NSF Challenge 1

Problem context:

Movement occurs at many physical scales. At the micro-scale, cancer cells move through the body in spaces the human eye cannot see. At the macro-scale, aircraft traverse the globe over distances and speeds that the human body cannot mimic. The most intuitive scale for most people to understand is the movement of their own body over the period of day: the rise and fall of your chest as you breathe, the path you travel as you walk your dog, or the way you dance in response to music. Visualizations of movement data allow us to artificially witness movement that we cannot directly observe or intuitively comprehend. This creates an inequitable learning opportunity for individuals who cannot interact with visual representations due to visual impairments. Additionally, visual representations limit the number of dimensions of variables that can be simultaneously represented at a given time.

Challenge Statement:

For your challenge, design an auditory representation of the movement of a specific object (you can choose the object and the scale). How can we use sound to humanize our relationship to data? Can we use sound to make data more accessible to more people (for example, people with visual impairments or people who cannot understand textual information quickly)? Can we use sound to inspire an emotional connection to data (what stories do our data tell, how might emotion inspire us to act on what we learn from data)? How many variables should be included in your system of sounds to describe the movement of your object? What purpose might your system of sounds serve?

We included a list of links and resources to help you construct your auditory representation.

- Pieces composed from sonified protein structure.
- Mueller Report Redactions sonified here.
    - Example code here.
    - Note how the data was converted to a CSV. The row numbers were basically transformed into musical time, and column G (% redacted) was turned into a MIDI value, which was the pitch.

We included a list of tasks and examples to begin your brainstorming process.

Recommended Brainstorm Tasks	*Example 1*	*Example 2*	*Example 3*
Choose a movement "object"	Metastatic cancer cells	Human body	Aircraft
Identify the "scale" of the object's movement	Micro	Mezzo	Macro
Identify "variables" that describe the movement of one of those objects over a period of time.	The **number** of cancerous lesions at the secondary (metastatic) site. The **distance** traveled by cancer cells from primary to secondary site.	The **length** of your stride while walking. The **distance** traveled over the course of a day.	The **speed** of one specific aircraft over the duration of one flight. The **altitude** of one specific aircraft over the duration of one flight.
Identify "variables" that describe the movement of a group of those objects over a period of time.	The **number** of cells that break way from the primary (original) tumor site. OR The **number** of circulating tumor cells that are detectable in the blood stream.		The **hourly traffic flow** at a specific airport over a week period. The **distance traveled** by each arrival flight at an airport over a 24-hour period.
Add a row about spatial location?	Networks of important sites within the body [secondary cancer propagating to other locations]...		Geography networks and hub airports... hub and spoke models... Variable that represents spatial location of the movement object?

Assign a sound to one or more of the variables.	*Both the number of cancerous cells and the distance traveled could be mapped onto frequency (Hz), MIDI pitches, volume, or timbre.*	*[Daniel?]*	*Speed could be mapped onto tempo or rhythmic activity, as well as pitch. Altitude could map onto pitch height as measured in frequency. Traffic flow and density could be mapped onto the number of instruments, sounds, or sound sources. Density mapped onto density.*
Brainstorm how that sound can change to represent the range of the variable's values.	*What is the most effective way of sonifying this data? Distance as conveyed by volume or number of instruments? Pitch or tempo mapped to the number of cancerous cells?* *How does this facilitate a greater understanding of this data?*	*[Daniel?]*	*What is the most effective way of sonifying this data? Do some variables map more directly onto physical space? How is density best mapped?* *How does this facilitate a greater understanding of this data?*
Design a system of sounds to communicate multiple movement variables.			
What purpose might the system of sounds serve?	Research? Education? Art? Decision-making? Etc	Research? Education? Art? Decision-making? Etc	Research? Education? Art? Decision-making? Etc