

Systematic Natural Science

(Sample manual)

Purpose

1. What is the definition of cold and hot?
2. Is your hand warmer than mine?
3. Is it warmer under the sun?
4. How to conduct heat insulation?
5. Does heat transfer?
6. Do objects expand when heated?
7. What substance can be attracted by magnet?
8. What is the difference between north and south pole of a magnet?
9. Magnetic line formed by a magnet bar
10. Magnetic line formed by U-shaped magnet
11. Two bar magnets attraction in serial connection
12. Two bar magnets repulsion in serial connection
13. Two bar magnets attraction in parallel connection
14. Two bar magnets repulsion in parallel connection
15. Parallel magnetic line of one end of magnet
16. Parallel magnetic line of U-shaped magnet
17. How does magnetic force work?
18. How to increase the magnetic field strength of a magnet?
19. Daily moon movement
20. Why do we always seeing the same particular side of the moon during a year?
21. What causes lunar eclipse?
22. Changes of moon phase
23. Does air contain water vapor?
24. Cloud formation
25. Fog formation
26. Rain formation
27. Why does a balloon expand when on the mountain? 6
28. Why does a balloon become smaller when increase the pressure in a sealed container?
29. Why is it difficult to cook food on the mountain? 7
30. Does light refract in the water?
31. Does light refract through thick acrylic block?



32. How does light refract through a prism?
33. What is an open circuit?
34. Is it right to turn off the light whenever you leave?
35. Is short-circuit really dangerous?
36. Experiencing the importance of fuse.
37. Why do all home appliances power connected in parallel?
38. What can we get when bulbs are connected in series?
39. What are the purpose and method for serial connection of batteries? 8
40. What are the purpose and method for parallel connection of batteries? 9
41. Reflection of lights in a plane mirror.
42. Reflection and focus determination of light in a convex mirror.
43. Reflection and focus determination of light in a concave mirror.
44. Refraction and focus determination of light in convex lens. 10
45. Refraction and focus determination of light in concave lens.
46. Principle of eye imaging
47. Causes and correction of myopia
48. Causes and correction of hyperopia
49. Principle of a camera
50. Principle of lens imaging
51. Do concave mirrors form an image?
52. Can levers save energy? 11
53. What is a fixed pulley?
54. What is a movable pulley?
55. How does pulley set save energy?
56. What causes day and night?
57. Why is the length of day and night different in four seasons?
58. How do changes of four seasons occur? 12
59. Do length of day and night even when in different latitudes?
60. Is electrical energy convertible to kinetic energy?
61. Is kinetic energy convertible to electrical energy?
62. How do sun eclipse formed?
63. What causes sun eclipse?
64. What causes partial eclipse of sun?
65. What causes annular eclipse of sun?
66. What color of cloth should we wear in winter?
67. Can white light be produced after combining red, blue and green lights?
68. How do objects react to different colored light?

69. Is shadow always black?
 70. Why do colors become darker after mixture?
 71. Do colored lights become brighter after color mixture?
 72. Does white light becomes beautiful rainbow after traveling through a prism?
 73. Does colored light become rainbow after traveling through a prism too?
 74. Propagation of sound in water
 75. Propagation of sound in air
 76. Propagation of sound in vacuum
 77. Do boys and girls share the same heart beat rate?
 78. Do grownups and children have different heart beat rate?
 79. Does heart beat change before and after exercise?

Accessory

No.	Description	Qty	No.	Description	Qty
1	Bottle with wide-mouth (250CC)	2	2	Rubber stopper	2
3	Bottle holder	1	4	Electronic thermometer	2
5	Copper and aluminum testing bar	2	6	Black and white cover	2
7	Foam insulation cylinder set	1	8	Ring Expansion set(ball with hand*1 , ring with a handle*1)	1
9	Balloon	1	10	Dual-use pump	1
11	Measured-pressure Rubber stopper	1	12	Silicone Tube	1
13	Buzzer (with 2 plastic zipper bags)	1	14	Sound set	1
15	Bar Magnet	2	16	U-shaped magnet	1
17	U-shaped magnet holder	1	18	Small compass	1
19	Iron bar	6	20	Magnetic field device set	1
21	Bar magnet holder	1	22	Breadboard	1
23	I-shaped connector	4	24	L-shaped connector	4
25	T-shaped connector	4	26	Battery connector	2
27	Circuit switch connector	1	28	Bulb holder connector	2
29	External voltage connector	1	30	External current connector	1
31	Motor coil and brush set	1	32	Fan	1
33	Galvanometer	1	34	Small bulb	3
35	AA battery	2	36	Fuse connector	1
37	Aluminum track*2	1	38	Slide implement	5

