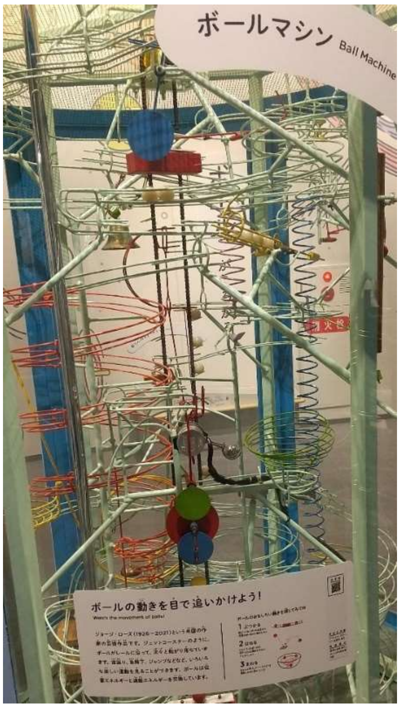
Exhibition hall 2nd floor “Enjoy Science Together”

1. **Balls**
2. **Mirrors**
3. **Wind**
4. **Sound**
5. **Magnets**

1. Balls



< id="2-1-01">Ball Machine

Watch the movement of balls！

This “Ball Machine”(manufactured in 1992) is one of George Rhoads’ Rolling Ball Sculptures. In this ball machine, the chain-driven lifter carries balls to the top of the sculpture. The balls trigger some switching motions and hit objects such as bells, chimes, drums and xylophone bars.The balls are exchanging potential energy for kinetic energy.

< id="2-1-02">Projectile Motion

Watch the trajectory of the rebounded ball.

The route of the ball is determined by the initial speed of the ball, the inclination of the slope, the height of the ramp and so on. With the same speed and the same slope, balls will always pass through the same trajectory.

< id="2-1-03">Golf on the Slope

Make a putt on the slope!

On a slope, the ball doesn’t move straight but moves in a parabola. If you hit the ball too hard, it goes off course; if you hit it too weak, it doesn’t reach the goal. The design of this experimental equipment takes its idea from golf putting. Aim at the goal by predicting the best path the ball can take.

< id="2-1-04">Race on a Spiral

The ball will get faster and faster!

When you release a ball, it moves slowly at first but goes faster and faster. It will be accelerated by gravity. Next, release two or three balls in succession. What happens to the space between the balls?

< id="2-1-05">Vortex on the Funnel

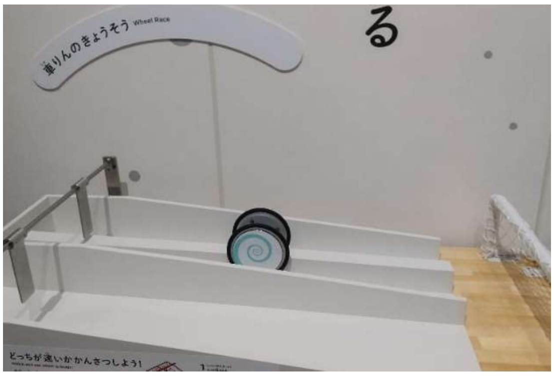
Let the ball roll on the funnel for as long as possible!

When you release a ball horizontally along the edge, it doesn’t fall into the hole directly but swirls around while speeding up. The highlight is where the hole is smallest. Wash basin swirl and black hole vortex are similar phenomena.

< id="2-1-06">Wheel Race

Watch and see which is faster!

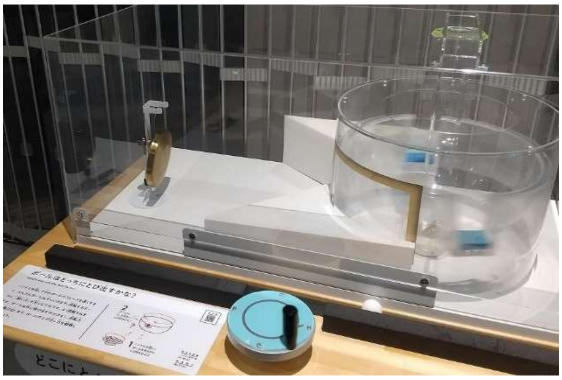
Both wheelsets have the same gravitational acceleration pulling them down and are the same weight, but the wheelset rolling down the rail on its axle goes slower than the one rolling down the slope on its wheels.



