Modelling Method of Respiration Internal Organ

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Modeling and Animation of Internal Organs of Human being
Human Respiratory Internal Organ
The respiratory system provides oxygen to the body’s cells while removing carbon dioxide, a waste product that can be lethal if allowed to accumulate.

There are many parts of the respiratory system, including the nose, mouth, pharynx, larynx, trachea, bronchi, and bronchioles, etc.
Respiration Organ System

- We have created 3D of respiratory representation model system in the purpose of:
  - Analyzing the each part of respiratory model
  - Showing explanation of each part
  - Being able to change to another model object
- There are two major parts in this system: lower respiratory and upper respiratory system.
Names of Upper Respiration Organ

- The parts of the respiratory system lying above the sternal angle (outside of the thorax), above the glottis (vocal cords), or above the cricoid cartilage.
- The **nose** and **nasal cavity** are the first section of the body’s airway.
- **Pharynx**, also know as the throat – is divided into 3 regions; the **nasopharynx, oropharynx, and laryngopharynx**.
- **Larynx**, also know as the voice box, is a short section of the airway that connects the laryngopharynx and the trachea and has the associated cartilage that produces sound.

https://en.wikipedia.org/wiki/Respiratory_tractt
The lower respiratory tract or lower airway is derived from the developing foregut and consists of the trachea, bronchi (primary, secondary and tertiary), bronchioles (including terminal and respiratory), and lungs (including alveoli.) It also sometimes includes the larynx.

https://en.wikipedia.org/wiki/Respiratory_tracttt
Larynx & Trachea structure

Thyroid cartilage, right lamina
Corniculate cartilage
Arytenoid cartilage
Lamina of cricoid cartilage
Membranous wall
Tracheal glands
Trachealis m.
Tracheal bifurcation
Left main bronchus
Right main bronchus
Left superior lobar bronchus
Right inferior lobar bronchus
Left inferior lobar bronchus
Right middle lobar bronchus

Tunica adventitia
Tracheal cartilage
Tracheal glands
Epithelium
Mucosa
Tracheal m.
Names of Respiration Organ—Respiration tree

Respiratory tree [edit]

The respiratory tree or tracheobronchial tree is a term also used to refer to the branching structure of airways supplying air to the lungs and includes the trachea, bronchi and bronchioles.

- trachea
  - main bronchus
    - lobar bronchus
      - segmental bronchus
        - conducting bronchiole
          - terminal bronchiole
            - respiratory bronchiole
              - alveolar duct
                - alveolar sac
                - alveolus

https://en.wikipedia.org/wiki/Respiratory_tract
### Names of Respiration Organ Tracts

<table>
<thead>
<tr>
<th>Upper Respiration</th>
<th>Lower Respiration</th>
</tr>
</thead>
<tbody>
<tr>
<td>paranasal sinuses (코결)</td>
<td>trachea (기관)</td>
</tr>
<tr>
<td>nasal (코)</td>
<td>main bronchi (주 기관지)</td>
</tr>
<tr>
<td>pharynx (인두)</td>
<td>lobar bronchus (옆 기관지)</td>
</tr>
<tr>
<td>larynx (후두)</td>
<td>segmental bronchus (분절 기관지)</td>
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<tr>
<td>trachea (기관)</td>
<td>conducting bronchiole (지휘 세 기관지)</td>
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<tr>
<td></td>
<td>terminal bronchiole (종단 세 기관지)</td>
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<tr>
<td></td>
<td>respiratory bronchiole (호흡 세 기관지)</td>
</tr>
<tr>
<td></td>
<td>alveolar duct (폐포 관)</td>
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<tr>
<td></td>
<td>alveolar sac (폐포 낭)</td>
</tr>
<tr>
<td></td>
<td>alveolus (치조)</td>
</tr>
<tr>
<td></td>
<td>right lung (오른쪽폐)</td>
</tr>
<tr>
<td></td>
<td>left lung (왼쪽폐)</td>
</tr>
<tr>
<td></td>
<td>diaphragm (횡경막)</td>
</tr>
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</table>
# Table of Respiration Organ Tracts

