Basic Animation Techniques Tutorial

Once you complete the steps in this video, you will create an animation like shown is this video:
https://youtu.be/7-Q3rdLYhAo?si=B_AYNAQShLOkBO5d
This animation uses the PDB structures of the voltage-gated sodium channel 6j8j and 5x0m.

Note: If you want to focus on creating the animations only, you can start with the **04-scene-recording.cxs** and navigate to the simplified story board to run the commands and save the movies. At the end of this tutorial you will find the commands to create an animated gif using the **04-scene-recording.cxs** session.

Preparation of the Assets

A: Getting the PDB structures into the ChimeraX session

1. File > Fetch by ID > 6j8j
2. Select > Chains > chain B
3. Action > Atom/Bonds > Delete
4. Select > Chains > Chain C
5. Action > Atom/Bonds > Delete
6. File > Fetch by ID > 5x0m
7. In the Models Panel hide the missing structure and labels

These steps result in two alpha subunits of the voltage-gated sodium channel, one in open, one in closed confirmation shown in the viewport

#1 6j8j -open
#2 5x0m -closed

Final results after these steps are completed
00-PDB-structures.cxs

B: Creating the morph: Start with the file from step A or open 00-PDB-structures.cxs

1. Align the structures
   match #2 to #1
2. Create morph that goes from closed to open confirmation over 50 Frames
   morph #2, 1 frames 50

C: Creating the closed state model:

1. Use the combine #3 command. This will create a copy of the morph. Note, that this the full morph. We will only use frame 1 as the closed state.

D: Highlighting the voltage-gated domains on the morph

1. Use the select and select add to select all relevant residues
   Paste into the command line:
   select #3/A:619;
   select add #3/A:616;
   select add #3/A:613;
   select add #3/A:610;
   select add #3/A:236;
   select add #3/A:233;
   select add #3/A:230;
   select add #3/A:227;
   select add #3/A:1265;
   select add #3/A:1268;
   select add #3/A:1271;
   select add #3/A:1274;
   select add #3/A:1277;
   select add #3/A:960;
   select add #3/A:957
2. Go to Actions > Atom/bonds > Show to show the side chains
3. Go to Actions > Atom/bonds > Atom Style > Sphere
4. Co to actions > Atom/bonds > Color > Yellow

Final result: 01-models.cxs

E: Saving views. Start with the file from Step D or open 01-models.cxs

1. Starting here you need to work with proper size ratio of the viewport as the content we are about to create is relative to the size of the window
   windowsize 1280 720
2. Position your molecule to the main view and save the view
   view name front
3. Turn the model 180 degrees on the y axis
   turn y 180
4. Save the next view as back
   view name back
5. Reset the front view
   view front
6. Turn the molecule 90 degrees on the x axis and save the view as top

view name top

7. Run the view list command to see all saved views in the log to make sure that all views are saved

Final result: 02-views.cxs

F: Creating labels, lines and arrows. Start with the file from Step D or open 02-views.cxs

1. Set the view to front
   view front
2. The membrane will be indicated using 4 lines. We can use the 2dlabels arrow command and set the attribute headStyle to pointer
   2dlabels arrow start 0.5,0.5 end 0.5,0.7 color gray weight 0.3 headStyle pointer
3. This creates a vertical line in the middle of the viewport. Go to the toolbar and choose the 'Right Mouse' tab and click on the Move label button. You can manually reposition the label by grabbing each tip with the right mouse button and dragging it where it belongs.
4. Repeat the command and position the rest of the membrane
5. Create the labels for the membrane using the 2dlabels command
   2dlabels text 'outside' size 30 color white;
   2dlabels text 'inside' size 30 color white;
   2dlabels text 'neuronal membrane' size 30 color white
6. Use the right mouse button with the Move label selected in the toolbar to position the labels
7. Choose the top view
   view top
8. Create label and arrow for ion pore and use the right mouse button to position the elements
   2dlabels text 'ion pore' size 30 color white;
   2dlabels arrow start 0.5,0.5 end 0.5,0.7 color white weight 0.5 headStyle blocky
9. Choose the front view
   view front
10. Show the morph with voltage domains highlighted. Be sure you are on frame 1
11. Create label and arrow for the voltage gated domains and use the right mouse button to position the elements
    2dlabels text 'voltage gated domains' size 30 color yellow;
    2dlabels arrow start 0.5,0.5 end 0.5,0.7 color yellow weight 0.5 headStyle blocky
12. Create the 6 plus signs indicating the positive charge on the voltage-gated domains
    2dlabels text '+' size 50 color yellow
13. Create the '++++' label indicating the voltage increase
    2dlabels text '+ + + + +' size 70 color red

