The Aging Voice: Physiological Changes and Singing Considerations:

I. Life span is getting longer
   A. More active adults
   B. Singing for longer periods of time
      i. 12% of the elderly have voice dysfunction
         1. Elderly people who live alone may not speak to anyone for extended periods of time
      ii. Increased popularity of senior citizen choirs
         1. Retirement communities
            a. Socialization
            b. Voice therapy
         2. Community choirs
         3. Church choirs

II. Physical changes in the singing mechanism
   A. There is extreme individual variation between people
      i. Three elements
         1. Acoustic
         2. Anatomic
         3. Physiologic
      ii. Correlation between healthy lifestyle and longevity
         1. Nutrition
         2. Exercise
            a. Age-related muscle atrophy in skeletal muscles can be slowed or possibly reversed by exercise
            i. Not extensive research on vocal benefits
            ii. As respiratory ability decreases with age, it is essential to remain as close as possible to optimum respiratory ability through cardiovascular exercise
         3. Good vocal/oral health
            a. Daily vocalization
               i. Can help eliminate vocal tremor and increase accuracy and endurance
            b. Hydration
            c. Rest when needed
               i. Respect vocal instrument
            d. Choosing appropriate literature for voice type and stage of development
   B. Natural decline in muscle mass and aerobic capacity
      i. Reduction in pulmonary ventilation, reduced endocrine function, and water metabolism
         1. Decreased force and rate of contraction of respiratory muscles
         2. Loss of elasticity of lung tissues
            a. Decreased recoil of lung tissues
         3. Can cause edema in vocal folds
            a. Develops in the superficial layer of the lamina propria
            b. In women, a decrease in estrogen causes edema
               i. Swelling of folds
               ii. Increase in mass of folds
         4. Many degenerative changes are a result of decreased blood supply to the larynx
            ii. Hinders foundational breathing for singing
               1. Voice is more fragile; also, there is not enough breath support to allow the voice to function correctly
iii. Atrophy of muscles

1. Atrophy of the thyroarytenoid muscle fibers tends to pull the medial surface of the vocal fold laterally, creating a bow in the fold
   a. Difficulty in closing the vocal folds uniformly across the medial surface
      i. Causes a weaker, breathier sound
   1. Diagram 1 (Sataloff, 116)

2. Loss of muscle fibers will also limit range of pitch, intensity, and register adjustment
   a. Due to thyroarytenoid
      i. Thyroarytenoid muscle atrophy differs from other skeletal muscle atrophy
         1. More fibrous

3. Loss of myonuclei
   a. Body is not able to quickly reproduce due to decrease of motor neurons and myonuclei (muscle nuclei)

4. Ligaments also atrophy

C. Changes to the voice

i. Limited amount of research specifically for singing
   1. Contradictions of some of the physical elements
      a. Thickening of folds
         i. Since some areas of the folds thin and others thicken, there has been confusion and misinformation
      b. Production of mucus
   2. Literature on the change in dimensions of the vocal tract are sparse

ii. Different between males and females
   1. Issues seem to affect women more dramatically
   2. Females
      a. Vocal changes occur around menopause
         i. “Laryngopathia prementrualis”
      b. The vocal folds in women tend to lose some of their natural elasticity
         i. Epithelium of the vocal fold thickens
      c. Viscosity of the lubricating mucus changes
         i. Mucus membrane thickens
d. Average fundamental frequency of the voice lowers
   i. Second formant values become progressively lower with age

e. Loss of chest register

f. Rapid change in pitch and timbre

g. Difficulty in accuracy of pitches and intonation
   i. Vocal jitter
      1. Vibratory synchrony or asynchrony
         a. Manifested by vocal-fold movement perturbations
            i. Small cycle-to-cycle variations of fundamental pitch
            ii. Highly affected by physical changes in the voice

h. Voice tremor
   i. Asymmetrical vibration
      1. Degree to which the two folds were mirror images to each other during vibration was not large

i. Vocal quality may become more husky-sounding

j. Hormones
   i. Hormone therapy has been recommended, but may cause other health issues
      1. Low dose of progesterone
      2. Conjugated estrogens may be preferable to estadiol
         a. May have less negative effects on vocal mechanism
   ii. Women should have hormone levels checked in mid-30s if they believe that they will need hormone therapy to continue singing

