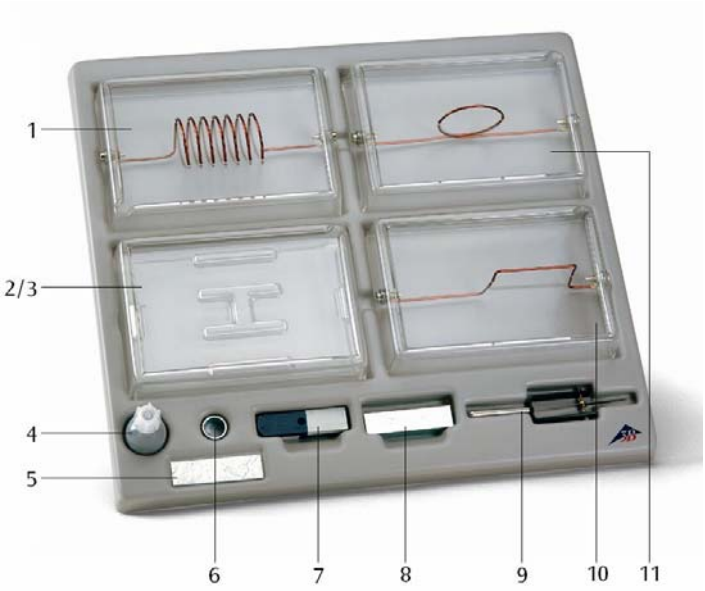
3B SCIENTIFIC® PHYSICS

Set of Apparatus for Displaying Magnetic Fields U8491790

Instruction sheet

10/07 ALF



1 Cylindrical coil on box made of Plexiglas
2 Magnet support base with guide studs on box made of Plexiglas
3 Plexiglas box with smooth surface
4 Scattering bottle with iron filings
5 Flat soft iron bar
6 Soft iron ring
7 2 Permanent flat bar magnet
8 2 Soft iron bars
9 Magnetic needle with holder
10 Straight conductor on box made of Plexiglas
11 Ring-shaped conductor on box made of Plexiglas

1. Safety instructions

Currents of approx. 12 A – 15 A are required to demonstrate magnetic field distribution of current carrying conductors.

- It is recommended that the power source be switched off immediately once the lines of the-magnetic force field become visible. (Danger that the copper leads are damaged due to the high current.)
- Do not touch the current carrying conductors with your fingers.

2. Description

The set of apparatus for displaying magnetic fields is used to illustrate magnetic field distribution of permanent magnets and current-carrying conductors. Experiment topics include among others: magnetic flux lines of bar and horseshoe magnets, magnetic screening, magnetic induction, lines of force of electromagnetic fields of straight conductors, ring-shaped conductors, cylindrical coils and electromagnets.

The equipment kit includes 5 Plexiglas boxes as well as 7 additional accessories (see point 2.1). The Plexiglas boxes used to scatter iron filings on is designed with a recess so that after use the iron filings can easily be refilled into the storage bottle. All of the components are arranged in a componentshaped premoulded storage tray. The equipment kit is also well suited for use on a daylight projector.

2.1 Scope of delivery

1 Straight conductor mounted on Plexiglas box
1 Ring-shaped conductor mounted on Plexiglas box
1 Cylindrical coil mounted on Plexiglas box
1 Magnet pad with guide studs on Plexiglas box
1 Plexiglas box with smooth surface for scattering materials on
2 Soft iron bars
1 Flat soft iron bar
2 Permanent flat bar magnets
1 Soft iron ring
1 Magnetic needle with holder
1 Scattering bottle with iron fillings
1 Pre-moulded storage tray

3. Technical data

Connections:	4 mm safety sockets
Plexiglas boxes:	185 x 125 x 40 mm^3
Storage tray:	430 x 380 x 25 mm^3
Weight:	approx. 1.5 kg

4. Operation

Additionally required:
Power supply approx. 15 A,
e.g. DC power supply, 0 – 16 V /0 – 20 A U117361

- For the experiment you need to pour a thin even layer of iron filings on the Plexiglas box.
- When performing the experiment with a daylight projector place the Plexiglas box on this and adjust the setting until the image is sharp.

To demonstrate the magnetic field of a current carrying conductor, electrical currents of approx. 12 A – 15 A are needed.

