D20-1507-W0 Ray Box L-2

D20-1645-W0 Ray Box L-2 & Accessories

March 2023

Safety Precautions

- Do not directly look into the light because the built-in light source unit emits a high-intensity and powerful beam that is still harmful to human eyes, even if not so much as a laser beam.
- Do not disassemble, repair, or remodel any part of this product. It might not work properly, and the warranty will be void.
- Teachers or trainers must instruct students about the operating procedure and the safe ways of conducting experiments with this product prior to use.
- Always carry students' experiments under the supervision of teachers/trainers.

Introduction

Product's Feature

[D20-1507-W0 Ray Box L-2]

Equipped with a unique structure of a light source (Beam LED) developed by Narika that emits belt-like beam with the height of 3 cm. Students' safety is secured because LED light source is much less harmful to their eyes than laser. Easy to manage students because experiments can be carried in a classroom with normal brightness (with indoor lighting on).

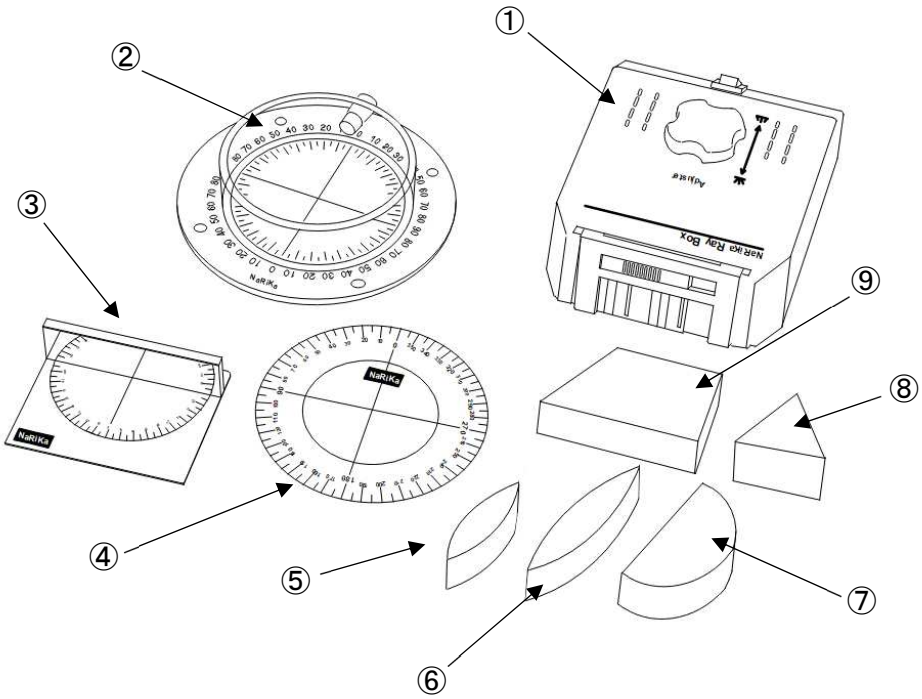
Equipped with a removable slit plate unit with a filter color-coded in red, green, black (to block the passing light) and colorless (for white color). The tricolor beams are made up of three colors: red one at one end, white one in the middle and green one at the other end. These beams help students better observe how each light travels before/after the refraction that occurs when a light is passing through a lens.

[D20-1645-W0 Ray Box L-2 & Accessories]

Set of various types of lenses, a circular water tank, a circle protractor, and a surface reflection mirror in addition to Ray Box L-2 (D20-1507-W0).

A light passing through a commonly available glass lens becomes invisible, thus cannot be traced. In contrast, lenses that come with the product are translucent ones and called "Smoke Lens". A light that passes through such lens is visualized based on the Tyndall scattering phenomenon.

Contents



[D20-1507-W0 Ray Box L-2]

① D20-1507-W0 Ray Box L-2: 1 pc

[D20-1645-W0 Ray Box L-2 & Accessories]

② D20-1507-W0 Ray Box L-2: 1 pc

② D20-1289 Circular water tank (with 4 magnets on the back) : 1 pc, ϕ90 (ϕ130) x t 27 mm

③ D20-1302-01 Surface Reflection Mirror with a Semicircular Protractor

④ Circular Protractor

⑤ D20-1607-01 Convex “Smoke Lens”: 1 pc, 50 x t 20 mm, f=ca. 50 mm）

⑥ D20-1607-02 Convex “Smoke Lens”: 1 pc, 76 x t 20 mm, f=ca. 100 mm

⑦ D20-1612 Semicircle “Smoke Lens”: 1 pc, φ60 x t 20 mm, (translucent/translucid type)

