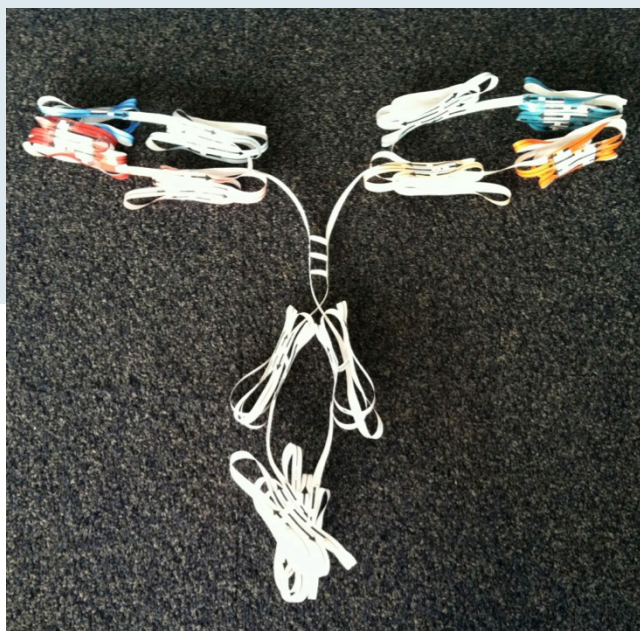
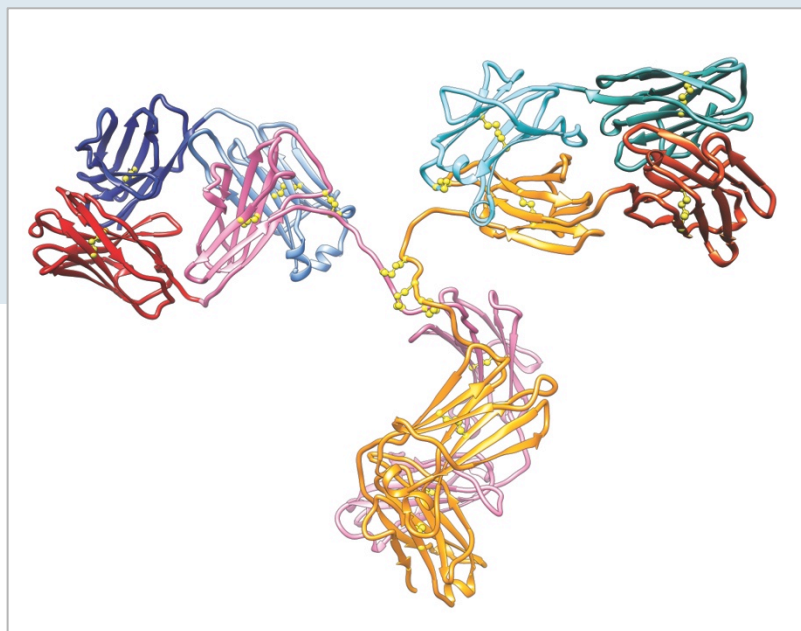


# Antibody (IgG):

Analyze the 3D structure of immunoglobulin IgG by assembling this paper model



Paper model



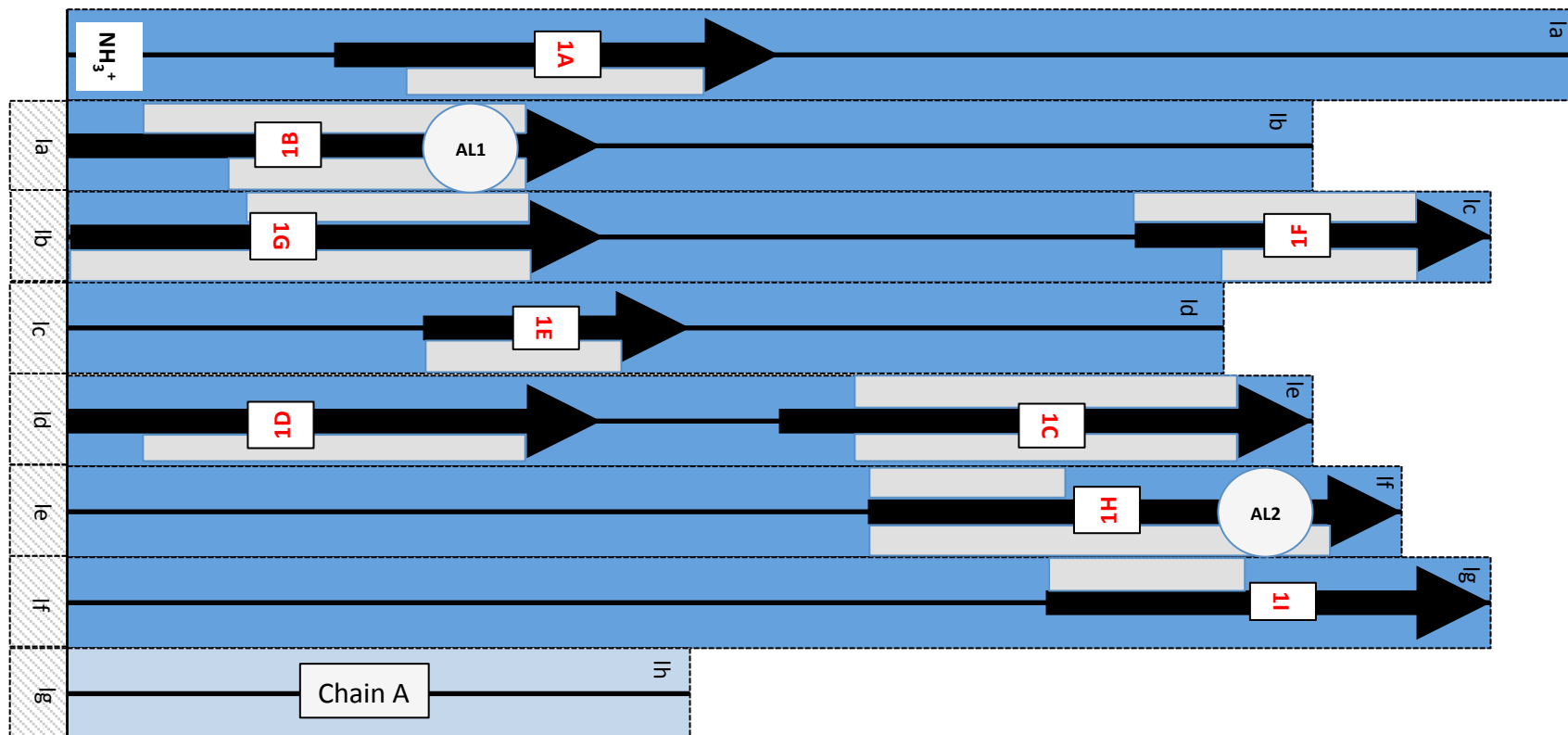
Based on X-ray structure (PDB ID: 1igt)