<table>
<thead>
<tr>
<th>Main Classification</th>
<th>Level 1</th>
<th>Level 2</th>
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</thead>
<tbody>
<tr>
<td>Upper Respiration Tract</td>
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</tr>
<tr>
<td>Nose (코)</td>
<td>Nostril</td>
<td>Nasal Cavity</td>
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<td>Nasal Conchae</td>
<td>Nasal Conchae</td>
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<tr>
<td></td>
<td>Nasal Vestibule</td>
<td>Nasal Vestibule</td>
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<tr>
<td></td>
<td>Olfactory epithelium</td>
<td>Olfactory epithelium</td>
</tr>
<tr>
<td></td>
<td>Internal Naris</td>
<td>Internal Naris</td>
</tr>
<tr>
<td></td>
<td>External Naris</td>
<td>External Naris</td>
</tr>
<tr>
<td>Paranasal sinuses (코관)</td>
<td>Frontal (정면)</td>
<td>Sphenoid (형상골)</td>
</tr>
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<td></td>
<td>Ethmoid (사골)</td>
<td>Ethmoid (사골)</td>
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<td>Maxillary (상악)</td>
<td>Maxillary (상악)</td>
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<td>Pharynx (인두)</td>
<td>Oral Cavity</td>
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<td>Nasopharynx</td>
<td>Nasopharynx</td>
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<tr>
<td></td>
<td>Oropharynx</td>
<td>Oropharynx</td>
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<tr>
<td></td>
<td>Laryngopharynx</td>
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<tr>
<td>Larynx (후두)</td>
<td>Epiglottis</td>
<td>Epiglottis</td>
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<tr>
<td></td>
<td>Thyroid Cartilage</td>
<td>Thyroid Cartilage</td>
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<tr>
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<td>Cricoid Cartilage</td>
<td>Cricoid Cartilage</td>
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<td>Arytenoid</td>
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</tr>
<tr>
<td></td>
<td>Corniculate</td>
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</tr>
<tr>
<td></td>
<td>Cuneiform</td>
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</tr>
<tr>
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<td>Laryngeal cartilage</td>
<td>Laryngeal cartilage</td>
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<tr>
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<td>Hyoid bone</td>
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</tr>
<tr>
<td></td>
<td>Membrane</td>
<td>Membrane</td>
</tr>
<tr>
<td></td>
<td>Ligament</td>
<td>Ligament</td>
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</table>
# Table of Respiration Organ Tracts

<table>
<thead>
<tr>
<th>호흡기관 대분류</th>
<th>호흡기관 중분류</th>
<th>호흡기관 세부항목</th>
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</thead>
<tbody>
<tr>
<td>Lower Respiration Tract</td>
<td>Trachea</td>
<td>Tracheal cartilage</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Anular ligament</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tracheal gland</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tracheal m.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Membranous wall</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tunica adventitia</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Epithelium</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mucosa</td>
</tr>
<tr>
<td></td>
<td>Left Primary Bronchus</td>
<td>Left Bronchial Tree (Left Secondary Bronchi)</td>
</tr>
<tr>
<td></td>
<td>Left Lobar Bronchus</td>
<td>Bronchiole – Terminal Bronchiole – Respiration</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bronchiole</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Respiration Portion (Alveolar Duct – Alveolar Sac - Alveolus)</td>
</tr>
</tbody>
</table>
| Lower Respiration Tract | Left Lung | Superior lobe  
|------------------------|-----------|----------------
|                        |           | Apex of lung  
|                        |           | Horizontal Fissure  
|                        |           | Oblique Fissure  
|                        |           | Middle Lobe  
|                        |           | Inferior lobe  
|                        |           | Inferior border  
|                        |           | Left pulmonary a.  
|                        |           | Left superior pulmonary v.  
|                        |           | Left main bronchus  
|                        |           | Left inferior pulmonary v.  
|                        |           | Costal surface  
|                        |           | Pulmonary ligament  
|                        |           | Parietal pleura, mediastinal part  
|                        |           | Anterior border  
|                        |           | Tracheobronchial node  
|                        |           | Cardiac impression  
|                        |           | Cardiac notch of left lung  
|                        |           | Lingula of left lung  
|                        |           | Diaphragmatic surface; base of lung  