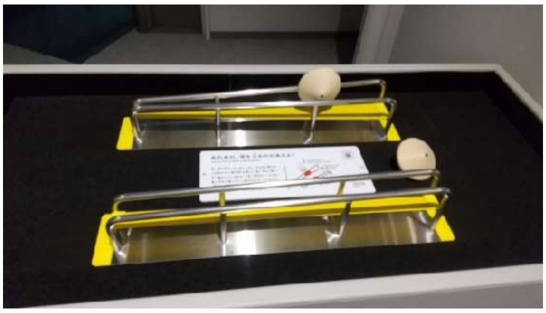
< id="2-1-07">Centrifugal Force

Which way will the ball fly to?

When you turn the handle and make the ball move faster, the ball goes up. This is because centrifugal force is generated on the spinning ball. Although often misunderstood, centrifugal force is not a force from the center toward the outside but an inertia force that appears along the rotational direction. See how the ball pops out.



< id="2-1-08">Why Does It Go Up?



What?! It is going up the hill!

When you put an abacus bead-shaped object (double cone roller) on the rail that is wider on the higher side, it will roll toward upper end. However, it will roll downward on the parallel rail as usual. When you look at the center (of the gravity) of the roller, you can see that the roller moves to the direction in which the center of the gravity is lower than the starting point.

< id="2-1-09">Which One Will Reach the Goal?

Which one will reach the goal?

One of them can roll the curve successfully and others always derail. Because the part of a spindle-shaped piece or a train wheel that rolls on the outer rail is bigger than the part that rolls on the inner rail, it can roll on the curved rail. Conversely, the hourglass-shaped piece has a larger radius on the inner rail, so it always derails.

2. Mirrors

< id="2-2-01">Anti-Gravity Mirror

Try this mirror trick to perform gravity-defying stunts.

Stand facing each other and reflect only half of your bodies. Next, get your feet in the mirror off the ground. It looks as if you are swimming through the air. This illusion is created thanks to the nature of mirrors and the fact that the human body is almost symmetrical.

< id="2-2-02">Lots of Faces

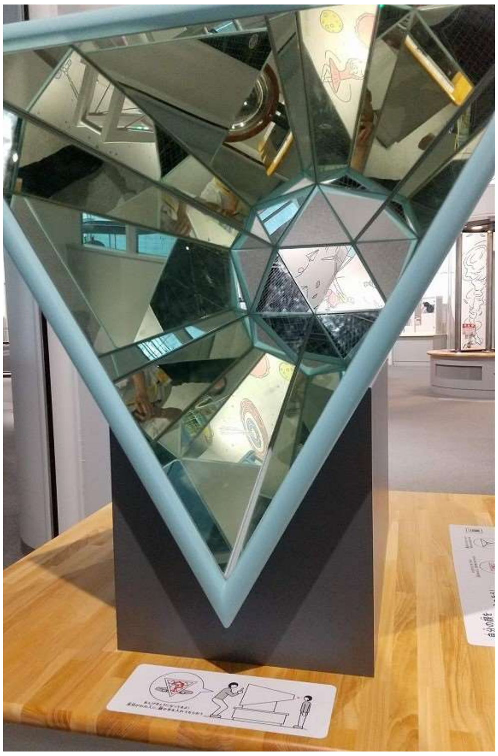
Look for a place where you can see your face in every mirror.

There are many mirrors on a concave surface. Look for a place where you can see lots of faces. In this exhibit, mirrors are facing a single point. The position where you see a lot of reflection of the face is the focus of the concave mirror surface. Look for that position. It has a similar structure to a foldable solar cooker.