⑧ D20-1400 Triangular Prism SP-1: 1 pc, 30 x t 20 mm

⑨ D20-1607-05 Trapezoid “Smoke Lens”: 1 pc, 70 x 40 x t 20 mm, acute angle 60°

How to use

D20-1507-W0 Ray Box L-2

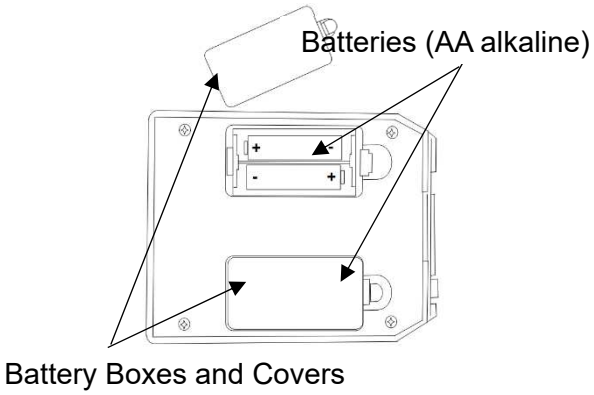


Fig. 1

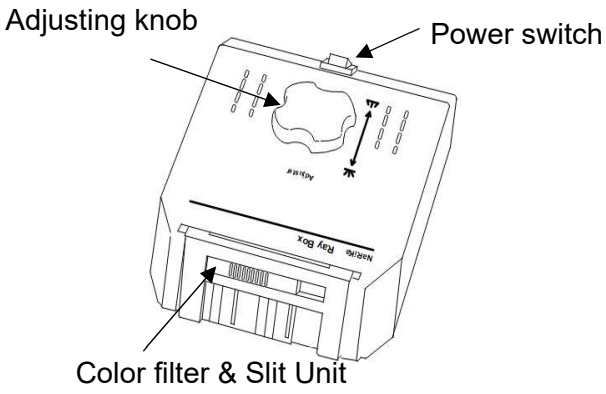


Fig. 2

1. How to insert batteries:
Remove the two battery covers on the undersurface side of the ray box (see Fig. 1). Insert two AA alkaline batteries (sold separately) in each battery box, and close both covers.

2. How to power on/off the ray box and adjust the parallelism of the rays:
Use the on/off red rocker switch on the ray box to turn it on or off (see Fig. 2). Adjust the parallelism of the rays by unscrewing the black adjusting knob slightly and moving it forward and or backward, so that the rays can either travel in parallel, converge, or diverge behind the slit of the ray box.

3. How to change the number and color(s) of rays emitted by the ray box:
Slide the color filter in the right-left direction to select the number and color(s) of rays from the below options, and then turn on the ray box (see Fig. 2)

[Option 1] Emit a white ray through the slit in the center (of the three slits).
[Option 2] Emit two white rays through the slits at the right/left ends.
[Option 3] Emit three white rays through all the three slits.
[Option 4] Emit three colored rays (white, red, and green) through all the three slits (white ray through the slit in the center and green/red rays through the slits at the right/left ends).

Light refraction experiment with “Smoke lenses”:

What to prepare:
① D20-1507-W0 Ray Box L-2
⑤ D20-1607-01Convex “Smoke Lens”

⑥ D20-1607-02 Convex “Smoke Lens”
⑦ D20-1612 Semicircle “Smoke Lens”
⑨ D20-1607-05 Trapezoid “Smoke Lens”

The "Smoke Lens" clearly visualizes the light path traveling through the lens and enables students to draw entire ray diagrams that pass across the lens (see Fig. 3 and Fig. 4).
1. If using a lab bench or table of dark color, place a piece of white paper between the surface and the lens to make the light paths clearly visible.
2. Slightly lower the illuminating level of the classroom/lab to make the light paths more visible.
3. Turn on the red rocker switch on the ray box. Then, slide its color filter in the right-left direction to choose [Option 4].
4. Place one of the lenses in a proper position in front of the ray box to observe how the light paths pass across the lens (see Fig. 3 and Fig. 4).