39	Adjustable metal slide implement	3	40	Convex lens with handle	2
41	LED lamp with handle	1	42	White screen with scale	1
43	Cross screen with a handle (black screen)	1	44	Half-screen with a handle	1
45	Concave mirror with handle (F+100mm)	1	46	Round hole grating with handle	1
47	Red filter	1	48	Blue filter	1
49	Green filter	1	50	Yellow filter	1
51	Prism	1	52	Prism holder	1
53	Parallel laser light	1	54	Semi-circular sink	1
55	Cylindrical parallel prism	1	56	Cylindrical right angular prism	1
57	Cylindrical plane mirror	1	58	Cylindrical concave and convex mirror	1
59	Cylindrical convex lens	1	60	Cylindrical concave lens	1
61	Normal eye lens	1	62	Myopia lens	1
63	Myopia correction lens	1	64	Hyperopia lens	1
65	Hyperopia correction lens	1	66	Normal eye teaching board	1
67	Myopia teaching board	1	68	Hyperopia teaching board	1
69	Camera theory teaching board	1	70	Irradiation platform teaching board	1
71	RGB optical filter with handle	1	72	Single grating with a handle	1
73	DC power supply (3V)	1	74	Parts storage box	3
75	Moon and earth device	1	76	Slotted bracket	3
77	Moon phase ball	1	78	Balancing lever	1
79	Iron bar (400mm)	2	80	Axle	1
81	Hook weight	7	82	Single pulley	2
83	Double pulley	2	84	Balanced weight	2
85	Cross connector	1	86	Hook connector	2
87	String	1	88	Transparent acrylic sheet	1
89	Alcohol lamp	1	90	Rod connector	1

27. Why does a balloon expand when on the mountain?

No.	Description	Qty	No.	Description	Qty
1	Bottle with wide-mouth (250CC)	2	3	Bottle Holder	1
4	Electronic thermometer	1	9	Balloon	1
10	Dual-use pump	1	11	Measured-pressure Rubber stopper	1
12	Silicone Tube	1			

● Expansion of a balloon

1. Set up experiment kit as figure 27-1.
2. Place the balloon into the bottle and use the dual-use pump for suction as to release the pressure inside the bottle.
3. Pressure is less due to the thin air on the mountains. Observe whether the balloon expands or shinks.

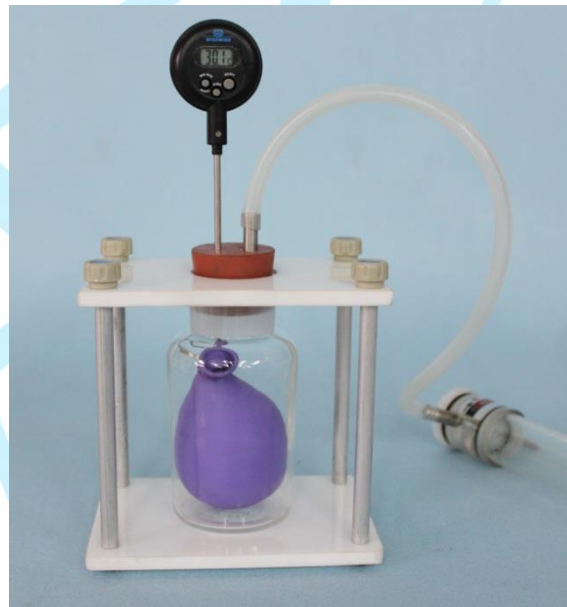


Figure 27-1 The balloon expands when the pressure is getting smaller.

● Questions and discussions

Q27-1 : What would happen to the balloon goes up in the air?