< id="2-2-03">You Look Distorted

You will appear highly distorted in these mirrors.

Because the mirrors are convex, concaved, or waved, your reflection will be thinner, plumper, or distorted. Stand in front of the mirrors that are lined up side by side, one at a time. Which mirror shows what kind of reflection? Which mirror do you like?



< id="2-2-04">Face Kaleidoscope

Your face is the object of the kaleidoscope.

A kaleidoscope is made by combining mirrors inside a cylinder. Light reflects many times between the mirrors, so you can see multiple reflections of the objects at the end of the cylinder. Kaleidoscopes were invented by Dr. Brewster, a Scottish physicist, in 1816 as a mechanism to collect light at lighthouses.

< id="2-2-05">Lots of Me!

Step into the angled mirrors to see many your clones!

Sets of two mirrors are placed together at 30-degree, 90-degree, and 120-degree angles to each other. The number of reflections of yourself changes depending on the angle of the mirrors. The narrower the angle of the mirrors, the larger

the number of reflections. Count how many of you are in the mirror. The relation between the angle of the mirrors and the number of reflections is 360 degrees divided by (the angle of the mirrors).

< id="2-2-06">Endless Reflections!

How many yourselves there are in the infinite mirror!

Light reflects in a mirror. That reflected light reaches your eyes, and you can see the reflection of yourself in the mirror. If you place two mirrors facing each other, light reflects between them repeatedly, so you get many images in them endlessly. Equipment shooting lasers also amplifies the light with facing mirrors inside.

< id="2-2-07">Looking Big!

Shake hands with yourself!

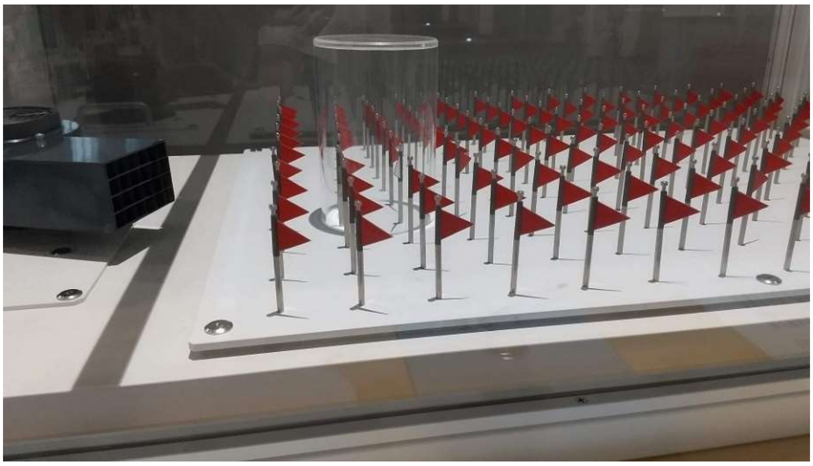
Bring your hand or face into the bowl-shaped mirror and see how the reflection changes. The reflection changes greatly at a certain point. It becomes bigger and upside-down.

< id="2-2-08">Various Mirrors

What kind of mirrors are used in our life?

Mirrors in different shapes that are used in our everyday lives are displayed. Find out what kind of mirrors are used where and why that shape of mirror is used. For example, a convex mirror is used where we want to see a wide range of area with one mirror. On the

contrary, a concave mirror is used where we want to see a narrow range of area in a larger image.



３．Wind

< id="2-3-01">Wind Flow

Let';s take a look at where the wind is blowing!

Many small flags show you the direction of the air flow by the wind. You can't see air itself, but the wind can be visualized by a weathercock, grassland, or streamer. When you visualize the wind, you can see that the wind comes around objects on the way and changes their direction.

< id="2-3-02">Make a Tornado

Touch the tornado!