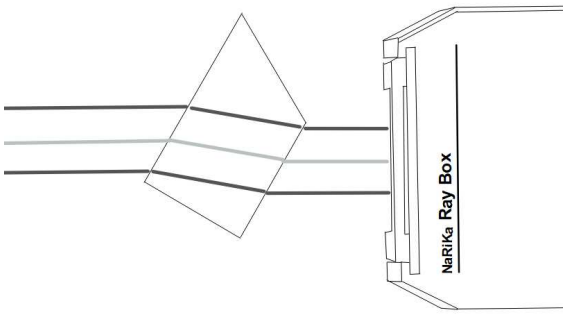


Fig. 3. Trapezoid “Smoke Lens”

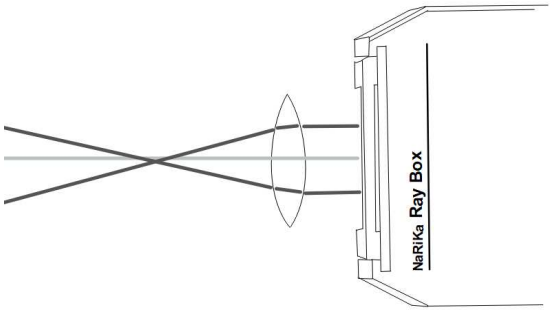


Fig. 4. Convex “Smoke Lens”

Dispersion of a white light using a prism

What to prepare:
① D20-1507-W0 Ray Box L-2
② D20-1400 Triangular Prism SP-1

1. Slightly darken the classroom/lab to make the light paths and spectrum of colors clearly visible.
2. Turn on the ray box. Then, slide its color filter in the right-left direction to choose the [Option 1].
3. Place Triangular Prism in a position in front of the ray box to split the white light into the colors of the spectrum and observe it (see Fig. 5).
* The observed spectrum will be something like a rainbow. However, it does not show a precisely continuous spectral distribution due to the LED light property.

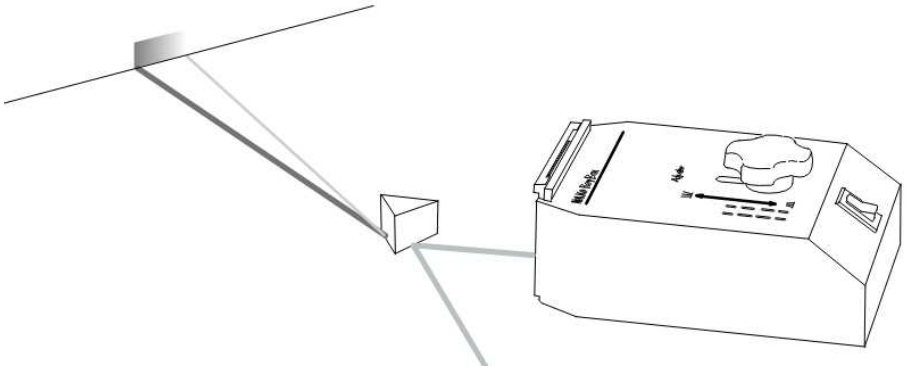


Fig. 5. Spectral prism

Reflection of light at a mirror

What to prepare:

① D20-1507-W0 Ray Box L-2

② D20-1302-01 Surface-Reflection Mirror with a Semicircular Protractor

The “Surface-Reflection Mirror with a Semicircular Protractor” is designed to correctly and easily measure angles of incidence and reflection because the incident ray strikes the mirror at the point that should exist exactly on the mirror surface.

1. Slightly darken the classroom/lab to make the light paths clearly visible.
2. Turn on the Ray Box. Then, slide its color filter in the right-left direction to choose [Option 1].
3. Place the mirror in the proper position in front of the ray box and observe an incident and reflected rays.
4. Measure the incident angle i and reflected angles r using the semicircular protractor.
5. Compare the measured values.

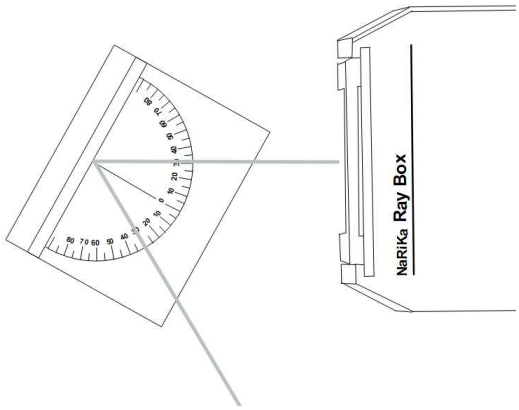


Fig. 6 Surface-Reflection Mirror with Semicircular Protractor in combination with Ray Box L-2

Total Internal Reflection in combination with Circular Water Tank

What to prepare:

① D20-1507-W0 Ray Box L-2

② D20-1289 Circular water tank

The ”Circular water tank with magnets” is designed to observe how a ray refracts and/or reflects at the interface of water and air.