## Contents of activity packet:

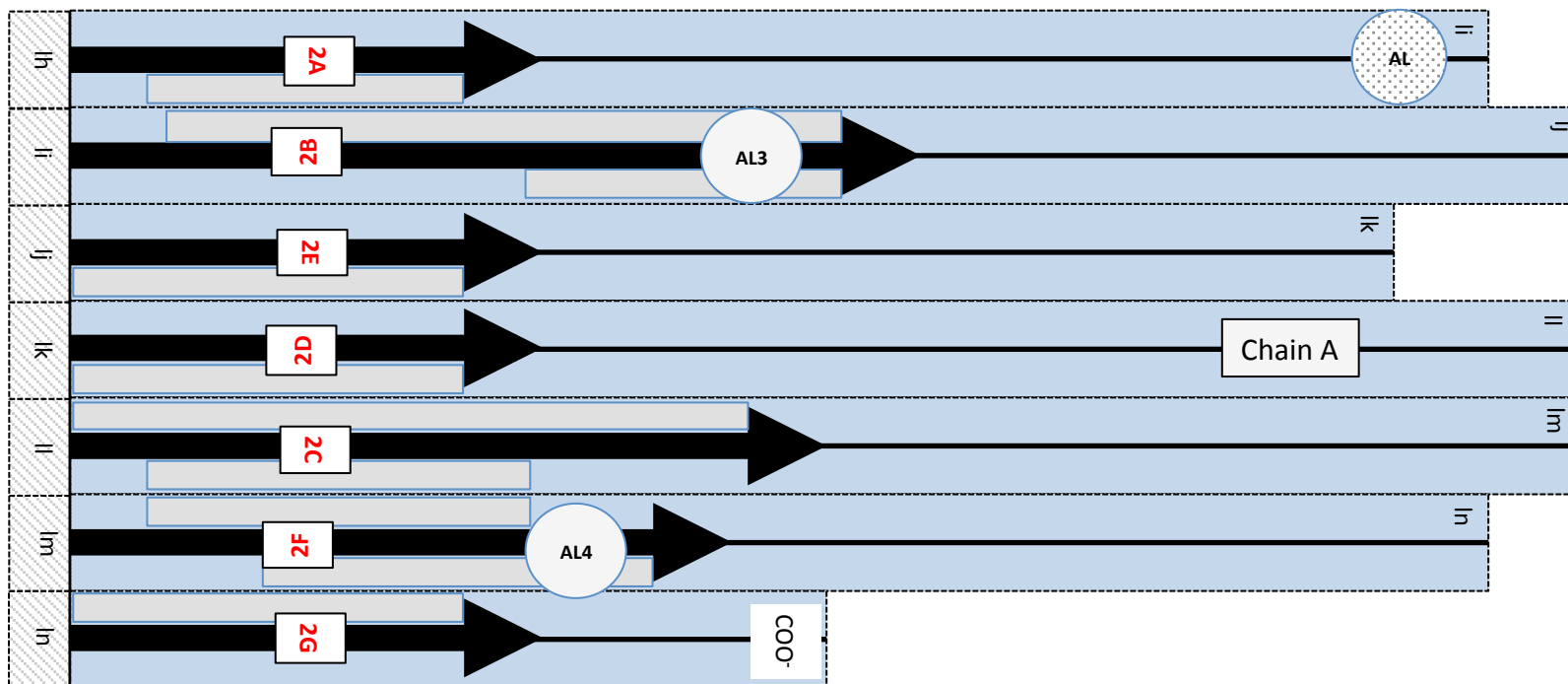
Paper model template: pages 2-14

Assembling instructions: pages 15 -28

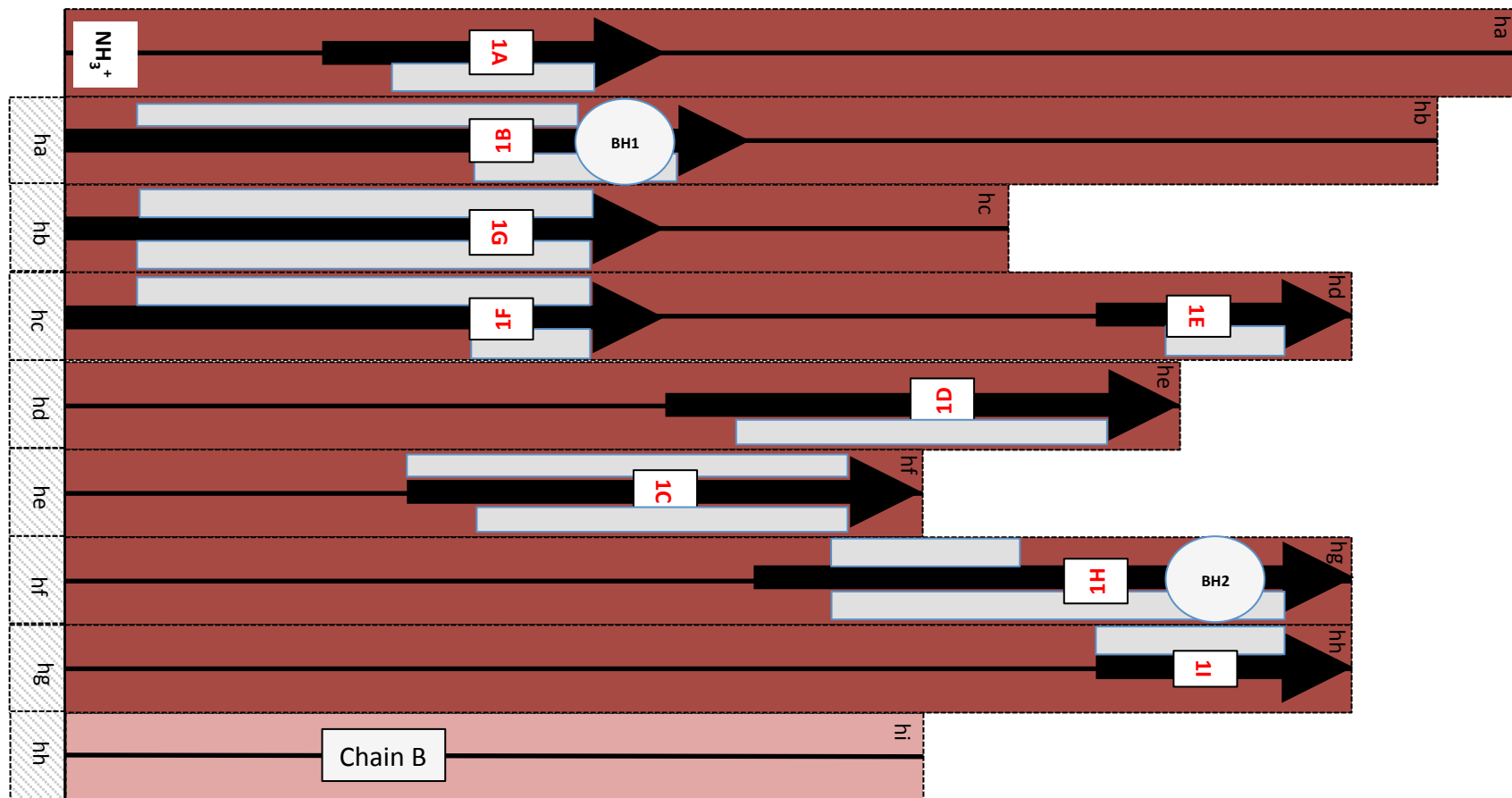
# Light Chain A | Domain 1



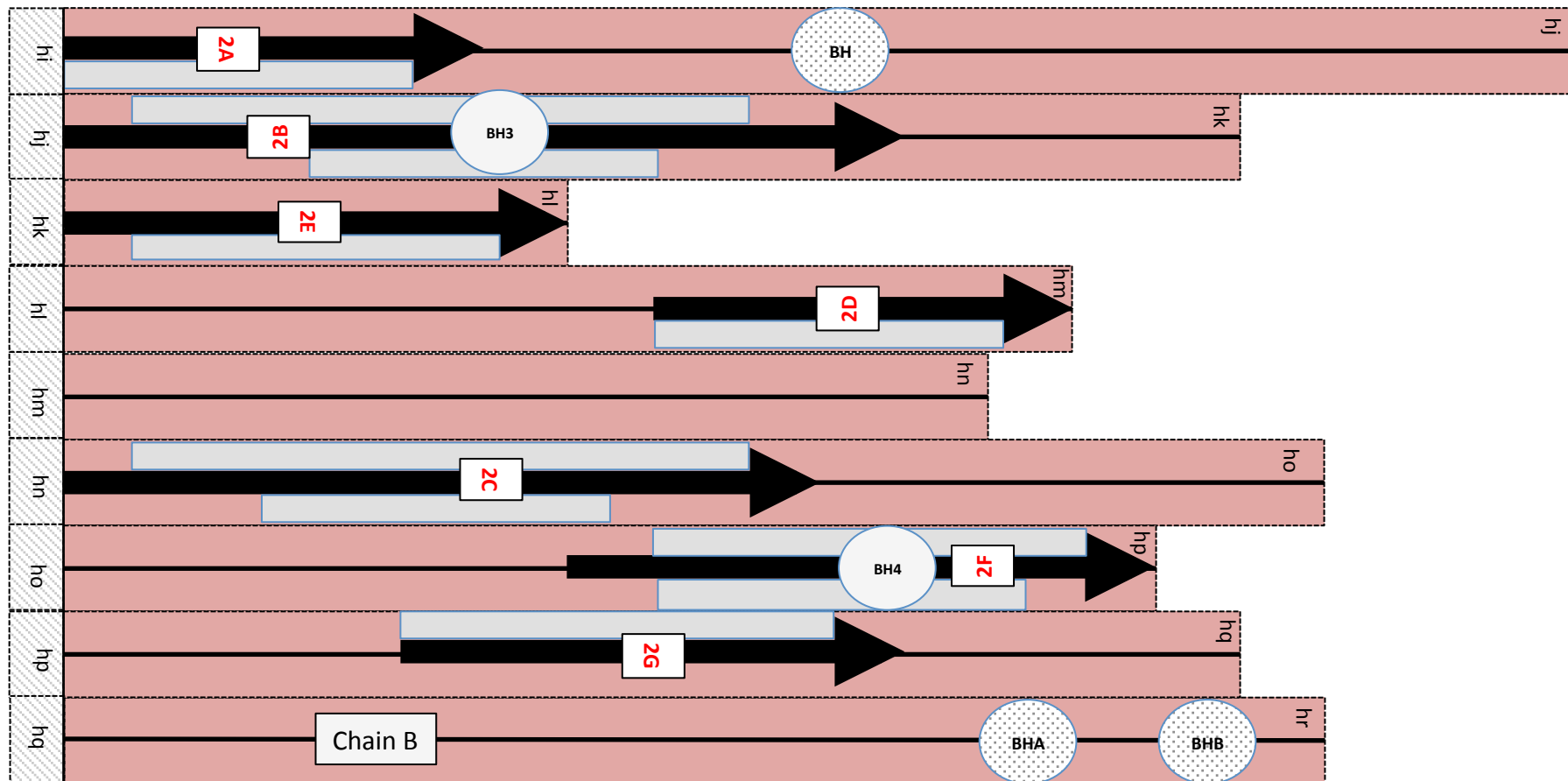
# Light Chain A | Domain 2



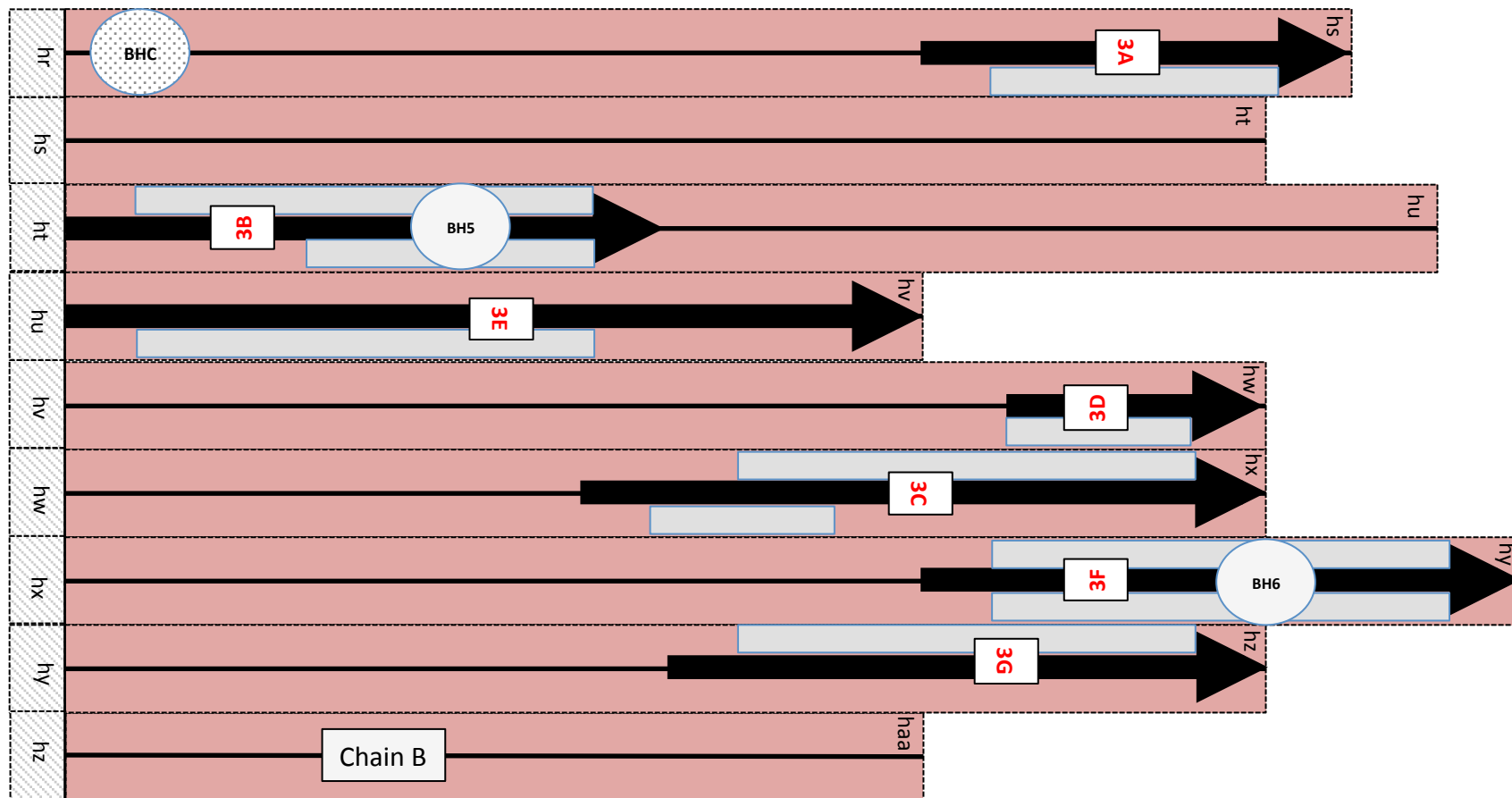
# Heavy Chain B | Domain 1



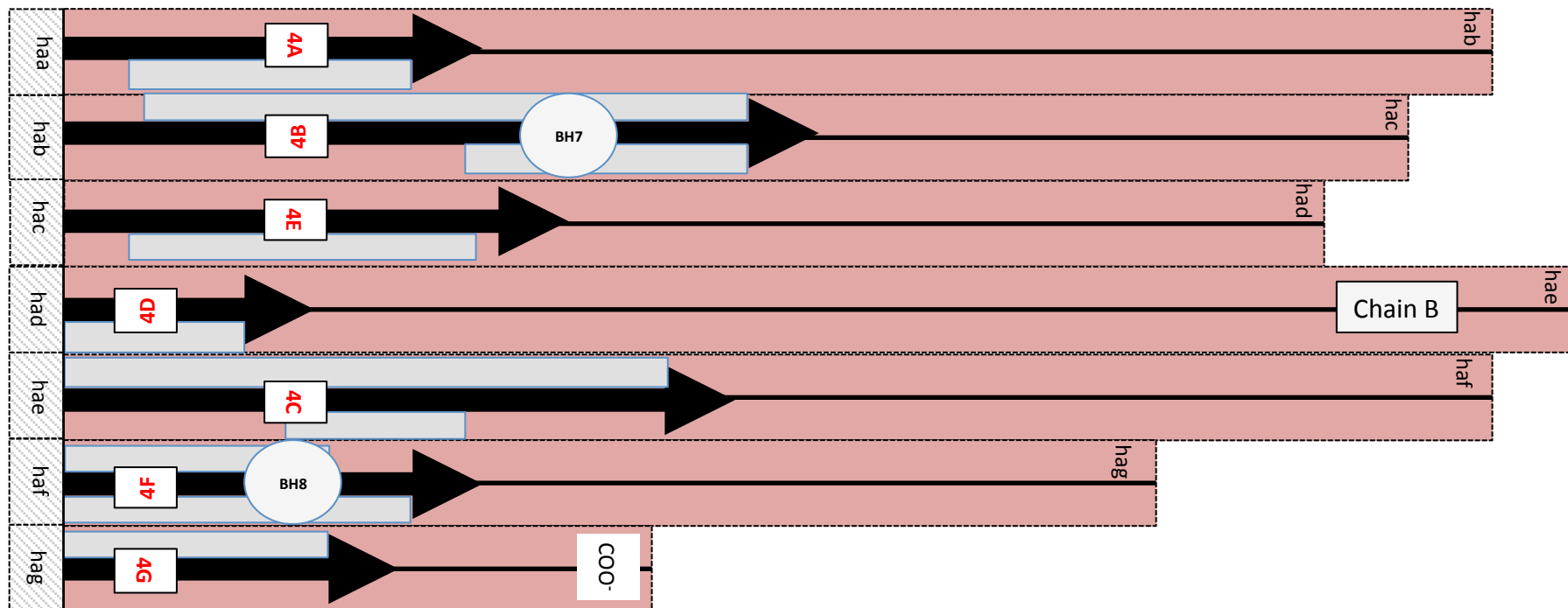
# Heavy Chain B | Domain 2



# Heavy Chain B | Domain 3



# Heavy Chain B | Domain 4

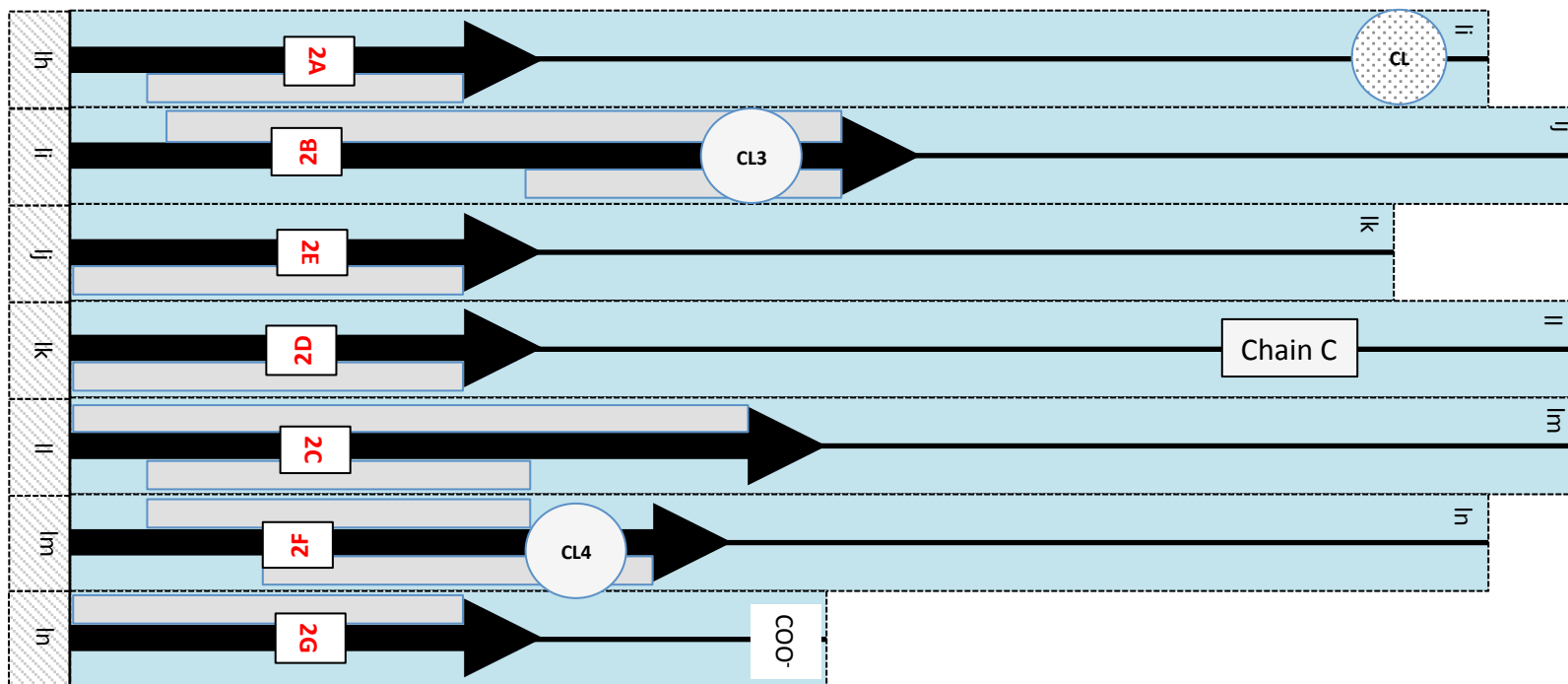


RCSB PDB  
PROTEIN DATA BANK