29. Why is it difficult to cook food on the mountain?.

No.	Description	Qty	No.	Description	Qty
1	Bottle with wide-mouth (250CC)	1	3	Bottle Holder	1
4	Electronic thermometer	1	10	Dual-use pump	1
11	Measured-pressure Rubber stopper	1	12	Silicone Tube	1

● Boiling on the mountain

1. Set up experiment kit as figure 29-1(a).
2. The boiling point of water is below 100 degrees due to the air pressure on the mountain is lower than 1 atm (atmosphere) (The boiling point is 100 degrees when it's 1 atm. The lower the boiling point gets the lesser air pressure becomes.)
3. Pour in water that's above 80 degree Celsius to 80% full. Place the rubber stopper over the top of the bottle and insert the thermometer. Use dual-use pump to exhaust and increase the pressure inside the bottle then observe the water boiling. (Figure 29-1(b))



(a) Experiment set-up



(b) Boiling of water

Figure 29-1

● Questions and discussions

Q29-1 : Why is it difficult to cook food on the mountain?

39. What are the purpose and method for serial connection of batteries?

You can get the voltage rate when connecting the external voltage connector to an object to be measured in parallel.(figure 39-1)

When the elements are connected in series, the total voltage is the sum of the voltages of the elements. There are two batteries connected in series in this experiment. Theoretically, the total voltage should equal the sum of the two voltage rates.

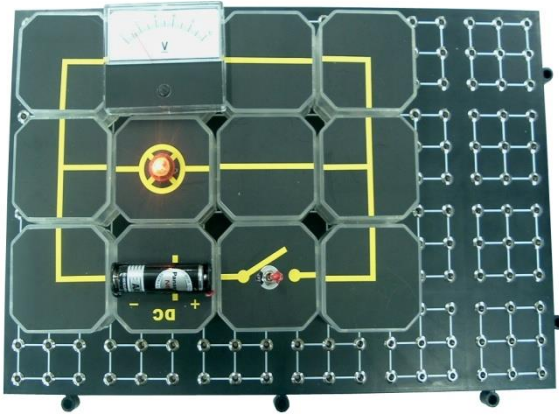


Figure 39-1 Voltage circuit

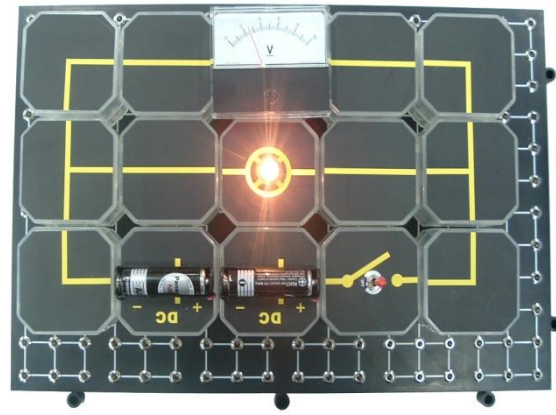


Figure 39-2 Circuit of batteries connection in series

No.	Description	Qty	No.	Description	Qty
22	Breadboard	1	23	I-shaped connector	4
24	L-shaped connector	4	25	T-shaped connector	2
26	Battery connector	2	27	Circuit switch connector	1
28	Bulb holder connector	2	29	External voltage connector	1
34	Small bulb	2	35	AA battery	2

● Serial battery configuration experiment

1. Set up experiment as figure 39-1. Connect light bulb and battery in series connection and external voltage connector in parallel connection for observation. (Note the pole end when insert battery)
2. Turn on the circuit switch to observe the brightness of the bulb and voltage rate shown.
3. Add another set of battery to connect with the original battery in series as figure 39-2 and observe the brightness of the bulb and voltage rate shown. Do a comparison with the result with one battery.

40. What are the purpose and method for parallel connection of batteries?

When all elements are connected in parallel, the voltage of each element equals one another and the total voltage is the sum of each element. The total voltage of the two batteries connected in parallel should equal to the voltage of each battery in this experiment. The equation of the theoretic value for the total voltage is:

$$\text{Total voltage}(v) = \text{voltage}(v_1) \text{ of battery 1} = \text{voltage}(v_2) \text{ of battery 2.}$$