1. Hold the tank with your hand and keep supporting it perpendicular to the surface of your lab bench/table.
2. Carefully pour water to the “90 degrees” scale.
3. Mount the tank magnetically on a metal surface like a whiteboard.
4. Align the water level to the printed line when the water inlet is on top.
5. Slightly darken the illumination of the classroom/lab to make the light paths clearly visible.
6. Turn on the Ray Box. Then, slide the color filter in the right-left direction to choose the aforementioned [Option 1].
7. Hold the ray box with your hand (see Fig. 7).
8. Position the ray box, so that the emitted white ray always pas through the center point of the tank (see Fig. 7). Then, keep moving the ray box around the tank to change the angle of incidence to the normal and synchronously, change the angle at which the incident ray would be bent toward/away from the normal.
9. Measure and record angles of incidence, refraction, and reflection, if any, that occur when light travels from one medium to another of different densities (from air to water and vice versa).

When a ray of light travels from water to air on the normal, it will just move straight without any refraction (see Fig. 7). When a ray of light travels from water to air at 30 degrees to the normal, it will bend away from the normal at a 50-degree angle at the boundary. If the angle of incidence is increased to 40 degrees, the ray of light will bend away from the normal at a 60-degree angle and reflects from the normal at a 40-degree angle. If the angle of incidence is increased further to 45 degrees, the ray of light undergoes total internal reflection at the boundary like a ray of light reflected by a mirror (Fig. 8).
Whereas, when a ray of light travels from air to water, it mostly enters into the water being reflected only a little (see Fig. 9).

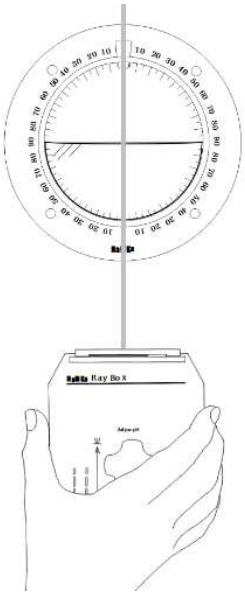


Fig. 7 Ray of light traveling on the normal

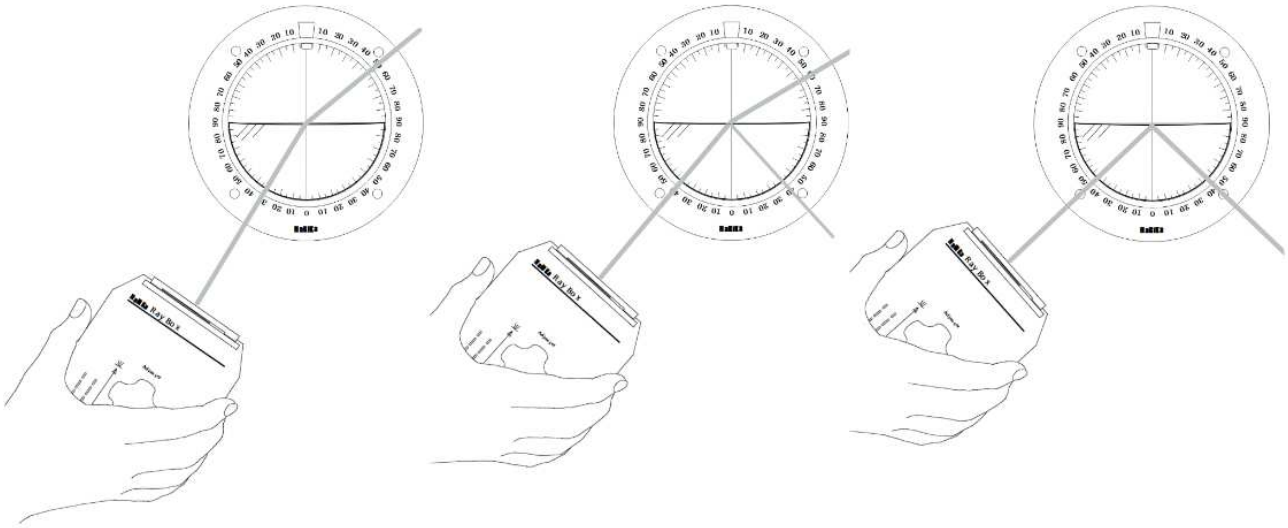


Fig. 8

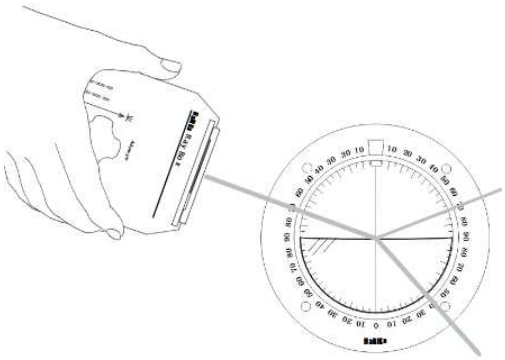


Fig. 9. Ray of light traveling from the air

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