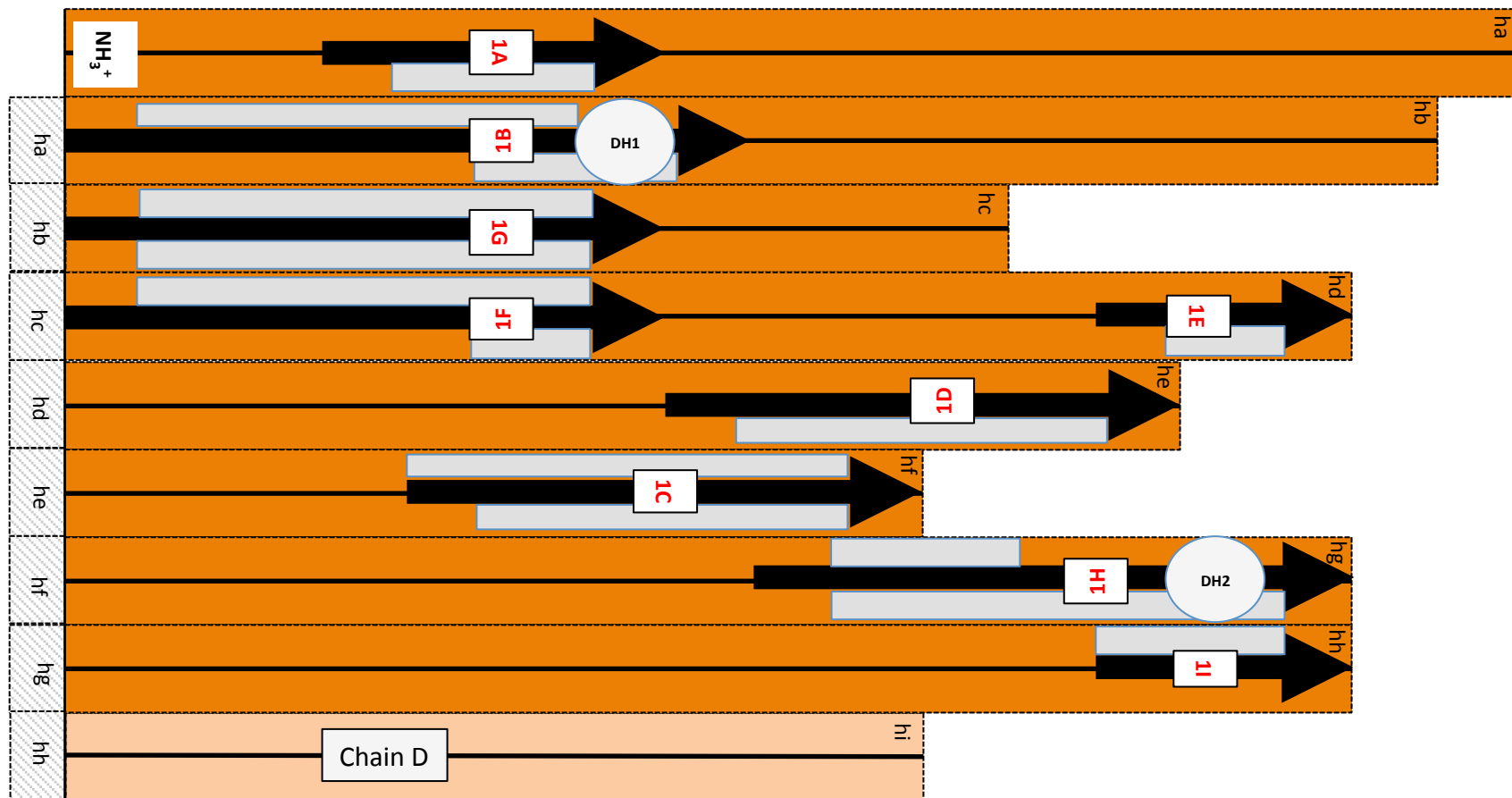




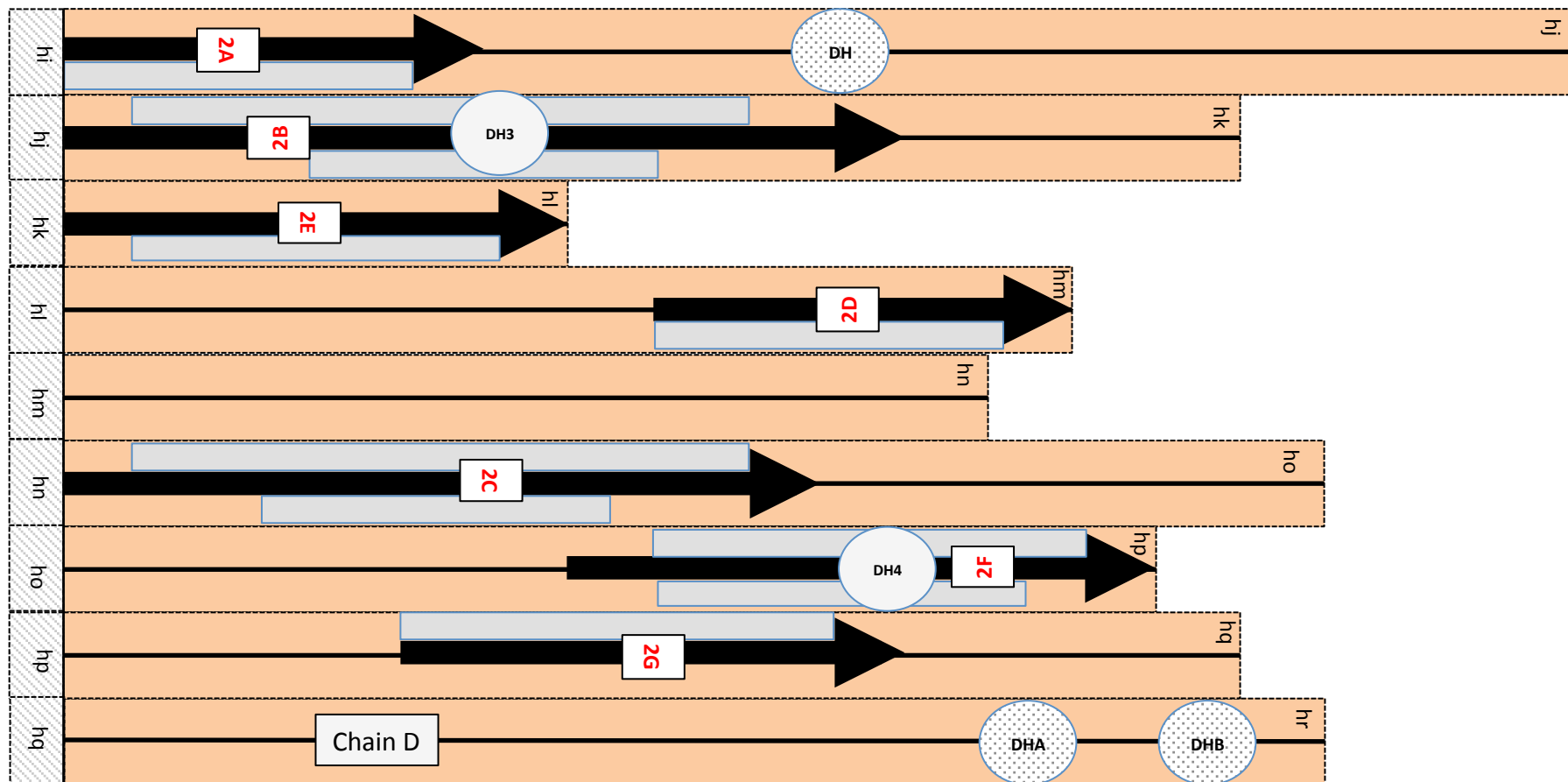
# Light Chain C | Domain 2



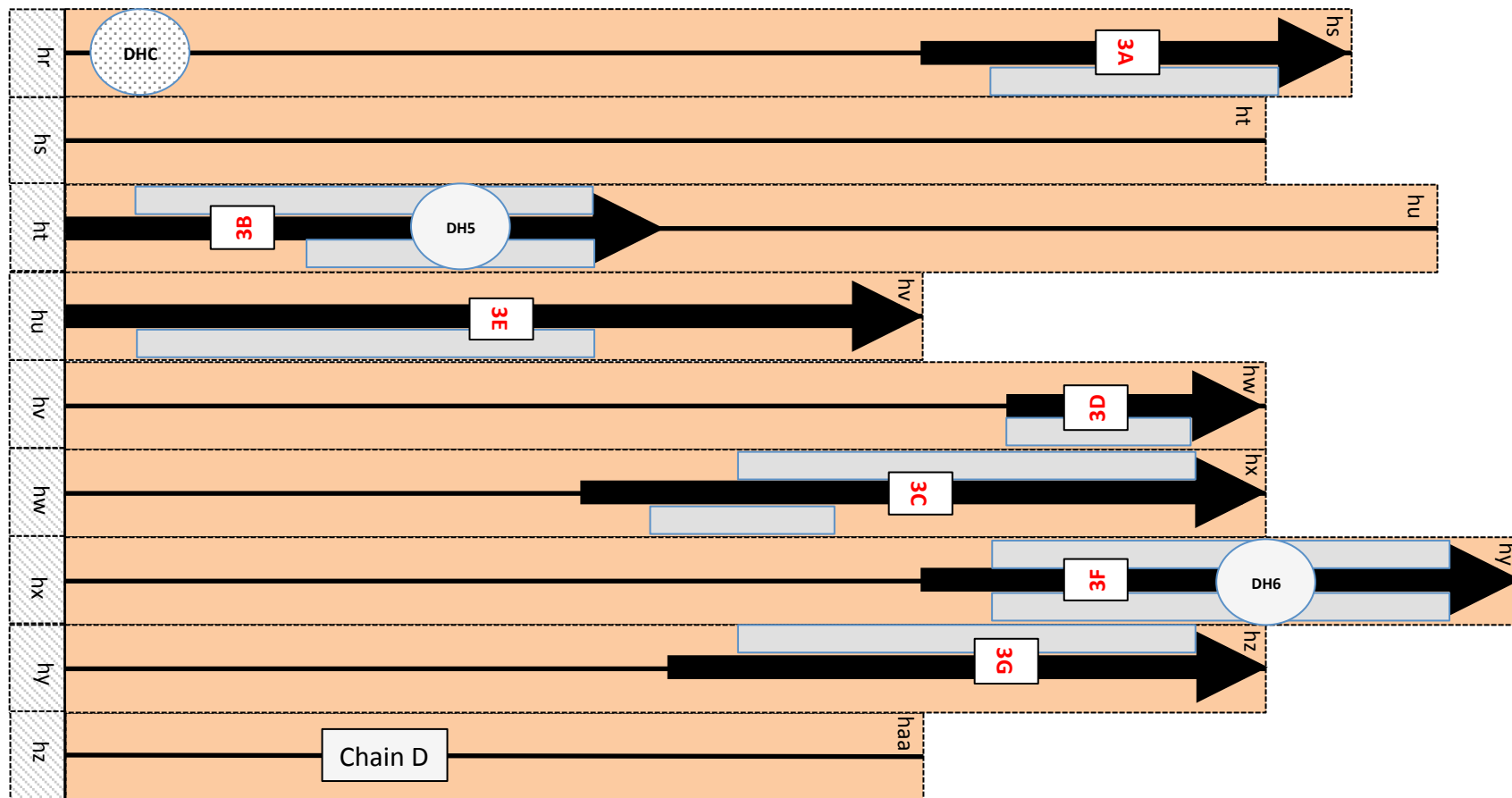
# Heavy Chain D | Domain 1



# Heavy Chain D | Domain 2



# Heavy Chain D | Domain 3



RCSB PDB  
PROTEIN DATA BANK



# Disulfide Linkages

AL1		AL2
AL3		AL4
AL		BH
BH1		BH2
BH3		BH4
BH5		BH6
BH7		BH8

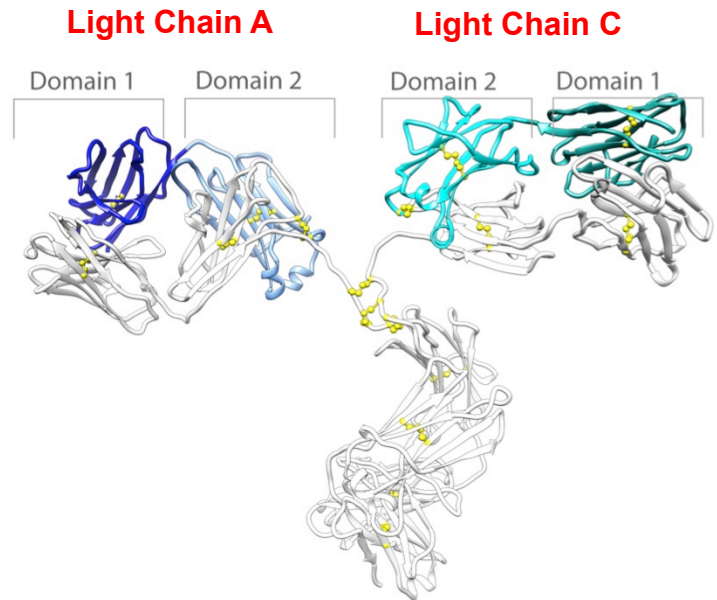
CL1		CL2
CL3		CL4
CL		DH
DH1		DH2
DH3		DH4
DH5		DH6
DH7		DH8

BHA		DHA
BHB		DHB
BHC		DHC

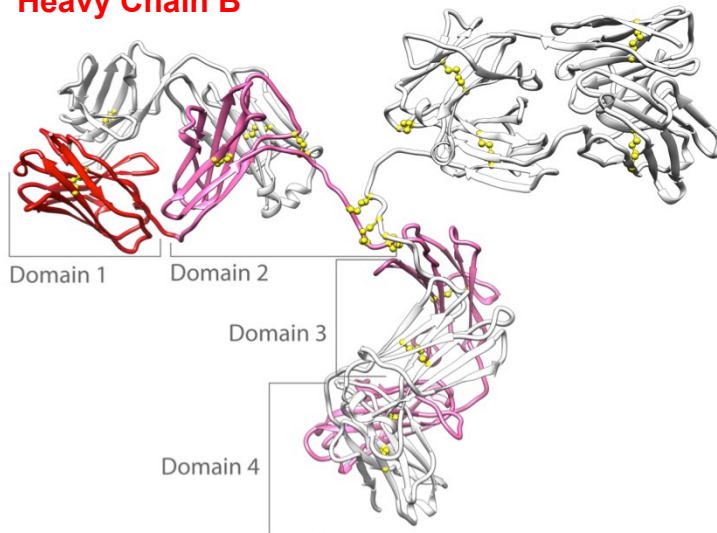
# Antibody Model: Overview

The Antibody consists of 4 **chains**:

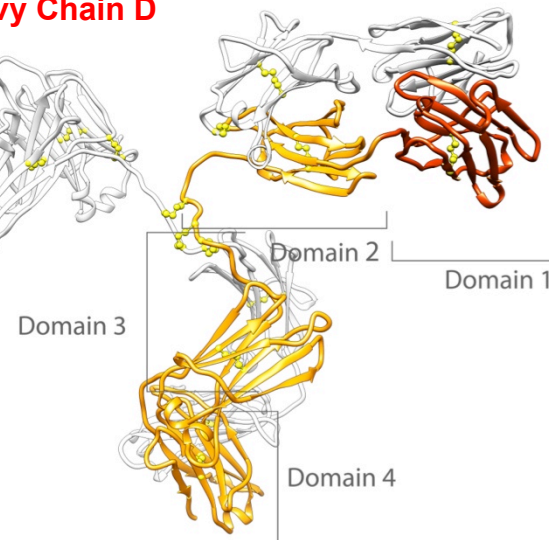
- **2 light chains: A, C**  
Each light chain is made up of **2 immunoglobulin domains**
- **2 heavy chains: B, D**  
Each heavy chain is made up of **4 immunoglobulin domains**



**Heavy Chain B**



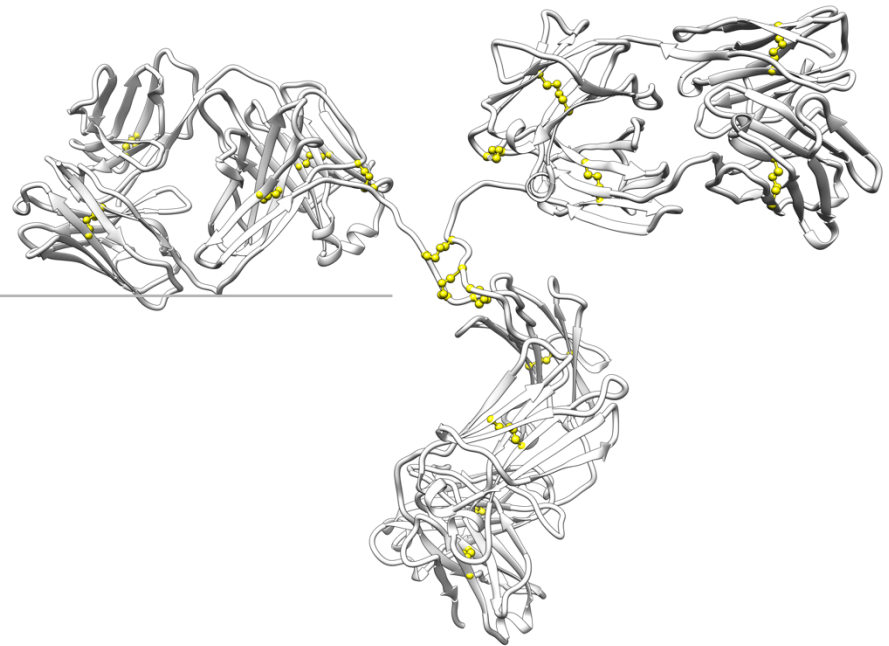
**Heavy Chain D**



# Antibody Model: Overview

## Assembly Overview:

- **Each page from 2 to 13** contains elements to build **1 domain**
- You will first create the domains and then assemble the chains
- The antibody structure is stabilized by **17 disulfide linkages colored yellow** on the image to the right