- The voltage should be increased slowly starting from 0.
- It is recommended that the voltage source be switched off immediately after the lines of the magnetic field become visible. (There is the danger that the high current could damage the copper wires.)
- To enhance the formation of the magnetic field it might prove useful to softly tap your finger against the Plexiglas box.
- After completing the experiment pour the iron filings back into the storage bottle and clean the Plexiglas box.

5. Sample experiments

5.1 Permanent magnets

5.1.1 Bar magnet

- Place a flat bar magnet on the H in the middle of the magnet rest.
- Scatter iron filings over the smooth surface of the Plexiglas box, place on top and gently knock against it.
- After the magnetic field lines have formed, demonstrate the distribution of magnetic flux using the magnetic needle.

5.1.2 Magnetic flux lines between two magnetic poles, N and S

- Place 2 flat bar magnets in the H in the middle of the magnet rest so that they attract each other but do not slide up to each other.
- Scatter iron filings over the smooth Plexiglas box and place it on top and knock against it gently.

Between the magnetic poles N and S densely packed flux lines form which are almost straight at the center and bend more and more, the further out they are.

- Demonstrate the outer flux lines using the magnetic needle.

5.1.3 Magnetic flux lines between two like magnetic poles

- Place 2 flat bar magnets in the H in the middle of the magnet support base so that the two poles with same polarity are facing each other.
- Scatter iron filings over the smooth Plexiglas box and place it on top and then gently knock against it.

No interlocking flux lines form between the like poles.

5.1.4 Horseshoe magnet

- Place 2 flat bar magnets to the left and right on the magnet support pad so that the magnetic poles are antiparallel.
- Add on one side a soft iron bar magnet so that the magnets together form a horseshoe magnet.
- Scatter iron filings onto the smooth Plexiglas box, place it on top and then tap it gently.
- After the magnet field lines form use the magnetic needle to demonstrate the magnet flux lines of the horseshoe magnet.

5.1.5 Magnetic shielding

- Assemble a horseshoe magnet as described in the experiment point 5.1.4.
- Place the soft iron ring in the empty space between the poles of the horseshoe magnet.
- Scatter iron filings onto the smooth Plexiglas box, place it on top and then tap it gently.

There is no magnetic field visible within the iron ring. These follow a path through the iron and the space within the iron ring remains free.

5.1.6 Magnetic induction

- Place a flat bar magnet on the H in the middle of the magnet pad.
- Position the soft iron bar on the magnet so that it only covers about half of it and the soft iron bar still protrudes into the middle.
- Scatter iron filings onto the smooth Plexiglas box, place it on top and then tap it gently.
- Demonstrate the polarity using the magnetic needle.

The arrangement behaves like a single bar magnet. At the free end of the soft iron bar, a pole has formed with the same polarity as the covered end of the bar magnet.

5.2 Electromagnetic fields

5.2.1 Straight conductor

- Scatter iron filings on the box with the straight conductor so that only the approximate surface around the vertical current-carrying conductor passing through the box is covered.
- Connect up the voltage source.
- Switch on the power and gently tap the Plexiglas box.
- Immediately switch off the power after the magnetic field lines have formed.

Ring-shaped field lines form around the conductor. These become weaker with increasing distance.

Explanation of Fleming's right-hand rule: if the thumb of your right hand is pointing up in the direction of the current, your fingers point in the direction of the magnetic field.

5.2.2 Ring-shaped conductor

- Carry out the experiment described under point 5.2.1 but with the ring-shaped conductor.
- Demonstrate the magnetic field using the magnetic needle.

Ring-shaped magnetic field lines form similar to the ones with the straight conductor. These lines are symmetrical to the center of the conductor loop.

5.2.3 Cylindrical coil (solenoid)

- Conduct the experiment as described under point 5.2.1 but this time use the cylindrical coil.

A comparison of the magnetic flux lines with those of the ring-shaped conductor shows that the current-carrying cylindrical coil constitutes several current carrying conductor loops added together.

5.2.4 Electromagnet

- Place a soft iron bar acting as a core into the cylindrical coil.
- Scatter iron filings on the Plexiglas box, switch on the power and gently tap against the box.

The electromagnet forms magnetic flux lines, which are most concentrated at the ends of the bar shaped electromagnet.