Definitions to know:

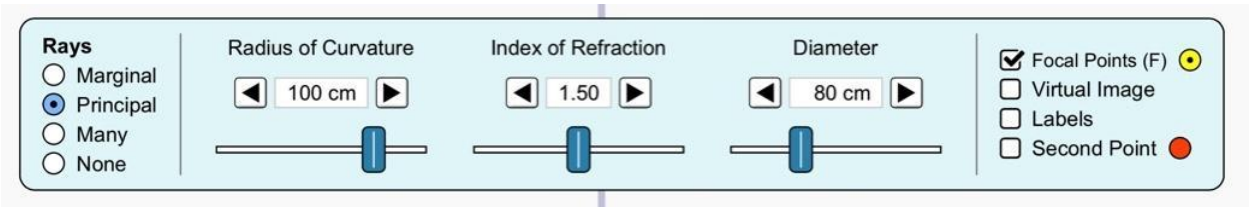
Geometric Optics: A branch of optics that deals with light in terms of rays. It focuses on how light travels in straight lines and how it interacts with lenses and mirrors to form images.
Principal Rays: Special rays used in geometric optics to find the image formed by a lens or mirror. These rays help in tracing the path of light and determining where the image will appear.
Radius of Curvature: The distance from the center of a curved lens or mirror to its surface. It affects how the lens or mirror bends light.
Index of Refraction: A measure of how much a material slows down light. A higher index means light travels slower in that material.
Diameter: The width of the lens. A larger diameter can collect more light, but it doesn't change how light is focused.
Focal Length (F): The distance from the lens or mirror to the point where light rays converge (meet) or appear to diverge from. It's where the image is formed.
Image: The result of light rays coming together after passing through a lens or reflecting off a mirror. It can be real (can be projected onto a screen) or virtual (can only be seen in the lens).
Real Image: An image formed by converging light rays that can be projected onto a screen. It's always inverted (upside down) compared to the object.
Virtual Image: An image formed by diverging light rays that cannot be projected onto a screen. It appears right-side up and can only be seen by looking through the lens.
Double Convex Lens: A lens that is curved outward on both sides. It converges light rays to a point.
Double Concave Lens: A lens that is curved inward on both sides. It diverges light rays, spreading them out.
Marginal Rays: Rays that travel close to the edges of the lens and are used to find the image in more detail.
Curvature Radius: The radius of the curvature of the lens or mirror's surface. It affects the focal length of the lens or mirror.
Diminished- smaller image than the object
Enlarged

Activity with PhET Simulation

1- Go to the Geometric Optics simulation page from PhET Interactive Simulations at University of Colorado Boulder.
https://phet.colorado.edu/sims/html/geometric-optics/latest/geometric-optics_en.html

2- In Geometric Optics, choose **principal rays** in the simulation screen, change the **radius of curvature** to 100 cm and keep **index of refraction** equal to 1.50 and **diameter** with 80 cm, like what you see in the figure below. Choose **Ruler** to measure the distances.

You may change the shape of the object you see in the simulation by available options on the left top corner of the page.



a) Place the object **beyond 2F** and find the location of the image. Show with the simulation. Write the image properties. Insert a screenshot from the simulation.

b) Place the object **at 2F** and find the location of the image. Show with the simulation. Write the properties of the image. Insert a screenshot from the simulation.

c) Place the object **between 2F and F**. Find the location of the image. Show with the simulation and insert a screenshot from the simulation. Write the properties of the image.

d) Place the object **at F**. Find the location of the image. Show with the simulation and insert a screenshot from the simulation. Write the properties of the image.

e) Place the object **between F and the lens** (in focal length). Find the location of the image. Show with the simulation and insert a screenshot from the simulation. Write the properties of the image.
Choose the **Virtual Image** in the simulation screen and Observe.

3- How can you change the focal length of the lens? In other words, what happens if you change the **refractive index/index of refraction** of the lens.

4- What happens to the image when you change the **refractive index** of the lens?

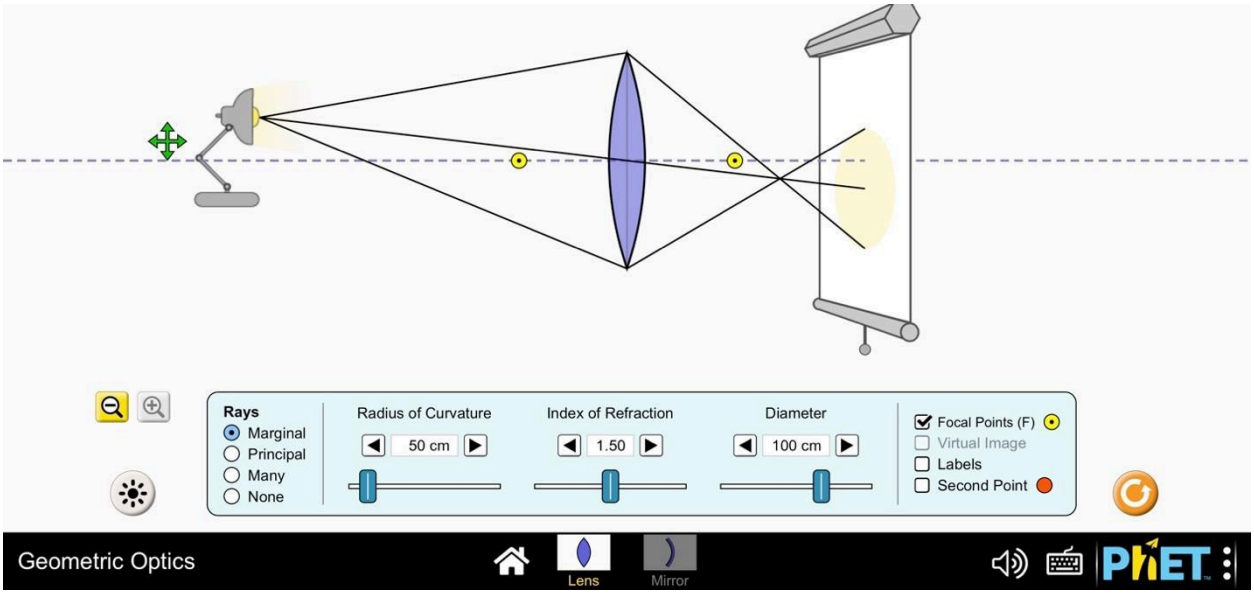
5- What happens to the image when you change the curvature radius of the lens?

6- What happens if you change the **diameter** of the lens? In other words, how the image is impacted by changing the **diameter** of the lens?

7- What changes when you change the lens from double convex to double concave?

8- In Geometric Optics, choose **marginal rays** in the simulation screen, change the **curvature radius** to 50 cm and keep **refractive index** equal to 1.50 and **diameter** with 100 cm, like what you see in the figure below. Choose **Ruler** to measure the distances. You may change the shape of the object you see in the simulation screen by the available options.
You can have a **screen** by selecting light as an object in the simulation and you can drag it to different locations.

Note: the screen is draggable.



a) The focal length is 50 cm, and the source of light is 120 cm away from the center of the lens. Where is the screen located to have a clear image of that? Insert a screenshot from the simulation.

b) Change the diameter, refractive index, and curvature radius of the lens and observe the point of the converged light rays on the screen. Play with simulation and explore more.