- The stripes in the paper model template, **on page 14**, represent these linkages
- Creating the disulfide linkages is the last step in making each Ig domain and finally the complete antibody molecule.



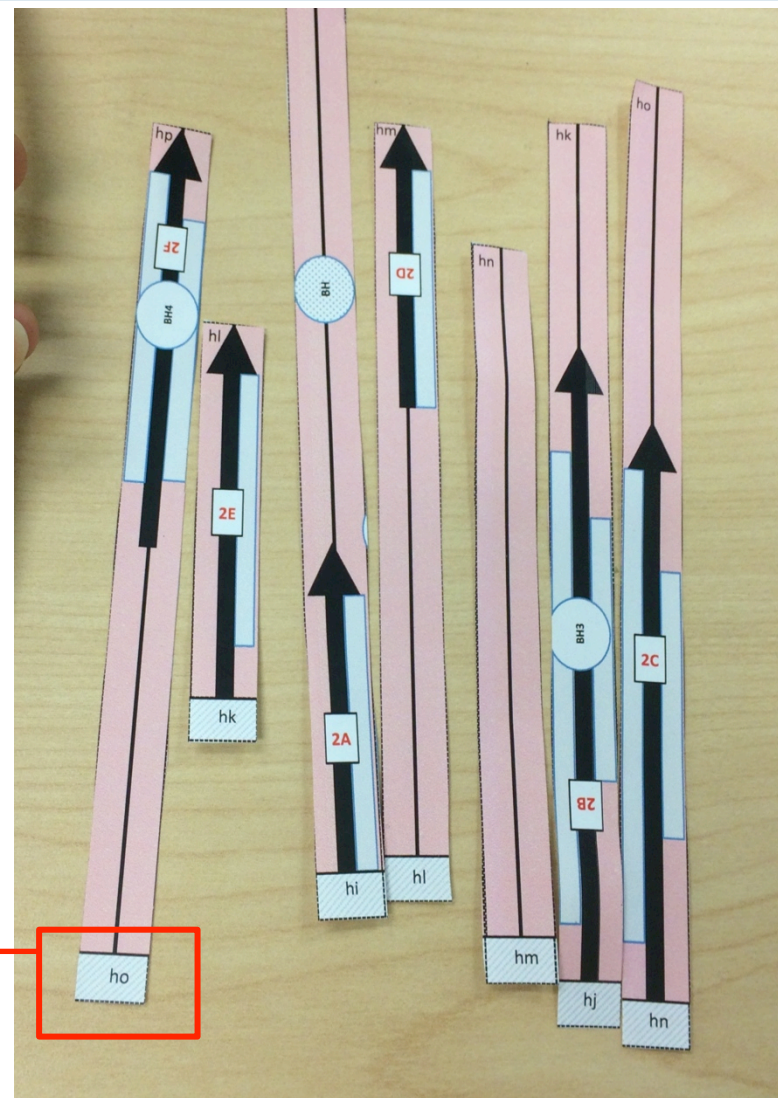


# Preparation

For each page from 2 to 13 :

- Cut out each strip along the dotted lines
- Note that the shaded regions labeled **ho**, **hk**, etc. should be included in the strip
- When creating the domains, work on one page at a time to avoid mixing up the strips.