3. Males
   a. Structural changes in the vocal mechanism more evident in males than in females
   b. Vocal changes occur around age 60
      i. Men’s voices lower until age 40-50, then rise with increasing age
   c. Average fundamental frequency rises
   d. Layers of the lamina propria show changes in thickness and elasticity
      i. Superficial (epithelium) and intermediate (lamina propria) layers tend to become thinner
         1. Contradictory research
         2. Elastic fibers in the intermediate layer become less dense and have a tendency to atrophy
            a. Thinning does not allow support for the folds and the chords bow
         3. Folds atrophy and bow (cell death)
      ii. Deep layer thickens
      iii. Atrophy of laryngeal muscles
   iv. Diagram 2 (Sataloff, 63)
e. Membranous vocal folds shorten
   i. Especially after age 70
f. Collagenous fibers in the deep layer of the vocal fold become denser and fibrotic
g. Cricoarytenoid joint cartilage changes
   i. May limit range of motion of arytenoid cartilage and reduce the degree and extent of the vocal fold closure
   ii. Changes in the cricoarytenoid joint mean that the voice is less responsive and less able to transmit sub-glottal pressure
h. Breathy and quiet tone quality
   i. Erosion of joint surfaces affects the approximation of the arytenoids
      1. Accuracy of tone is hindered
   j. Imprecise articulation
      i. “Glottal gaps” common
         1. Inability to completely close glottis
         2. Delay of onset
         3. Inability for smooth breath-tone connection
            a. Severe cases lead to surgical and injection treatments
               i. Use of Teflon injected into the fold to restore rigidity
               ii. Laryngeal framework surgery
                  1. Implantation of supports within the larynx to alleviate bowing
j. Age-related changes of the conus elasticus have been well defined in the male vocal mechanism
   i. Few affects on the female voice
   iii. Increased ossification and calcification of the laryngeal cartilages
     1. Elastic cartilages: vocal process and apex of the arytenoid corniculate and epiglottis do not ossify
     2. Hyline cartilages: thyroid, cricoid, and most of the arytenoids do ossify
        a. Hyline cartilage becomes replaced by bone and exhibit Harversian systems and lamellae with osteocytes
           i. Compact bone that forms tiny, concrete platelets called lamellae
              1. Each system has blood vessels and lmnh abilities
2. Relationship to petal-like crystals of kidney stones
3. Stiffening of thyroid may lead to hindering of vocal cord adduction
   a. Process begins in thyroid, then cricoid, and finally the arytenoids
      i. Begins in the inferior horns and progresses along the inferior and
         posterior borders
      ii. Ossification then moves to the anterior border
   b. Largest concentration of ossification occurs in the zones near where muscles
      are inserted
4. Ossification begins earlier with males
   a. Males begin around age 30
   b. Females begin around age 40
      i. Ossification elements always present in larynges, but the degree
         increases with age
         1. Hyoid bone starts to ossify by age two
5. Complete ossification of laryngeal skeleton
   a. By approximately age 65
   b. Cuneiform and corniculate cartilages do not ossify
   c. Not constant in all people
6. Change of articular surface
   a. Ossification changes structure
      i. Interferes with smoothness of the arytenoid cartilage movement
         1. Affects positions of the vocal folds
            a. Leads to glottal incompetency
iv. Joint changes
   1. Cricoarytenoid arthritis
      a. Same structure as other joints that are susceptible to arthritis
         i. Begins with inflammation of the synovial lining and the articulating cartilages
         ii. Cartilage is eventually replaced by connective tissue
iii. As this cartilage is destroyed, a compensatory overgrowth occurs on the opposite cartilage
   1. Sensation is of a fullness in the throat
      a. Foreign object or tension
   2. Pain when speaking or swallowing
   3. Pain radiating to the ear

iv. Treatment
   1. Rest
   2. Steroid/drug therapy

v. Hearing loss
   1. Aural feedback needed for accurate pitch and also tone quality
      a. Loop is disrupted and brain has no way to monitor the sound being produced

vi. Articulators
   1. Loss of saliva
      a. Decrease in output from salivary glands
      b. Challenges with quick and precise articulations
         i. Loss of acinar components
            1. Smallest secreting area of gland
         ii. Increase in fat around gland area
         iii. Vascular and connective tissue changes

