# **Basic Animation Techniques Tutorial**

Once you complete the steps in this video, you will create an animation like shown is this video: <a href="https://youtu.be/7-Q3rdLYhAo?si=B">https://youtu.be/7-Q3rdLYhAo?si=B</a> 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 > 6i8i
- 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 >  $5 \times 0$ m
- 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

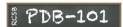
#### B: Creating the morph: Start with the file from step A or open 00-PDB-structures.cxs

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:1271;
select add #3/A:1271;
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

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

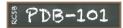
- 10. Show the morph with voltage domains highlighted. Be sure you are on frame 1
- 11. Create label and arrow for the voltage gated domains and use the right mouse button to position the elements

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'

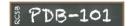
2dlabels text 'sodium enters' size 30 color red;

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