## Table of Respiration Organ Tracts

<table>
<thead>
<tr>
<th>Lower Respiration Tract</th>
<th>Right Primary Bronchus</th>
<th>Right Bronchial Tree (Right Secondary Bronchi)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Right Lobar Bronchus</td>
<td></td>
</tr>
<tr>
<td>Bronchiole – Terminal Bronchiole – Respiration Bronchiole Respiration Portion (Alveolar Duct – Alveolar Sac - Alveolus )</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lower Respiration Tract</td>
<td>Right Lung</td>
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<td>-----------------------------------------------------------------------------</td>
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</tr>
<tr>
<td></td>
<td>Superior lobe</td>
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<tr>
<td></td>
<td>Apex of lung</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Horizontal Fissure</td>
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<td></td>
<td>Oblique Fissure</td>
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<td></td>
<td>Middle Lobe</td>
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<td></td>
<td>Inferior Lobe</td>
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<tr>
<td></td>
<td>Inferior border</td>
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<tr>
<td></td>
<td>Right pulmonary a.</td>
<td></td>
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<tr>
<td></td>
<td>Anterior border</td>
<td></td>
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<tr>
<td></td>
<td>Right pulmonary v.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cardiac impression</td>
<td></td>
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<tr>
<td></td>
<td>Right superior lobar bronchus</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Right main bronchus</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Right middle and right inferior lobar bronchi</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Inferior tracheobronchial node</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Parietal pleura, mediastinal part</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pulmonary ligament</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Diaphragmatic surface; base of lung</td>
<td></td>
</tr>
<tr>
<td>Lower Respiration Tract</td>
<td>Diaphragm</td>
<td></td>
</tr>
<tr>
<td>-------------------------</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>Interior vena cava</td>
</tr>
<tr>
<td></td>
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<td>Phrenic nerve</td>
</tr>
<tr>
<td></td>
<td></td>
<td>distribution on thoracic side</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Right phrenic nerve</td>
</tr>
<tr>
<td></td>
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<td>Left phrenic nerve</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Esophagus</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Right phrenic artery</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Left phrenic artery</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Aorta</td>
</tr>
</tbody>
</table>
Visualization System for Representing Respiratory Internal Organ
There are two 3D object models of the respiratory system: lower and upper respiratory system.
Upper Respiratory Organ of Larynx

Epiglottis (후두덮개)
Hyoid bone (설골)
Left thyroid membrane
Thyroid cartilage
Left Arytenoid cartilage
Right thyroid membrane
Right Arytenoid cartilage
Lamina of cricoid cartilage
Trachea (기관)
Partition of Right Lung

Lower Respiratory Organ (Right Lung)

Right Lung

오른호파 Right lung
오른호파, 위엽 Right lung, superior lobe
- 꼭대기부역 Apical segment [S I]
- 뒷부역 Posterior segment [S II]
- 앞부역 Anterior segment [S III]

오른호파, 중간엽 Right lung, middle lobe
- 가족부역 Lateral segment [S IV]
- 안쪽부역 medial segment [S V]

오른호파, 아래엽 Right lung, middle lobe
- 위부역 Superior segment [S VI]
- 안쪽앞부역 Medial basal segment [S VII]*
- 앞앞부역 Anterior basal segment [S VIII]
- 가족앞부역 Lateral basal segment [S IX]
- 뒷앞부역 Posterior basal segment [S X]

* 이 구역은 일반적으로 독립적인 구역이 아니며, 다소 앞앞부역과 붙어있다(S V VIII).