Make sure these shaded regions remain attached to the strips



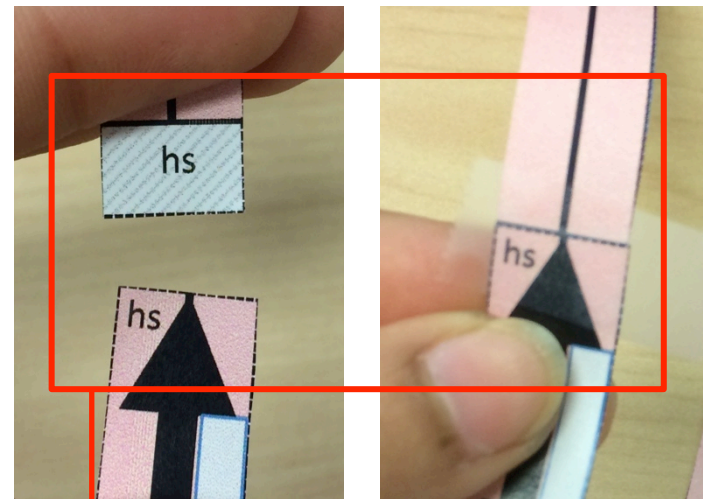
# Immunoglobulin Domains

For each page from 2 to 13 :

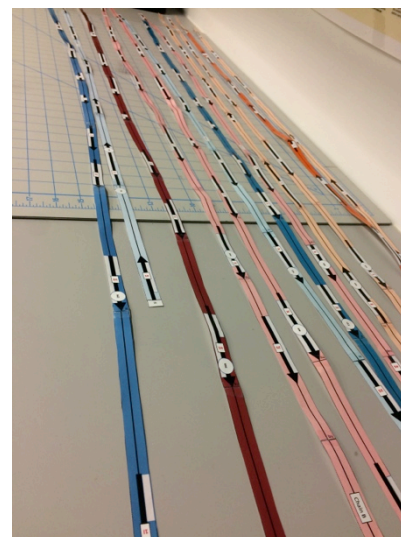
## Step 1

Create the representation of the  
**polymer backbone**

- Tape together the strips into a **long strand**
- The labels **la, lb, etc.** on the **grey background** should be **hidden underneath** the labels on the **colored background**



Find matching labels and tape together  
**hiding** the hatched grey label.



Polymer backbones for  
all 12 domains.

# Immunoglobulin Domains

## Step 2

### Create Immunoglobulin Domains

The **solid black arrows** labeled **1A, 1B, 1C, 1D** etc. represent the **beta strands**.

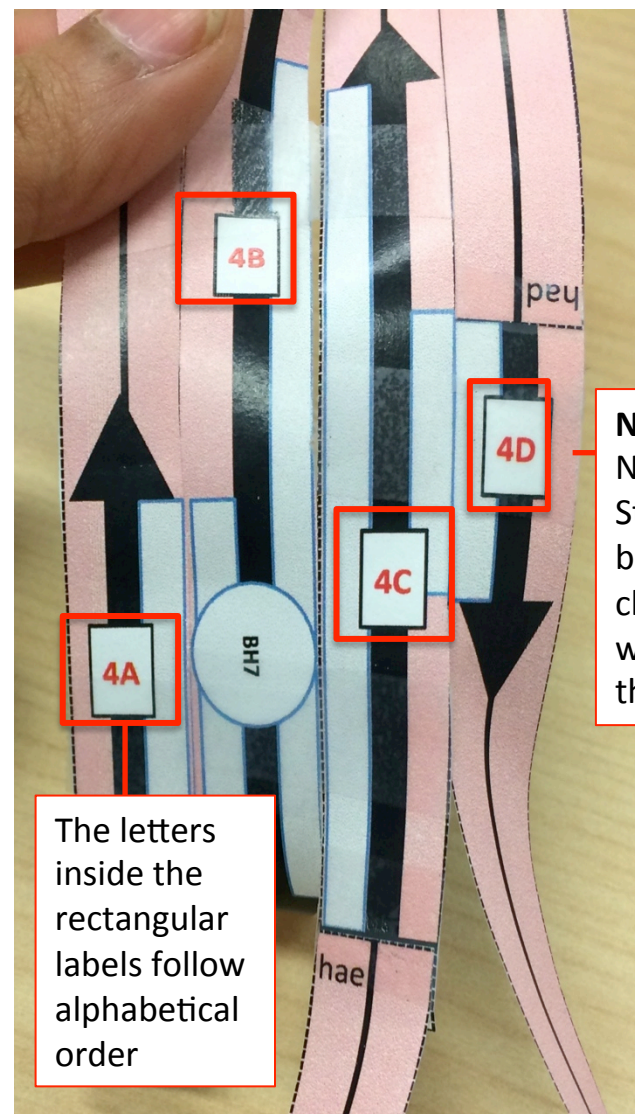
Create the **beta strand clusters** by taping together the strands side by side.

For each domain, make sure that:

1. The **letters** on the rectangular labels **are in alphabetical order**, for example **4A-4B-4C-4D**, or **4E-4F-4G**.

**Note:** Don't connect the strips if there isn't any **grey area** in between them.

2. The **grey area** between the strands **is aligned**. (*See next page*)
3. The beta strand **arrows point up and down alternately** (*See next page*)



**Note:**  
No grey area.  
Stop here and  
begin a new  
cluster starting  
with 4E  
through 4G.

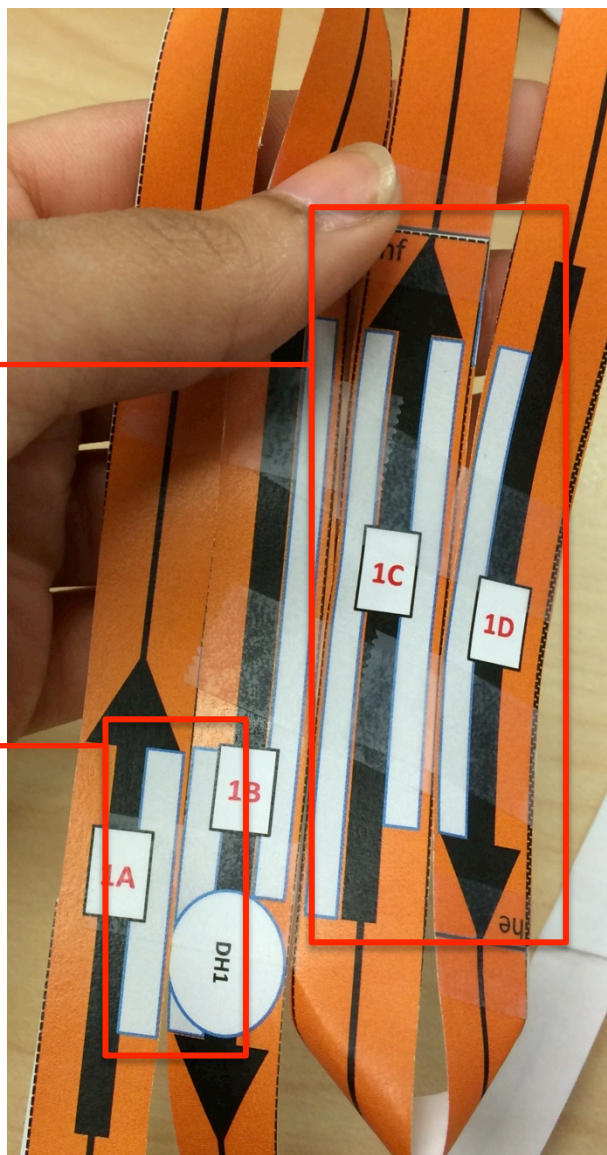
The letters  
inside the  
rectangular  
labels follow  
alphabetical  
order



# Immunoglobulin Domains

The beta strand  
arrows point  
**up and down  
alternately**

The gray area  
between  
strands is  
aligned.



All 12 domains assembled

# Heavy and Light Chains

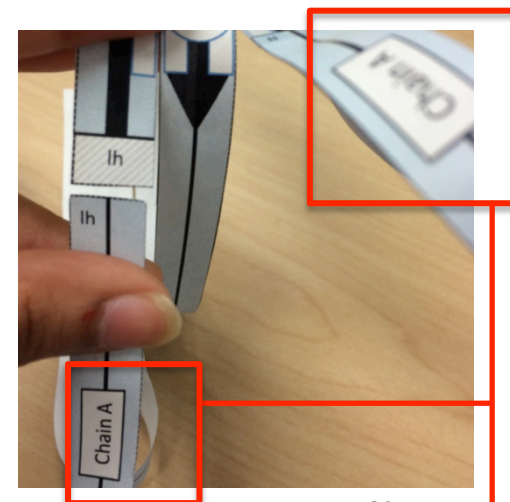
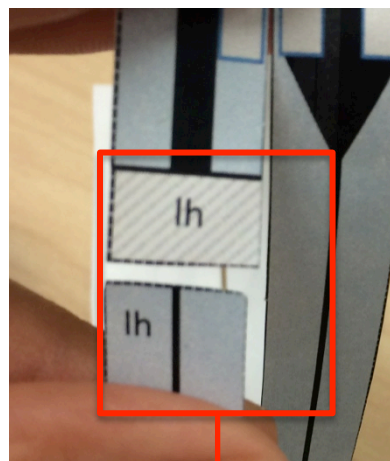
Assembling the 4 polymer chains:

Light Chains **A** and **C**:

- **Tape** together the **2 domains** of each chain at the label **lh**;

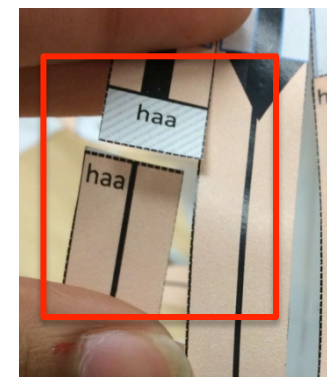
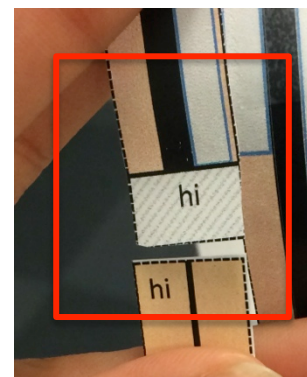
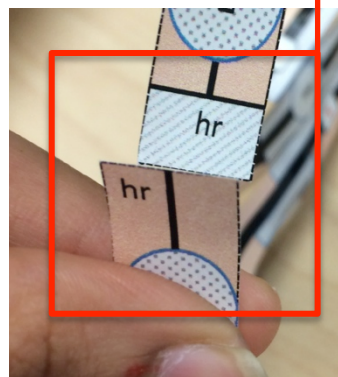
Heavy Chains **B** and **C**:

- **Tape** together the **4 domains** of each chain at the labels **hi**, **hr** and **haa**



Align and tape;  
Gray labels should be  
hidden underneath  
the colored ones.

