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Glossary

Absorption (into bloodstream): the process wherein a substance enters into bloodstream, usually referring to absorption of a soluble substance that has dissolved from a deposited particle.

Acinus: a lung structural unit deriving from a single transitional bronchiole and comprising all the airways distal to it.

Aerodynamic diameter: the diameter of a standard density sphere that has the same settling velocity as the particle under consideration of whatever shape and density.

Aerosol: a suspension of liquid or solid particles in a gas.

Aerosol bolus: a bolus of aerosol that is usually inspired by a subject for study of dispersion and deposition of inhaled particles.

Aerosol diagnosis: identification of diseased conditions with aerosols.

Aerosol dispersion: the process wherein particles are spread out while they remain airborne.

Aerosol therapy: medication through inhalation of an aerosolized drug.

Airway: a passageway for air in the lungs.

Allergen: a substance capable of sensitizing tissue so that the tissue will respond with enhanced sensitivity when challenged by the same substance later.

Alveoli: air cells of the lungs that provide surfaces for gas exchange.

Anatomical dead space: volume of the respiratory tract in which no gas exchange occurs, excluding those alveoli that do not take part in gas exchange.

Antagonism: an interaction between two or more agents that results in a reduction in adverse effect of each agent.

Aspiration efficiency: fraction of ambient particles entering an inlet such as the nose or mouth.

Axial velocity: velocity in the axial direction.

Bifurcation: division of an airway into two branches.

Bifurcation plane: the plane containing a daughter branch and her parent tube in a bifurcation.

Boltzmann equilibrium charge distribution: the distribution of charges on particles when it has reached the equilibrium after exposure to bipolar ions.

Branching angle: the angle between the axes of a daughter branch and her parent tube in a bifurcation.

Breathing frequency: the number of breaths taken in a unit time.

Bronchi: larger airways in the tracheobronchial region.

Bronchioles: smaller airways in the tracheobronchial region.

Bronchitis: inflammation of the lining of bronchial airways.

Bronchoconstriction: constriction in bronchial airways due to contraction of airway walls.

Bronchodilation: dilation of bronchial airways usually by a chemical spray.

Brownian diffusion: the net transport of particles by Brownian motion in the presence of a concentration gradient.

Brownian motion: random motion of particles due to bombardment by surrounding gas molecules.

Carcinogen: an agent that is capable of producing cancer.

Carina: a ridge-like structure formed by the bifurcation of an airway.

Ciliated cell: a type of cell having hair-like structure on its upper surface.

Clearance: the process by which deposited particles are removed from the respiratory tract.

Compartments-in-series model (for respiratory deposition): a deposition model that
consider the respiratory tract as a series of compartments.

**Continuous model (for respiratory deposition):** a deposition model that considers the respiratory tract as a continuous conduit of variable cross section.

**Convective Brownian Diffusion:** transport by Brownian diffusion taking place in flowing fluids.

**Count median diameter (CMD):** the particle diameter that divides, according to particle size, an aerosol into two portions of equal particle numbers.

**Deposition:** the process wherein an airborne particle during its transit or pause in an airway comes into contact with a wall surface and attaches there.

**Deposition density:** the number or mass of particles deposited over a unit surface area.

**Deposition efficiency:** the fraction of entering particles that have deposited in an airway segment.

**Deposition flux:** the rate of deposition per unit surface area.

**Deposition fraction:** the fraction of inhaled particles that have deposited in a respiratory region or the entire respiratory tract in a breath.

**Deposition rate:** the number or mass of particles deposited on a given surface area per unit time.

**Deposition velocity:** the ratio of deposition flux to the mainstream concentration.

**Diffusion coefficient:** the ratio of diffusion flux to concentration gradient.

**Dissolution rate:** the rate at which molecules of a solid enter into a liquid solution.

**Dose-response relationship:** the relationship between the dose an individual receives and the response to that dose.

**Drag force:** the resistance force experienced by a particle moving in a fluid.

**Dry powder inhaler:** a device for delivering therapeutic agents in the form of dry powder.

**Dynamic shape factor:** the ratio of the drag force on the particle under consideration to that on a sphere of equivalent volume diameter.

**Electrostatic attraction:** the attraction between two electric charges of opposite signs.

**Emphysema:** over-inflation of structures arising from a breakdown of alveolar walls.

**Epiglottis:** a plate of flexible cartilage that folds back to cover the glottis during swallowing.

**Epithelium:** a membranous cellular tissue that covers a surface or lines a tube in a body.

**Equivalent diffusion diameter:** diameter of a sphere having the same diffusion coefficient as the particle under consideration.

**Equivalent volume diameter:** diameter of a sphere having the same volume as the particle under consideration.

**Esophagus:** a muscular tube passing from the pharynx to the stomach.

**Expiratory reserve volume (ERV):** the maximum volume of air that can be exhaled from the functional residual capacity.