그림 917 오른호파: 가관지호파구역: 가족면
Partition of Left Lung

Lower Respiratory Organ (Left Lung)

Web3D Consortium
Lower Respiratory of Lung
Partition of Trachea and bronchi

- Thyroid cartilage, right lamina
- Median cricothyroid ligament
- Tracheal cartilages
- Median cricothyroid ligament
- Anular ligaments
- Tracheal bifurcation
- Left main bronchus
- Right superior lobar bronchus
- Right main bronchus
- Right inferior lobar bronchus
- Bronchial cartilage
- Left main bronchus
- Left superior lobar bronchus
- Left interior lobar bronchus
- Bronchial cartilage
지침 909 후두: 기관과 기관지: 앞면

기관명골
Tracheal cartilages

기관성
Tracheal glands

고리연대
Angular ligaments

막
Membranous wall

기관근
Trachealis m.

구리기관지
Right main bronchus

오른위엽기관지
Right superior lobar bronchus

오른아래엽기관지
Right inferior lobar bronchus

오른중엽기관지
Right middle lobar bronchus

외기기관지
Left main bronchus

외기기관지
Left superior lobar bronchus

외기기관지
Left inferior lobar bronchus
그림 910 기관; 가로단면; 현미경 저배율 확대
• 3D object Event
  • Click on each model object to show model title button
  • Click on each model title button to show model detail description

• Menu Option Button Event
  • Click on 1\textsuperscript{st} option to switch to upper model object (new scene)
  • Click on 2\textsuperscript{nd} option to stay on current model object (current scene)
Respiratory Organs Development

3D models of lower and upper respiratory tract

Development Features

We have imported those 3D models to create some features:

- Scene/ add object
- UI buttons and panels
- Menu option to switch objects
- Script events

Upper Respiratory Tract

Lower Respiratory Tract
1. Click on object part to show object title button

```csharp
void OnMouseDown()
{
    GameObject.FindGameobjectWithTag("btnLung").SetActive(true);
    btnLung.gameObject.SetActive(true);
    // mesh = this.gameObject.GetComponent<MeshRenderer>();
    switch (this.gameObject.name)
    {
    case "Trachea":
        Debug.Log("Trachea");
        // call method to clear panel
        panel.clearPanel(panelLung);
        panel.clearPanel(panelDiaphragm);
        // call method to show and hide button
        showHideButton("btnLung", false, 0, 0, 0);
        showHideButton("btnDiaphragm", false, 0, 0, 0);
        showHideButton("btnTrachea", true, 1, 1, 1);
        //showHideLine(lineTrachea, true);
        showHideLine(lineLung, false);
        showHideLine(lineDiaphragm, false);
        lineTrachea.GetComponent<Renderer>().enabled = true;
        mesh.material.color = Color.red;
        break;

    case "Lung":
        Debug.Log("Lung");
        // call method to clear panel
        panel.clearPanel(panelTrachea);
        panel.clearPanel(panelDiaphragm);
        // call method to show and hide button
        showHideButton("btnTrachea", false, 0, 0, 0);
        showHideButton("btnDiaphragm", false, 0, 0, 0);
        showHideButton("btnLung", true, 1, 1, 1);
        //showHideLine(lineLung, true);
    }
```
2. Click on model title button to show model detail

```csharp
public class PanelScript : MonoBehaviour {
    public GameObject panelLung, panelDiaphragm, panelTrachea;
    private int lungCounter;
    private int diaphragmCounter;
    private int tracheaCounter;

    // Use this for initialization
    void Start()
    {
        Debug.Log("START");
        lungCounter++;
        diaphragmCounter++;
        tracheaCounter++;
        panelLung = GameObject.Find("PanelLung");
        panelDiaphragm = GameObject.Find("PanelDiaphragm");
        panelTrachea = GameObject.Find("PanelTrachea");
        clearPanel(panelLung);
        clearPanel(panelDiaphragm);
        clearPanel(panelTrachea);
    }

    public void hide/showPanelTrachea()
    {
        tracheaCounter++;
        diaphragmCounter = 1;
        lungCounter = 1;
        if (tracheaCounter % 2 == 1)
        {
            Debug.Log(tracheaCounter + " HIDE TRACHEA");
            panelTrachea.gameObject.SetActive(false);
        }
        else
        {
            Debug.Log(tracheaCounter + " SHOW TRACHEA");
            panelTrachea.gameObject.SetActive(true);
        }
    }
}
```
3. Click on menu button to switch object model (scene)
Thank you!