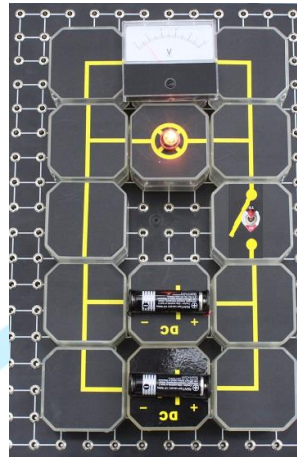


Figure 40-1 Circuit of batteries connection in parallel

No.	Description	Qty	No.	Description	Qty
22	Breadboard	1	23	I-shaped connector	4
24	L-shaped connector	4	25	T-shaped connector	4
26	Battery connector	2	27	Circuit switch connector	1
28	Bulb holder connector	2	34	Small bulb	2
35	AA battery	2	29	External voltage connector	1

● Parallel battery configuration experiment

1. Set up experiment as figure 40-1. Connect batteries in parallel connection and external voltage connector, light bulb in parallel connection for observation. (Note the pole end when insert battery)
2. Turn on the circuit switch to observe the brightness of the bulb and voltage rate shown.
3. Do a comparison with the serial battery configuration experiment.

44. Refraction and focus determination of light in convex lens.

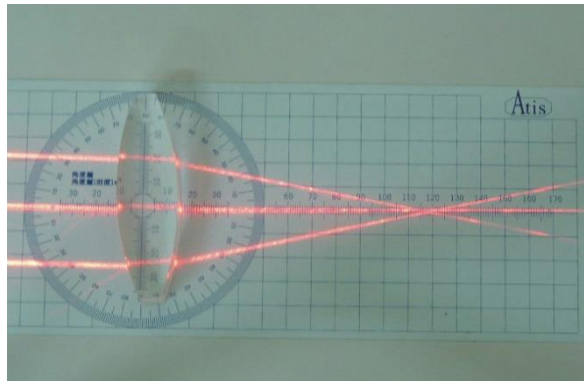


Figure 44-1 Focus determination of convex lens

When parallel lights travel through a convex lens and the refracted light come together at a focus point F. You can tell the laser light refracted twice in the convex lens. (Only draw one refraction for experiment record.)

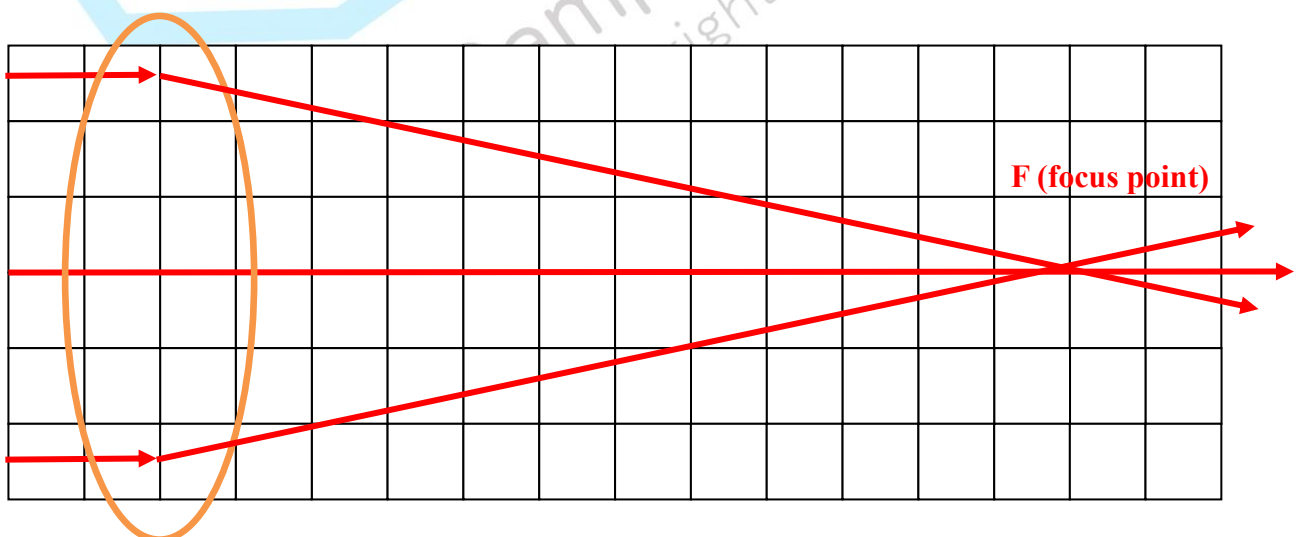
No.	Description	Qty	No.	Description	Qty
53	Parallel laser light	1	59	Cylindrical convex lens	1
70	Irradiation platform teaching board	1	83	DC power supply (3V)	1