**Extrathoracic region:** region of the respiratory tract extending from the nose and mouth to the larynx.

**Fibrogenic dust:** particles that is capable of causing gradual scarring or fibrosis of the alveolar region.

**Fibrosis:** a condition characterized by increase of interstitial fibrous tissue.

**Fick’s first law of diffusion:** a relationship first derived by Fick stating that the flux of a diffusing species is equal to the diffusion coefficient multiplied by the negative concentration gradient of the species.

**Flow separation:** detachment of the primary flow from the wall creating a "separated" region with slowly swirling flow.

**Friction coefficient:** the ratio of drag force to particle velocity.

**Functional residual capacity (FRC):** the volume of air in the lungs at end-exhalation of a
normal breath.

**Gas exchange:** the process by which inspired air supplies oxygen to the body and exhaled air transports carbon dioxide out of the body.

**Geometric mean diameter:** the exponential of the mean for a distribution of the logarithms of particle diameter. In a lognormally distributed aerosol, the geometric mean diameter is equal to the count median diameter.

**Geometric standard deviation:** the exponential of the standard deviation for a distribution of the logarithms of a variable such as particle diameter.

**Gravitational settling velocity:** velocity of a particle after the drag and gravitational force have reached an equilibrium.

**Head airways region:** region of the respiratory tract extending from the nose and mouth to the larynx.

**Hot-wire anemometer:** a device for determining gas velocity by measuring the change in electrical resistance of a heated wire.

**Hygroscopic particle:** a particle that is capable of absorbing moisture.

**ICRP model:** a mathematical model for deposition, retention and dosimetry of inhaled radioactive substances developed by the International Commission on Radiological Protection.

**Image force:** attractive force between a charge and the image charge it induces in a nearby surface.

**Inertial deposition:** deposition of a particle due to its inertia.

**Inertial impaction:** impaction of a particle onto a surface due to its inertia when the flow in which the particle is suspended makes a sudden turn.

**Inhalable fraction:** the fraction of ambient particles that can enter the nose or mouth.

**Inhalable particulate mass (IPM):** the mass fraction of ambient particles that can enter the nose or mouth.

**Inspiratory capacity (IC):** the maximum volume of air that can be inspired from the functional residual capacity.

**Interception:** the mechanism by which an aerosol particle is captured when it passes by a surface within a particle radius.

**Interstitium:** interstitial tissue.

**Jet (flow):** a stream of fluid discharged from a narrow opening.

**Kinematic viscosity:** the ratio of the viscosity to density of a fluid.

**Knudsen number:** mean free path of gas molecules divided by particle radius.

**Laminar flow:** the type of fluid flow characterized by streamlines that do not mix with each other.

**Larynx:** the part of airways that contains the vocal cords.

**Lipophilicity:** affinity for lipids.

**Local deposition:** deposition over a small surface area of airway walls.

**Lognormal distribution:** a form of distribution in which the distribution density is normally distributed with respect to the logarithms of a variable.

**Lymphatic system:** a part of the immune system consisting of lymph nodes and lymphatics (the small vessels that link the lymph nodes).

**Macrophage:** a wandering cell that is capable of engulfing particles or other materials.

**Magnetic resonance imaging (MRI):** a noninvasive imaging technique based on nuclear magnetic resonance of atoms in body tissues induced by the application of radio waves.

**Mass median aerodynamic diameter (MMAD):** the aerodynamic diameter that divides,
according to particle size, an aerosol into two portions of equal particle masses.

Mass median diameter (MMD): the particle diameter that divides, according to particle size, an aerosol into two portions of equal particle masses.

Mean free path of gas molecules: the average distance that a gas molecule travels between two successive collisions.

Mechanical mobility: the ratio between the velocity of a particle and the force producing that velocity. It is equal to the inverse of the Stokes friction coefficient.

Metal fume fever: a fever caused by inhalation of fumes from molten metals.

Metered-dose inhaler: a device for delivering exact doses of therapeutic agents with a metering valve.

Minute volume: the total volume of air inspired in one minute.

Molecular diffusion: the process by which fluid molecules move from a region of higher to one of lower concentration as a result of thermal motion.

Monodisperse aerosol: an aerosol in which all particles are of the same size.

Mouth inhalability: the fraction of ambient particles that can enter the mouth.

Mucociliary escalator: mucus flow that moves up tracheobronchial airways as a result of beating by underlying cilia.

Nasal augmenters: normal nose breathers.

Nasal septum: wall between the two nasal cavities.

Nasal turbinates: three scroll-like cartilaginous plates on the lateral walls in the main nasal cavity.

Nasal valve: the part of nasal airways located about 1.5 cm downstream of the nostrils.

Nasopharynx: the portion of the respiratory tract between anterior nares and epiglottis.

NCRP model: a mathematical model for deposition, retention and dosimetry of inhaled radioactive substances developed by the National Council on Radiation Protection and Measurements.

Nebulizer: an atomizer that generates droplets from a liquid kept in a small container.

Nose inhalability: the fraction of ambient particles that can enter the nose.

