RESEARCH EXPERIENCE FOR TEACHERS

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Activities for Characterizing Tissues

#1: Strength of Materials Testing

Practice Problems:

Determine the area of moment inertia for a beam that is 4 cm wide and .5cm tall

Determine the area of moment inertia for a beam that is 5cm wide and 4 cm tall

Describe which orientation would resist bending more. Give an example of how this concept is used in the real world.

How far would a steel beam 3cm wide and 5 cm tall deflect that is 2 m long a 20 N force applied.

Steel
E = 100,000,000 Pa

What is the Elastic Modulus of beam that 1 cm wide and 4 cm tall deflects 30cm with a 100N load applied 4 m from the support

Calculate the Area of Moment of Inertia (I) for your beams in 2 orientations. Show your work

Calculate Elastic Modulus for Oak and Maple using the data from above.

#2: Modeling Tissue

How do stem cells respond to their physical environment?

What is the Extracellular matrix?

Why is it important to measure the physical properties of tissues?

Describe the Bioengineering process.-from notes not google

What is the term we use to measure stiffness in materials?

What is stress? How do you measure it?

What is strain how do you measure it?

The purpose of this lab is to measure the physical properties of a tissue so that we can create a model for the tissue to complete further study.

Data collection
Area:
Starting Height:

Force N	Height cm

1. Create an Excel spreadsheet
2. Input force data
3. Create a column for area in m^2
4. Create a formula that calculates stress N/m or Pa
5. Input height data
6. Create a column that converts cm to m
7. Create a column that calculates strain (change in height/starting height)
8. Create a column that calculates Elastic Modulus
9. Create a graph stress/strain for the muscle

1. Look up the reported value of the elastic modulus of muscle. Calculate the % error of your measurements compared to literature values. What factors do you think may have caused this error?

2. Compare the elastic modulus of the muscle with that of the intestine and tendon. Which one is stiffer? Does this make sense physiologically? explain.

3. Creating Stress Strain Curves

An engineer is collecting data about how the stiffness of tissues is related to function. They collect the following data about Bone, Muscle, Tendon, and Fat.

To perform the test they apply an increasing amount of force to the tissue. The force is applied over a small rectangular area that is 1cm by 1 cm. The following data is collected

Fat

Force N	Height cm
0	10
0.01	9.9
0.02	9.8
0.025	9.75
0.05	9.5
0.075	9.25
0.105	8.95
0.14	8.6
0.175	8.25

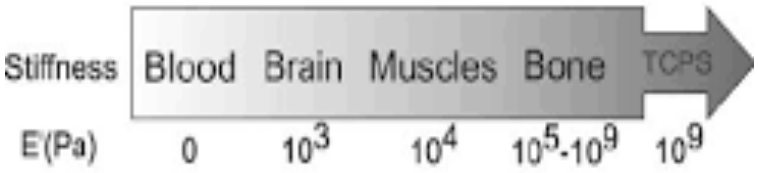
Muscle **Bone**

Force N	Height cm	Force N	Height cm
0	10	0	10
0.1	9.99	10000	9.99
1.1	9.89	20000	9.98
2	9.8	30000	9.97
3.1	9.69	40000	9.96
4	9.6	50000	9.95
4.9	9.51	60000	9.94
6	9.4	70000	9.93
6.8	9.32	80000	9.92

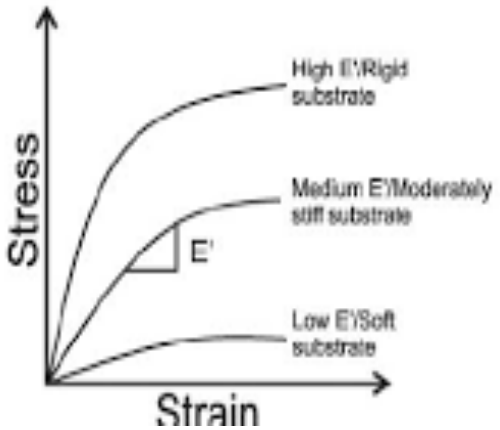
Steps

1. Create an Excel spreadsheet
2. Input force data
3. Create a column for area in m^2
4. Create a formula that calculates stress N/m or Pa
5. Input height data
6. Create a column that converts cm to m
7. Create a column that calculates strain (change in height/starting height)
8. Create a column that calculates Elastic Modulus
9. Create a graph stress/strain for all 3 tissues

(a)



(b)



4. Performance test

Part 1 as a group

Collect enough accurate data to calculate the Young's modulus of your ballistic gel.

Material you can use

Spring Scale

Washer

Ruler

Everyone must record their own data. Use the table below to record relevant data

Give each heading a title and correct units. Use as much of the table as you want.

Part 2 Excel Graph Performance Test
As an individual

Open a new Excel file
Input force data from table
Create a column for area in m^2
Create a column that calculates stress in N/m
Create column for height in cm
Create a column that converts cm to m
Create a column that calculates strain (change in height/starting height)
Create a column that calculates Elastic Modulus
Create a stress/strain curve for the gel

Graph must include

- Correct values for x and y
- A title for the graph
- Both axis labeled with units
- Trend line

Acknowledgements

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