# Product Design Specifications

# Respiratory Demonstration Device

Janelle Anderson, Malini Soundarrajan, Chris Goplen, Lynn Murray, Kristen Seashore
December 3rd, 2007

**PURPOSE & DEVICE FUNCTION:**

Currently, a basic balloon and latex membrane model is being used to represent the lungs, and diaphragm, respectively for classroom instructional purposes. While they demonstrate respiratory mechanics, the models have a short lifespan and do not display alveolar and intrapleural pressure changes. Further, current models do not accurately depict the anatomical scaling of the lungs with respect to the thoracic cavity.

Our goal is to design and build an adequate mechanical respiratory model for class instruction purposes. This model should demonstrate pressure differences between alveolar and intrapleural spaces. It must further demonstrate the expansion of the thoracic cavity from the rib cage as well as the diaphragm, thereby displaying a 3-D expansion. The size of the lungs relative to the size of the thoracic cavity enclosure should be scaled to represent the human anatomy. The lungs in the current model inflate to fill roughly 1/15 of the thoracic cavity, when in actual humans the lungs inflate to fill nearly the whole cavity with the exception of the space occupied by the heart and major blood vessels [1]. The device must also be portable and small enough to use with a document camera.

**CLIENT REQUIREMENTS:**

- Long-lasting, easily replaceable parts
- Portable
- Displays alveolar and intrapleural pressures
- Scales lungs, thoracic cavity, and diaphragm correctly
- Operable by one user

**DESIGN REQUIREMENTS:**

1. Physical and Operational Characteristics
    a. Performance Requirements
        i. Reusable. The unit will be used about four weeks per year, so the pieces should be durable.
        ii. Easily replaceable lungs and diaphragm.
        iii. Operable by a single user.
    b. Safety
        i. Non-toxic and non-absorbing materials.
        ii. Durable. The device should withstand regular usage.
        iii. No sharp edges. Edges should be rounded to prevent any cuts or scrapes from being incurred by the demonstrator or students.
    c. Shelf Life
        i. Approximately 30 years.
    d. Operating Environment

i. Lecture hall and laboratory instructional settings.
ii. Between room temperature and temperature of document camera (25°C-30°C).

e. Size
i. Must fit on a document camera for lecture demonstrations (11” x 13”).
ii. Portable such that a professor or lab instructor can lift the device to transfer it easily to and from classrooms.
iii. Device should be small enough to fit in a standard cabinet or storage closet for easy storage.

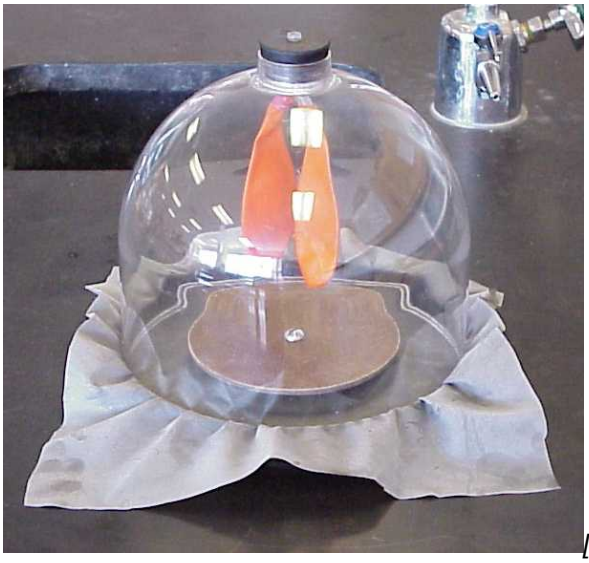
f. Weight
i. The device should weigh less than 15 pounds so that it can be transported around, when not in use, without inducing excessive stress on the lab instructor’s arm and back muscles.

g. Pressure Measurement
i. Must display alveolar and intrapleural pressures relative to each other.
ii. Analog gauges only.
iii. Pressure measurements should be easily readable using lecture document camera.

h. Aesthetics
i. Transparent container to better visualize lung mechanics.
ii. Red colored lungs to enhance physiological representation.
iii. Cylindrically shaped container to model the thoracic cavity.

2. Production Characteristics
a. Quantity: 1 unit
b. Target Product Cost: under $500

3. Miscellaneous
a. Competition:
i. Acrylic model with latex diaphragm and balloon lungs


*[2]*

b. Ethics:
i. Model could replace use of animals in teaching students.

***References:***

[1] http://www.lib.mcg.edu/edu/eshuphysio/program/section4/4ch2/asidpg28.htm. Thoracic Cavity Volume.

[2] http://www.xecu.net/kiirenza/anatomy/resp_models.htm. *Picture of current model.*