When you press the button, a tornado will be formed. This equipment blows out the wind from the four surrounding pillars in a circular motion and sucks it out with the fan on the top. It also generates fog from the floor to make the tornado easy to see. A real tornado pulls things in with its strong wind and is very dangerous.

< id="2-3-03">Dancing Balloons

Why don't balloons fly away with the wind?

Balloons are floating in the wind, going up and down, but they don't fly away. The wind has a property that pulls things in. This is called Bernoulli's principle.

< id="2-3-04">Bernoulli’s Law

Let’s make the ball float in the wind blowing diagonally!

If you take a ball where the wind is blowing and gently release it, it will not fall or be blown away; rather, its position becomes almost stable. The wind has a property called Bernoulli’s principle where things are wrapped around and their position is stabilized. Airplane wings and breaking balls in baseball apply this property.

< id="2-3-05">Pulled by Wind

Why? As the wind blows, the ball goes up!

The ball goes up, but it doesn’t mean that the blower is directly sucking the air inside the pipe. The wind has a property of pulling things in (Bernoulli’s principle). If you blow the wind in a thin stream between two hanging balloons, you can do a magic trick that puts two balloons together without touching them. Try it at home.

4. Sound

< id="2-4-01">Musical Instruments

Various musical instruments have been developed all over the world. Basically, the larger the instrument, the lower the sound, and the smaller the instrument, the higher the sound, but they do not produce a single note. Depending on its shape and structure, sounds of various wavelengths (frequencies) mix together to produce a unique tone. Can you imagine what it sounds like?

< id="2-4-02">Inside a Piano

Let's take a look at how the piano works!

If you press a piano key, a hammer inside the piano moves and hits a string. The vibration of the string is transmitted to the soundboard and becomes the vibration of the air, and you hear it as a sound. Pitch changes depending on the length, thickness, and tension of the strings. In fact, if you play a certain scale, other strings also vibrate and produce the unique sound of a piano.

< id="2-4-04">Play Instruments

There are some cute instruments. Enjoy the differences in pitch, tone, and material of each instrument. There is also a musical instrument called a Rainstick that makes a mysterious sound. In fact, the wooden box with holes that is used as a chair is also a musical instrument called a Cajon. Try hitting different sides of the Cajon while sitting.

< id="2-4-05">Kundt' s Tube

Where is the vibration strong?

Sound is the vibration (waves) of things. The area where the beads tremble strongly (the position where the beads stand up) is Sound is the vibration (waves) of things. The area where the beads tremble strongly (the position where the beads stand up) is where the vibration of the waves is strong. The face of the speaker vibrates strongly, and the opposite end of the tube cannot vibrate. The pitch of the sound changes depending on the wavelength of the sound vibration. Observe that the position of beads changes depending on the pitch of the sound.

< id="2-4-06">Hit to Make Do-Re-Mi

Hit the pipes with different lengths.

Pay attention to the pitch (musical scale) and the length of the pipes (wavelength). The shorter the pipe is, the higher the note is produced. In contrast, the longer the pipe, the lower the sound. The pipe for the C one octave lower is twice as long as the pipe for the original C. The sound of the wavelength based on the length of the pipe is resonating inside.

< id="2-4-07">Echoing Clapping

You can hear an echo when you clap.

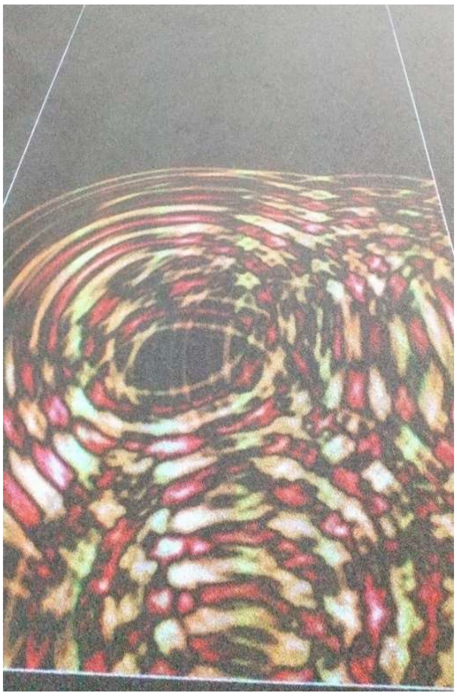
The pipe is 15 meters long. The sound echoes when you clap. Part of the sound that transmits through the pipe goes straight ahead and bounces back, while another part comes back after reflecting off the wall of the pipe many times. That';s why the sound remains for a long time. The same principle works in the echoes of mountains and baths.