vii. Control of voice
   1. Contradictory statements about loudness versus softness
      a. Softness
         i. Loss of breathing foundation and support
         ii. Atrophy of muscles and joints does not allow full closure
      b. Loudness
         i. Loss of control due to atrophy
         ii. Hearing loss forces singer to sing louder to hear themselves

viii. Changes in oral cavity
   1. Loss of dentition
      a. Unfamiliarity with dentures and dental implants
   2. Xerostomia
      a. Dry mouth
         i. Feeling of soreness in throat due to lack of moisture

ix. Presbyphonia
   1. Vocal condition in aging people
      a. Combination of many of the vocal challenges
         i. Reduced loudness
         ii. Hoarseness
         iii. Harshness
         iv. Increased breathiness
         v. Strain
         vi. Unsteadiness

III. Exercise and Repertoire Considerations

   A. Female voice lowers and male voice raises
      i. Range from A2 to F4
         1. Tessitura should be mid-range for both
      ii. Psychological considerations
         1. Frustration with loss of ability
            a. Former sopranos are now not able to sing notes accurately and easily
               i. Can cause tension in the voice
1. Compensation for deterioration
2. Pride and acceptance/leadership
b. Selection of appropriate repertoire
c. Focus on positive elements of “new voice”

2. Repertoire that is musically and intellectually challenging, but not as vocally taxing
a. Limited ranges
   i. Shrinking of vocal register
b. Limited melismas
   i. Loss of accuracy to core of pitch
c. Limited sustained passages
   i. Reduced respiratory function
      1. Smaller amount of available air
      2. Tendency for air leakage due to incomplete closure of the glottis
d. Standard repertoire from the canon
   i. Focus on musical elements
   ii. Focus on historical context
   iii. Focus on performance practice
e. Folk songs and nostalgia works
   i. Historical context
      1. Personal relationships and experiences
   ii. Reputable repertoire, but accessible ranges
   iii. Positive psychological elements
      1. Favorite pieces
      2. Reminiscing

B. Exercises
   i. Focus on flexibility and agility
      1. Gliding exercises
         a. Example 1

\[ \text{Example 1} \]
2. Stepwise, repeating pattern exercises
   a. Example 2

b. Example 3

ii. Monitor and focus on breathing throughout exercises and rehearsal
   1. Diaphragmatic breathing
   2. Increasing extent of thoracic expansion
   3. Increasing period of rib elevation
   4. Increasing ability to hiss for longer periods of time
      a. “Bubble lips”

iii. Work entire range to keep folds agile
   1. Arpeggios to help extend range
      a. Example 4

C. Rehearsal considerations
   i. Plan for more breaks
      1. Re-establish breathing foundation when returning from break
   ii. Be mindful of tessitura
1. Within specific piece
2. Consecutive pieces

D. Repertoire Suggestions
i. Telemann: "Jesu, meine freude"
ii. Durante: "Magnificat"
   1. Many Baroque pieces have more of a limited range, but the melismas may be a challenge
iii. Traditional hymn arrangements
   1. Many arrangements that can fit your specific voicing as well as musical level of the ensemble
iv. Virgil Ford: “Unto Thee, O Lord” (G. Schirmer: HL50310820)
v. Handel: “Hallelujah, Amen” from Judas Maccabeus
vi. Cherwien (arr.): “Prayer for Peace” (Concordia: 98-3652)
vii. Siegfried (arr.): “Shaker Songs” (earthsongs)
viii. Mozart: “Ave Verum Corpus,” K.V. 618
ix. Schütz: “Ego sum tui plaga doloris” (Presser: 312-40368)
x. Warland (arr.): “Coventry Carol” (Concordia: 98-1928)
xi. Ray: “He Never Failed Me Yet” (Hal Leonard: 44708014)
xii. Morley: “Lirum, Lirum”
xiii. Thomas: “Keep Your Lamps”
xiv. Pieces to avoid
   1. Beethoven: “Missa Solemnis”
   2. Barber: “Agnus Dei”
   3. Tavener: “Song for Athene”
   4. Bernstein: “Make Our Garden Grow”