**Note:**  
Follow the **chain labels** to make  
sure you are connecting the  
domains from the proper chains.



# Light and Heavy Chains

2 light and 2 heavy  
polymer chains  
assembled

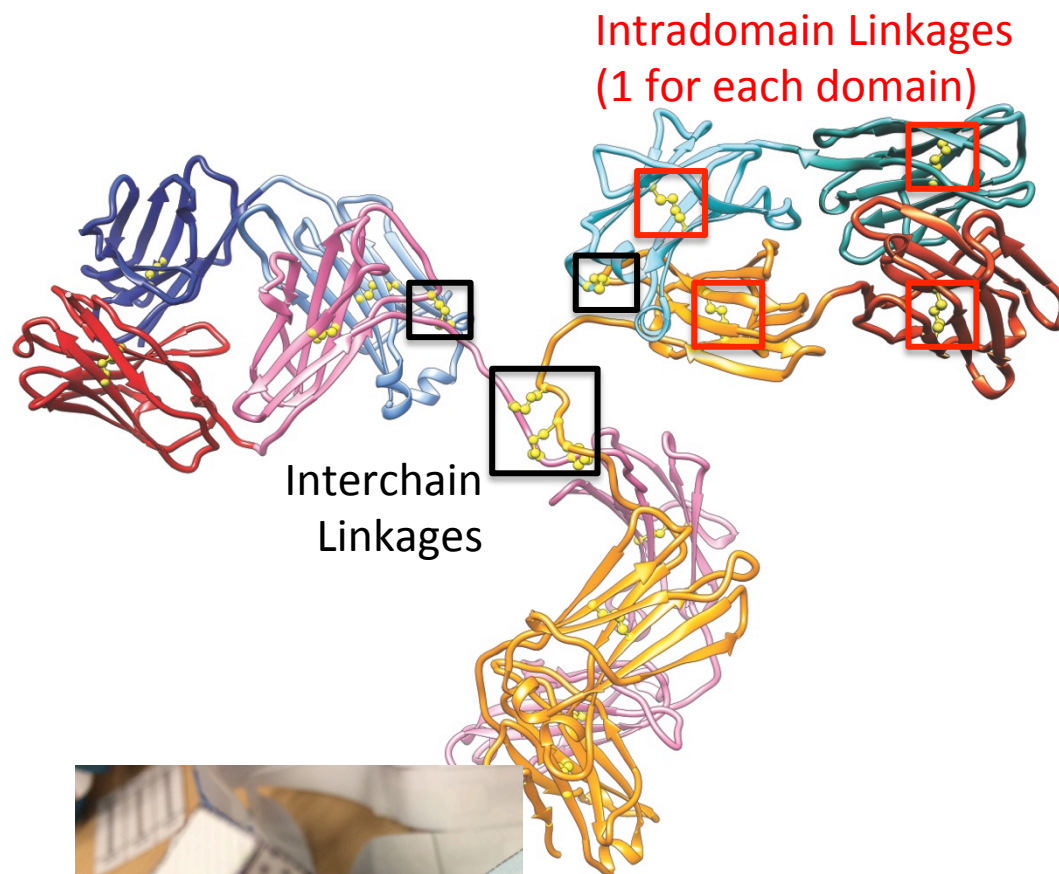




# Disulfide Linkages

The Structure of Antibody is stabilized by 2 types of **disulfide linkages**:

- **12 Intradomain** linkages stabilize each of the **12** immunoglobulin domains.
- **5 Interchain** linkages hold the different chains together
- The **17 strips** on **page 14** represent the disulfide linkages
  - Cut out all strips on the dotted lines
  - Fold down each strip on both hatched regions.

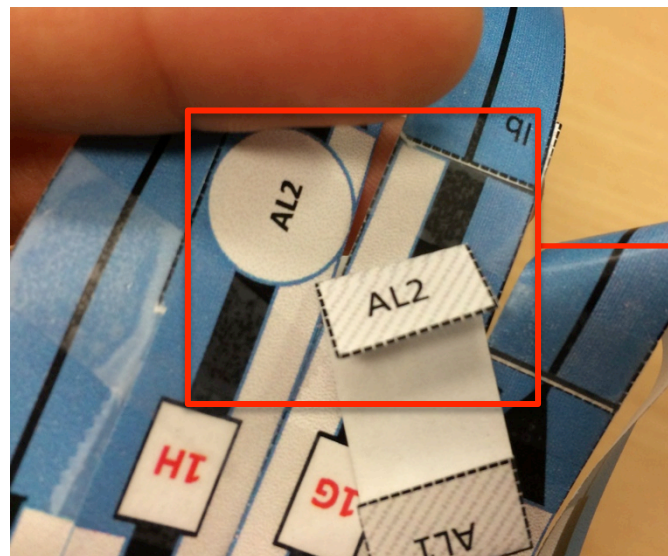


# Disulfide Linkages

## Create the **Intradomain Disulfide Linkages**:

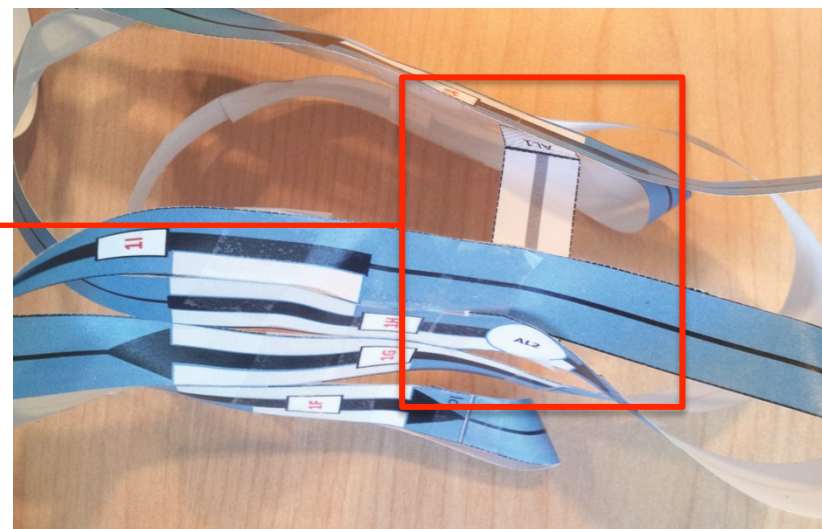
### For each domain:

- Find corresponding labels on the domains (**round**, marked **AL1** and **AL2**) and on the linkages
- Align the strip label **underneath** the **domain's round label** and tape



Corresponding labels

The linkage strip labels are **aligned and taped underneath** the round labels





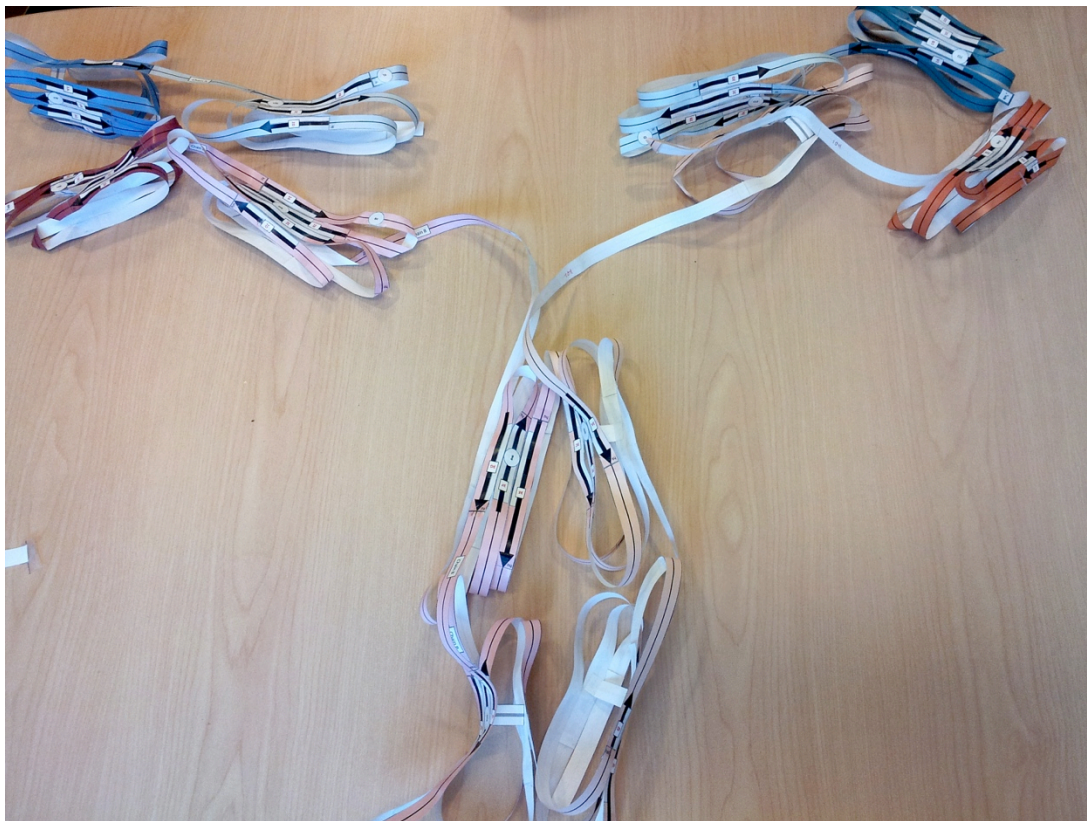
# Disulfide Linkages

## Note:

Before you start the final step, it might be a good idea to align the light and heavy chains.