14. Create the label and arrow for 'sodium enters'
    2dlabels text 'sodium enters' size 30 color red;
    2dlabels arrow start 0.5,0.5 end 0.5,0.7 color red weight 0.5 headStyle blocky

Now you have all the assets created and you can start scripting the commands for the movie recording. Continue with the file from previous step or open the file **04-scene-recording.cxs**

Narration	Visuals	Assets to Create	Movie commands
Shot 1			
The voltage-gated sodium channels are found in neuronal membranes. **6 seconds** **150 frames**	Start with the closed state model (#4). Begin with the cartoon view of the molecule in the membrane (back) and spin 180 degrees. After the rotation is done, this will be the main (front) view. Indicate membrane (#5.1-4) and label 'inside', 'outside', 'neuronal membrane' (#6.1-3)	Models: Closed state in cartoon Views: front back Labels: inside outside neuronal membrane Lines: 4 membrane lines	Models Panel: Show model #3; Hide #4 **Shot set up (or reset):** windowsize 1280 720; hide #5-6; show #5.1-4; show #6.1-3 view back **Movie commands:** movie record; fly 130 back front wait 20; movie encode ~/Desktop/shot1.mp4
Shot 2			
In the center of the protein is the ion pore that is closed when the neuron is at rest. 6 seconds 150 frames	Hide membrane elements. Rotate the structure 90 degrees in x to show the ion channel from the top (top). Label 'ion pore' (#6.4) plus arrow(#5.5). Wait	Views: Top Labels: Ion pore Lines: Arrow for ion pore	Models Panel: Show model #3; Hide #4 **Shot set up/reset:** windowsize 1280 720; hide #5; hide #6; view front **Movie Commands:** movie record;

	for a few seconds and hide the label and return to front view.		fly 75 front top show #6.4; show #5.5; wait 50 hide #6.4; hide #5.5; fly 25 top front wait 10; movie encode ~/Desktop/shot2.mp4
Shot 3			
The pore is tethered to voltage-gated domains. 4 seconds 100 frames	Show the closed state channel in the membrane with the voltage gated domains represented as atoms (#3). Show label: voltage-gated domains (#6.5) + arrow (#5.6). Add a couple of + signs labels next to the voltage-gated domains to indicate charge (#6.6-11)	Models: Closed state with voltage-gated domains shown Labels: voltage-gated domains Arrows: Voltage-gated domains	Models Panel: Show model #4; Hide #3 **Shot set up/reset:** windowsize 1280 720; hide #5; hide #6; view front **Movie Commands:** movie record; show #5.1-4 show #6.6-11 wait 25; show #6.5; show #5.6; wait 75; movie encode ~/Desktop/shot3.mp4
Shot 4			
These domains sense the increase of positive charges inside the cell. 5 seconds	Show some plus signs (#6.12) under the membrane to indicate voltage change.	Labels: +++++	Models Panel: Show model #4; Hide #3 **Shot set up/reset:** windowsize 1280 720; hide #5; hide #6; view front show #5.1-4

(125 frames)			view front **Movie Commands:** movie record; wait 25; show #6.12; wait 100; movie encode ~/Desktop/shot4.mp4
Shot 5			
6 seconds 150 frames	Show the channel to morph to the open state with the voltage domains highlighted to indicate the motion. Show an arrow (#5.7) going through the ion pore indication the movement of the atoms. Label 'sodium enters (#6.13)'.	Models: Model of the morph from closed to open state. Labels: Sodium enters Lines: Arrow through the pore	Models Panel: Show model #4; Hide #3 **Shot set up/reset:** windowsize 1280 720; hide #5; hide #6; view front show #5.1-4 view front coordset #3 51,1 (the last command rewinds the morph in case it's not on frame 1) **Movie Commands:** movie record; wait 25; coordset #3 1, show #5.7; show #6.13; wait 100 movie encode ~/Desktop/shot5.mp4

Now you can go to Adobe Express or any other video editing software to combine your clips into one video, add narration, effects, etc.

Creating a GIF animation using our animation session

Start with the **04-scene-recording.cxs** or the scene you created with all assets in.

1. First hide the assets that are not needed. Only show the morph with the voltage-gated domains highlighted. Set the size of the GIF and the camera view:

```
windowsize 300 120;
view front
```

2. Start recording the frames. We will need a few static frames and then the morph will play.

```
movie record;
wait 10;
coordset #3 1,51
```

3. Wait until the morph finishes playing before you enter the next set of commands. Add a few static frames and play the morph backwards

```
wait 10;
coordset #3 51,1
```

4. Wait until the morph finishes playing before you start encoding the movie:

```
movie encode ~/Desktop/morph.mp4
```

5. Go to any site that converts movies to gifs and upload your file (e.g. Adobe Express), and convert the .mp4 into .gif