Orientation angle: the angle between the normal of the bifurcation plane of the tube under consideration and the normal of the bifurcation plane of the parent tube.

Particle Reynolds number: the Reynolds number based on particle diameter.

Péclet number: the ratio of convective mass transfer to diffusional mass transfer.

Phagocytosis: the process by which a cell engulfs a solid particle.

Pharynx: the part of airways between the nasal cavity and the larynx. It is also the passageway for food from the mouth to the esophagus.

Physiological dead space: volume of the respiratory tract in which no gas exchange occurs, including those alveoli that do not take part in gas exchange.

Poiseuille flow: laminar flow in a circular tube with a parabolic velocity profile.

Polydisperse aerosol: an aerosol in which particles have various sizes.

Pneumoconiosis: disease characterized by scars due to increase in interstitial fibrous tissue resulting from retention of certain types of mineral particles in the alveolar region.

Projected area diameter: diameter of a circle that has the same area as the projected area of the particle under consideration.

Pulmonary region: gas exchange region of the lungs.

Recirculation (flow): flow that recirculates in a small region.

Regional deposition: deposition in a single region of the respiratory tract.

Relaxation time: the time a particle takes to adjust its velocity when it is subject to a new set of forces.

Residual volume: the lung volume at the maximum expiratory level.
Glossary

**Respirable fraction:** fraction of ambient particles that can reach the alveolar region.

**Respiratory tract:** the entire airway system extending from the nose and mouth to the pulmonary region.

**Retention:** the amount of deposited particles remaining in the respiratory tract.

**Reynolds number:** a dimensionless number related to the ratio of inertial to viscous forces in a fluid flow.

**Schmidt number:** the ratio of kinematic viscosity to diffusion coefficient.

**Secondary flow:** a small flow superimposed on the primary flow.

**Sherwood number:** the ratio of total mass transfer to diffusional mass transfer.

**Slip correction factor:** a correction to Stokes law to account for deviation from the assumption that the gas velocity is zero on the particle surface.

**Stokes law:** a relationship first derived by Stokes that describes the drag force on a sphere moving at a constant velocity relative to fluid.

**Stokes number:** a dimensionless number defined as the ratio of the stop distance of a particle to a characteristic length of the system under consideration.

**Stop distance:** the distance a particle continues to travel in the absence of external forces before coming to a stop by the resistance of air.

**Synergism:** the interaction of two or more agents that produces an adverse effect greater than the sum of the effects resulting from exposure to each agent separately.

**Targeting (in aerosol therapy):** delivering therapeutic agents to specific parts of the lungs.

**Terminal settling velocity:** the steady velocity acquired by a particle settling in the gravitational field.

**Thermodynamic particle diameter:** diameter of a sphere having the same diffusion coefficient as the particle under consideration.

**Thoracic regions:** the part of respiratory tract comprising the tracheobronchial and alveolar regions.

**Tidal volume (TV):** the volume of air inhaled and exhaled during a breath.

**Total deposition:** deposition in the entire respiratory tract.

**Total lung capacity (TLC):** the volume of air in the lungs at maximum inspiration.

**Trachea:** the part of airways between the larynx and main bronchi.

**Tracheobronchial region:** the part of airways extending from the trachea to terminal bronchioles.

**Transition zone:** the region between the outlet of the parent tube and the inlets of daughter branches in a bifurcation.

**Turbulent flow:** the type of fluid flow characterized by random eddy motion.

**Typical path lung model:** a lung model using a single typical pathway to represent the entire lungs or a lobe.

**Ultrafine particles:** particles smaller than 0.1 μm in diameter.

**Vital capacity (VC):** the maximum volume of air that can be exhaled from the lungs after maximum inspiration.

**Womersley number:** ratio of the magnitude of oscillatory disturbance in the boundary layer to the magnitude of the steady flow boundary layer.

**Acronyms**

- **ABD** Aerosol bolus dispersion
- **ACGIH** American Conference of Governmental Industrial Hygienists
- **ADAM** Aerosol-derived airway morphometry
- **COPD** Chronic obstructive pulmonary disease
Glossary

| Abbreviation | Definition |
|--------------|------------|
| ERV          | Expiratory reserve volume |
| FRC          | Functional residual capacity |
| IC           | Inspiratory capacity |
| ICRP         | International Commission on Radiological Protection |
| IPM          | Inhalable particulate mass |
| IRV          | Inspiratory reserve volume |
| NCRP         | National Council on Radiation Protection and Measurements |
| PM           | Particulate matter |
| PM$_{10}$    | Particulate matter smaller than 10 μm in aerodynamic diameter |
| PM$_{2.5}$   | Particulate matter smaller than 2.5 μm in aerodynamic diameter |
| ROS          | Reactive oxygen species |
| RV           | Residual volume |
| SARS         | Severe acute respiratory syndrome |
| TGLD         | Task Group on Lung Dynamics (an ICRP task group) |
| TLC          | Total lung capacity |
| VC           | Vital capacity |