● **Refraction experiment of convex lens**

1. Place a convex lens on the board and turn on the parallel laser light (three light-beam source) as figure 44-1.
2. Record and draw the refracting and focusing process of the three parallel laser lights travel through a convex lens. The laser lights reflection has to come together at the center laser light. Find the location of the focus point F.

● **Experiment record**

Refraction pattern and the location of the focus point for cylindrical convex lens:



52. Can levers save energy?

No.	Description	Qty	No.	Description	Qty
37	Aluminum track (Holder connected to track ×2)	1	39	Adjustable metal slide implement	1
78	Balancing lever	1	79	Iron bar (400mm)	1
81	Hook weight	7	86	Hook connector	1

● First-class lever experiment

1. Set up the experiment as figure 52-1.
2. Place two hook weights with the equal weight at the same distance from the center on both ends. Lever shows that the object weight (two hook weights) is equal to the force (two hook weights).
3. Add hook weights on one end and adjust the distance to the center on the other end to keep the lever in the horizontal state. You'll find the same force can handle heavier object as shown in figure 52-1.



Figure 52-1

● Questions and discussion

Q52-1 : Try to describe which the object weight is and how to apply force in order to save energy.

58. How do changes of four seasons occur?

No.	Description	Qty	No.	Description	Qty
37	Aluminum track (Holder connected to track ×2)	1	39	Adjustable metal slide implement	2
41	LED lamp with handle	1	73	DC power supply (3V)	1
75	Moon and earth device	1	76	Slotted bracket	2

● The change of four seasons

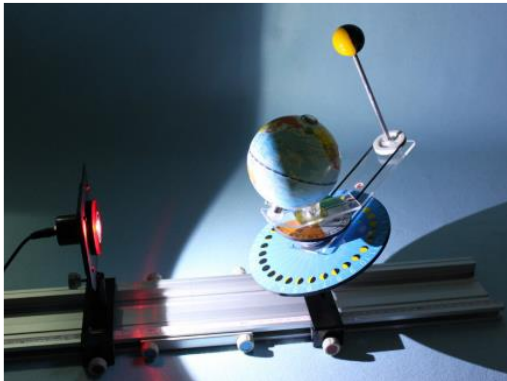


Figure 58-1

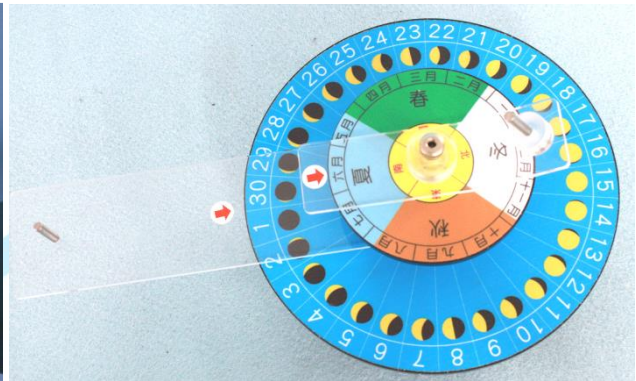


Figure 58-2

1. Refer to moon and earth device set up steps on page 28. Base on the red pointer on the four season disc, the sunshine on the earth is changeable to cause changes of seasons. (as figure 58-2)
2. The 23.5-degree tilt of the axis sustains life on Earth and produces seasons. (as figure 58-1)
3. Earth's orbit is not a perfect circle. It is a bit lop-sided. During part of the year, Earth is closer to the sun than at other times. However, in the Northern Hemisphere, we are having winter when Earth is closest to the sun and summer when it is farthest away.
4. Six months later, the sunlight perpendicular incidence on the south atmosphere and the oblique incidence on the north atmosphere. Thus the seasons exchange, summer on the south atmosphere and winter on the north atmosphere.

● Questions and discussion

Q58-1 : What is the main cause for the temperature changes of the four seasons on earth?



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