Use the images on pages 15 (overview section) for help with domain and chain placement in the model.

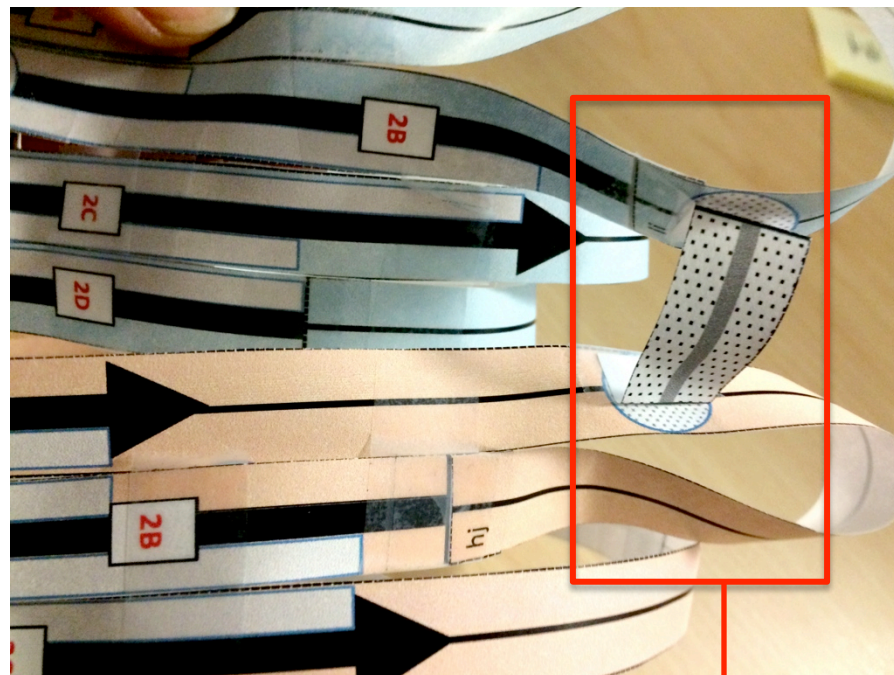
This step will help with label identification and proper placement of the interchain linkages.



# Disulfide Linkages

Create the **interchain disulfide linkages**:

- Chains A and B:  
Identify the **round, dotted** labels **AL** and **BH** on the model and connect them with corresponding disulfide strip.  
**The printed sides of the labels should face each other.**
- Repeat for chains C and D (labels **CL** and **DH**)



Chains are connected at round dotted AL and BH labels.  
The **printed sides** of the labels **face each other**.

# Disulfide Linkages

## Create the **interchain disulfide linkages**:

Chains B and D:

- Identify the dotted round labels

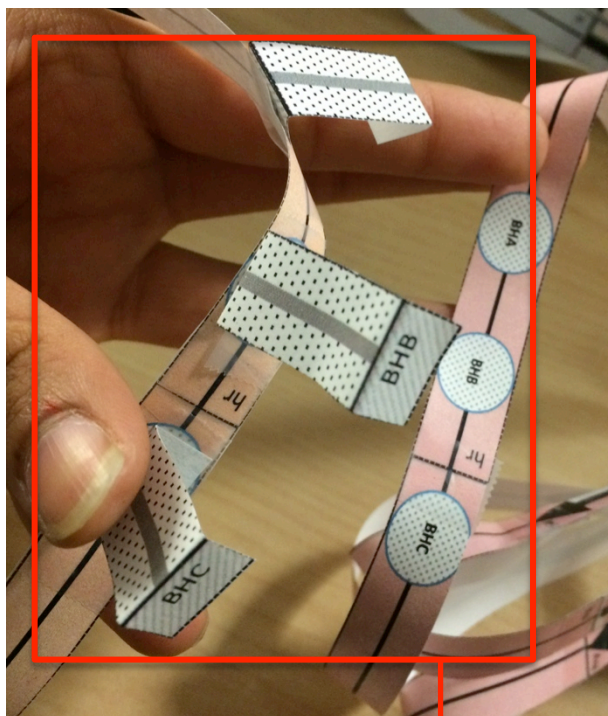
**BHA–DHA**

**BHB–DHB**

**BHC–DHC**

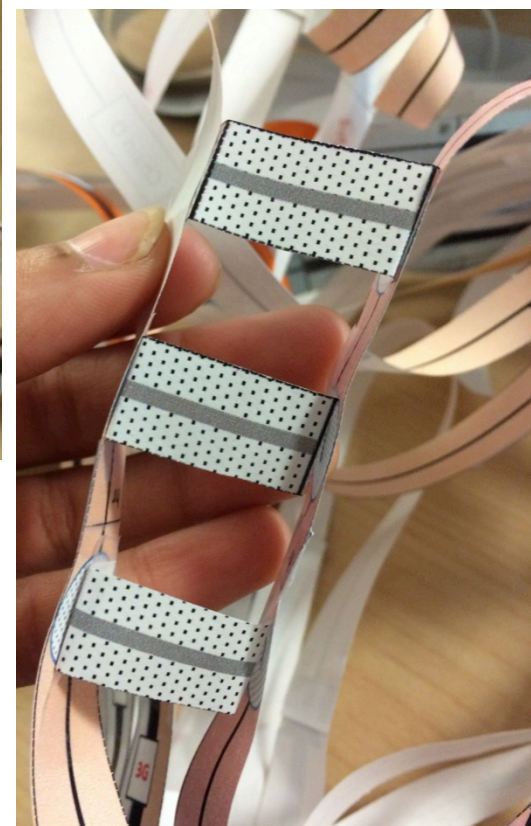
on the model and on the disulfide strips

- Tape the **printed side** of the hatched regions **on top of** the dotted round labels.



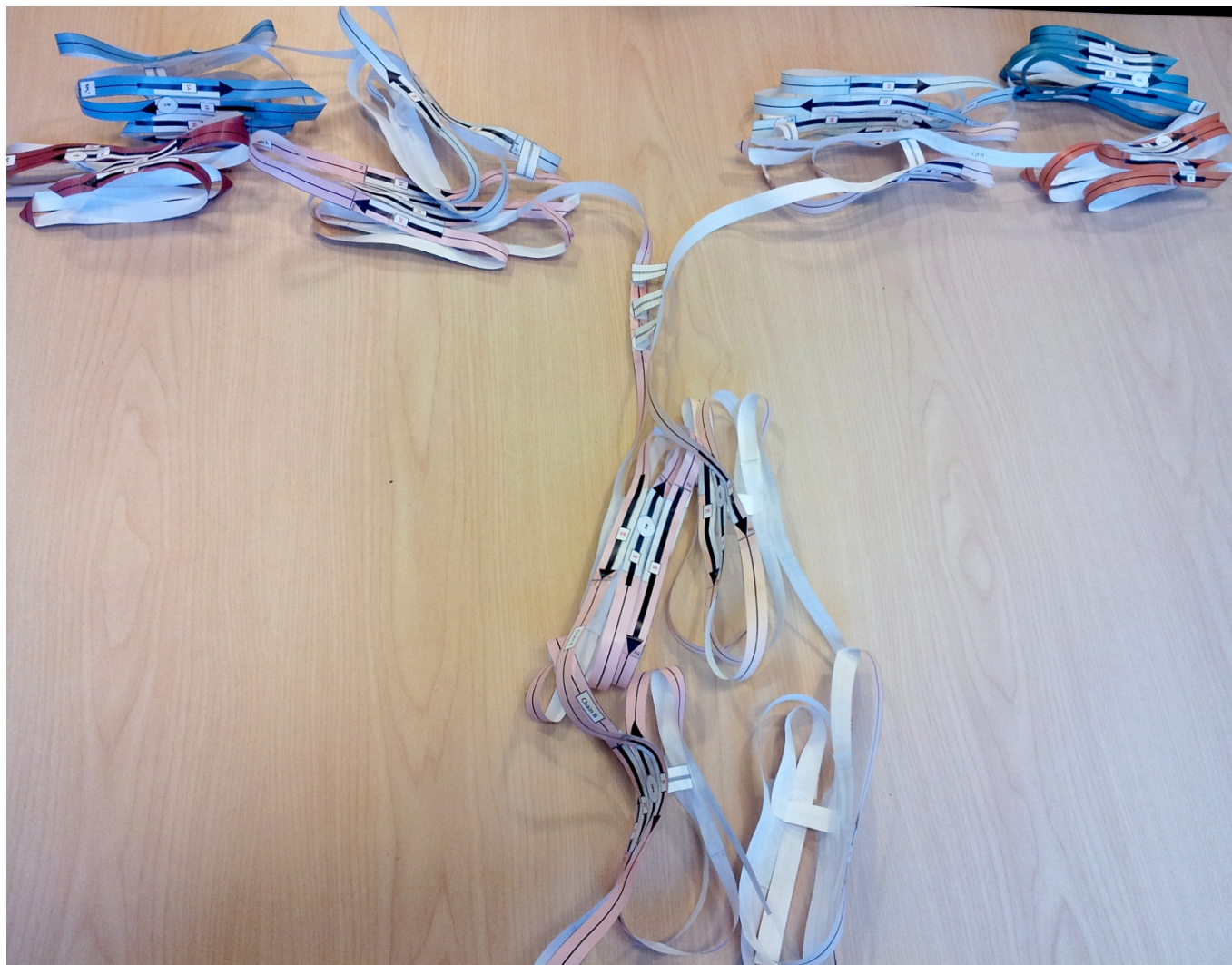
Chains B and D are connected at round dotted labels.

The **printed sides** of the labels face each other.





# Finished Model



## Suggestion:

This model can be made as a group project.

Assign each domain to a different individual.

The 12 different domains in the antibody can be assembled together and all the disulfide bridges put in place as a group.