< id="2-4-09">Collecting Sounds

How can we hear small sounds far away?

A paraboloid can gather not only light and radio waves but also sound. Sound that came from far away reflects in the paraboloid and gathers a little further away. As a familiar example, sound collectors used for birdwatching are an application of a paraboloid. Our ears also gather sound like a paraboloid.

< id="2-4-10">Wave Projector



Waves will spread from your footsteps!

The wavefront changes its strength as it expands and overlaps with other waves. It bounces back off the wall and bends at the slits. Here, waves precisely recreated by computer expand from your feet. Watch how waves propagate and reflect while playing with them.

< id="2-4-11">Wave Machine

See the difference between two types of waves.

A wave can be longitudinal (a wave that vibrates in the same direction of travel) or transverse (a wave that vibrates perpendicular to the direction of travel). You often see transverse waves, but where do longitudinal waves appear? In fact, a sound wave is a good example of a longitudinal wave. Longitudinal waves are also called compression waves, and they transmit high-density and low-density areas as waves.

5. Magnets

< id="2-5-01">Fishing with Magnets

Let's fish balls with electromagnets as many as you can!

Electric current runs through the tip of the rod only while pressing the button and becomes a magnet. Control the rod and catch the balls within the time limit.

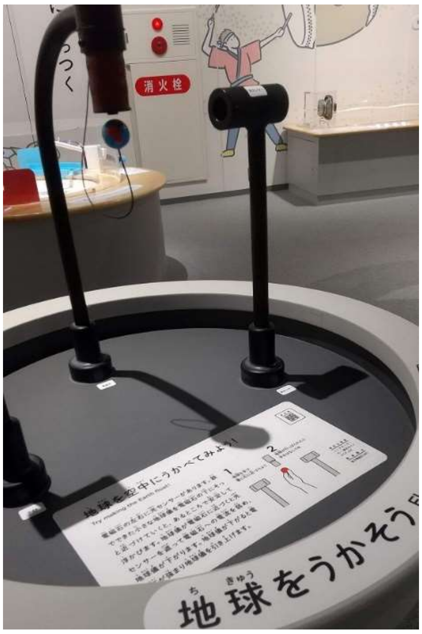
Electromagnets, which become a magnet with an electric current, are used in speakers, motors, and lifting magnets.

< id="2-5-02">Magnetic Field Viewer

Let's observe the pattern of the magnetic field!

The sheet contains a special ink that reacts to a magnet. When you bring a magnet closer to the sheet, a variety of patterns of magnetic field lines emerge depending on the magnet. Watch what kind of pattern it will be. In addition, if you bring familiar things closer, you can see that magnets are used in many different places.

< id="2-5-04">Float the Earth



Try making the Earth float!

There are light sensors on both sides of the electromagnet. When you gently bring a small globe made of iron closer to the bottom of the electromagnet, it will float stably at one point. When the globe gets closer to the electromagnet, it blocks the sensor, weakening the electric current to the electromagnet, and the globe goes down. When the globe goes down, the electromagnet becomes stronger and lifts the globe up.

< id="2-5-05">Dancing Magnets

Look at all of the magnets wobbling!

Magnets next to each other turn around by the magnetic force of the other magnet. When you turn around one magnet, the movement is transmitted to the magnet next to it like a wave. When they are settled, magnets next to each other face the same direction by spontaneous symmetry breaking, and as a whole, they are aligned to form a closed circle.

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