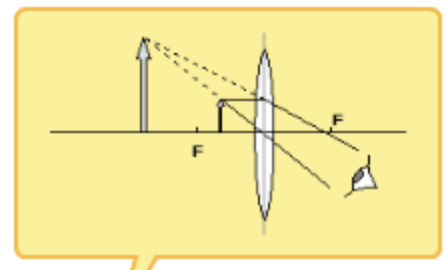
# Lenses

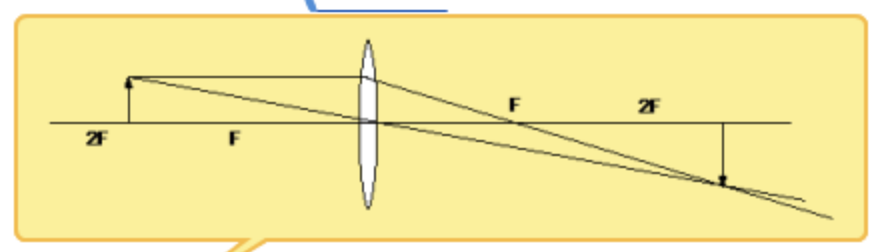
## Terminology

- **Principal Focus ( F)**
  - the point on the principal axis where rays, parallel and close to the principal axis converge (convex lens)
  - the point on the principal axis where rays, parallel and close to the principal axis, appear to diverge (concave lens)
- **Principal Axis** — the straight line connecting the optical centre with principal foci
- **Focal length ( f )** — the distance between a principal focus and the optical centre of a lens
- **Optical centre (O)** — the point which lies on the principal axis through the rays of light passes without any deflection (the geometric centre of a lens)
- **Virtual image** — rays only appear to originate from the image
- **Real image** — light rays actually pass to the image
- **Converging rays** — rays coming closer together
- **Diverging rays** — rays moving away from each other

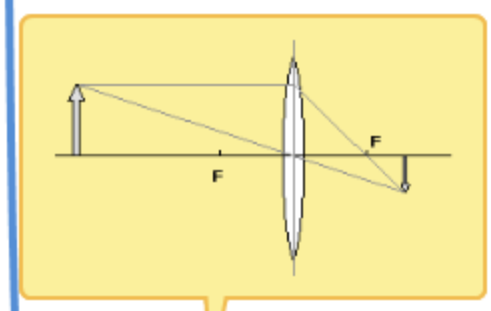
## Convex




- **Object placed within the focal length f** — image is
  - upright
  - magnified
  - virtual

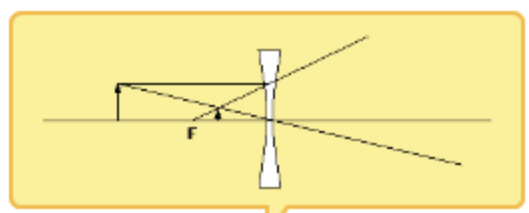



- **Object placed between f and 2f** — image is
  - inverted
  - magnified — Magnification = Image height/object height
  - real




- **Object placed beyond 2f** — image is
  - inverted
  - diminished — Magnification less than 1
  - real

## Concave




- **Object placed any distance from the lens** — image is
  - upright
  - diminished
  - virtual

## Ray diagrams

- **A ray heading for the optical centre** — passes through undeviated
- **A ray parallel and close to the Principal Axis** — Refracted
  - Convex lens: through the Principal Focus on the other side to the object
  - Concave lens: appears to originate from the Principal Focus on object side
- **A ray travelling through A Principal Focus** — emerges parallel to the Principal Axis