Guided Exploration: AR Model of a Solenoid

Group ID:		Date:
Student Name		
Members present		

Objective

To explore and visualize the magnetic field lines around a solenoid using an Augmented Reality (AR) simulation.

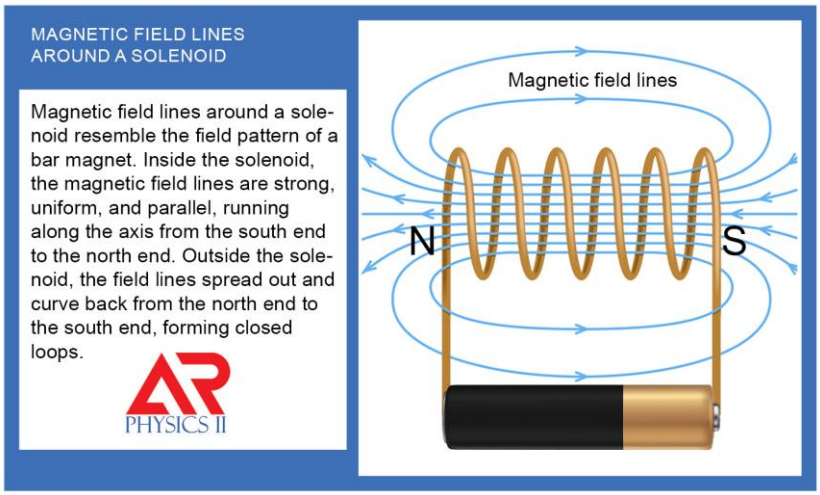
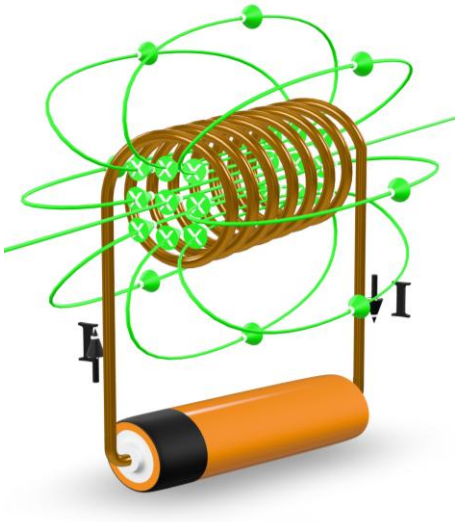


Figure 1: AR marker showing the magnetic field pattern around a current-carrying solenoid

Part A: Getting Started with the AR Solenoid



1. Launching the Model
   - Open the AR app.
   - Scan the above marker
   - Move around to view the model from multiple angles.

2. What you should see
   - A current-carrying solenoid with the direction of current clearly indicated
   - Magnetic field lines around the solenoid and through the center

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Part B: Guided Exploration and discussions

3. Properties of the Magnetic Field Lines

- ☐ Observe the current carrying solenoid from multiple viewing angles
- ☐ Examine the direction of the magnetic field lines relative to the current flow
- ☐ Pay close attention to the cross (×) and dot (•) symbols on the arrowheads, as they indicate direction for both the current and the magnetic field lines.
- ☐ Rotate and examine the solenoid so that you are facing the vertical wire segment where the current is directed upward in the. Based on this orientation, which direction do the magnetic field lines point inside the solenoid, and which direction do they point outside?

- ☐ Which rule explains the relationship between the direction of current flow and the magnetic field?

Think Pair Share

While observing the AR model of the solenoid, imagine wrapping your right hand around the coils so that your fingers follow the direction of the current. Then extend your thumb along the axis of the solenoid. In which direction is your thumb pointing, and what might that indicate about the direction of the magnetic field inside the solenoid? As you continue exploring the model, observe how the magnetic field lines behave both inside and outside the solenoid. How do their direction and spacing compare? What might this suggest about the field's strength in different regions? Discuss your observations with a partner, comparing how each of you applied the right-hand rule

Part C: Applying Knowledge (Near & Far Transfer)

1) Which rule is used to determine the direction of the magnetic field in a solenoid?

a) Fleming's left-hand rule
b) Fleming's right-hand rule
c) Right-hand grip rule
d) Lenz's law

2) According to the right-hand grip rule for a solenoid, which part of the hand indicates the direction of the magnetic field inside the solenoid?

a) Thumb
b) Index finger
c) Middle finger
d) The four curled fingers excluding the thumb

3) When viewing the end of a solenoid, if the current appears counterclockwise, what is the direction of the magnetic field inside the solenoid?

a) Into the solenoid (away from you)
b) Out of the solenoid (toward you)
c) Tangent to the coils
d) Radially outward

4) The magnetic field pattern of a solenoid is most similar to which object?

a) A straight wire
b) A charged ring
c) A bar magnet
d) A single loop

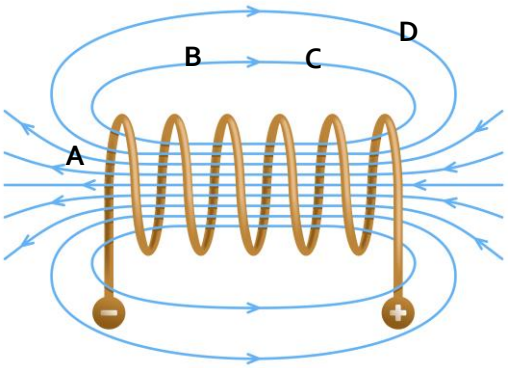
5) What happens to the magnetic field inside a solenoid if the direction of the current is reversed?

a) It remains unchanged
b) It becomes weaker
c) It reverses direction
d) It disappears

6) When observing a solenoid, the magnetic field lines appear closely spaced inside and more spread out outside. What does this difference in spacing indicate?
   a) Direction of current
   b) Direction of force
   c) Strength of the magnetic field
   d) Shape of the solenoid

7) Considering the diagram which location has the highest magnetic field

   a) A
   b) B
   c) C
   d) D



8) The order of magnetic field strength from largest to smallest

   a) D, C, B = A
   b) A, B = C, D
   c) B = C, A, D
   d) A = B, C, D

9) In the diagram the field lines inside the solenoid are straight and closely spaced, while outside they curve and spread out. What does this pattern suggest?

   a) The field is weaker inside and stronger outside
   b) The field is strongest outside the solenoid
   c) The field is strongest and most uniform inside the solenoid
   d) The field has no direction inside the solenoid

10) When observing a solenoid from one end, how can you determine which end is the north pole?

   a) The end where field lines enter
   b) The end where field lines exit
   c) The end with no current
   d) The end with the weakest field