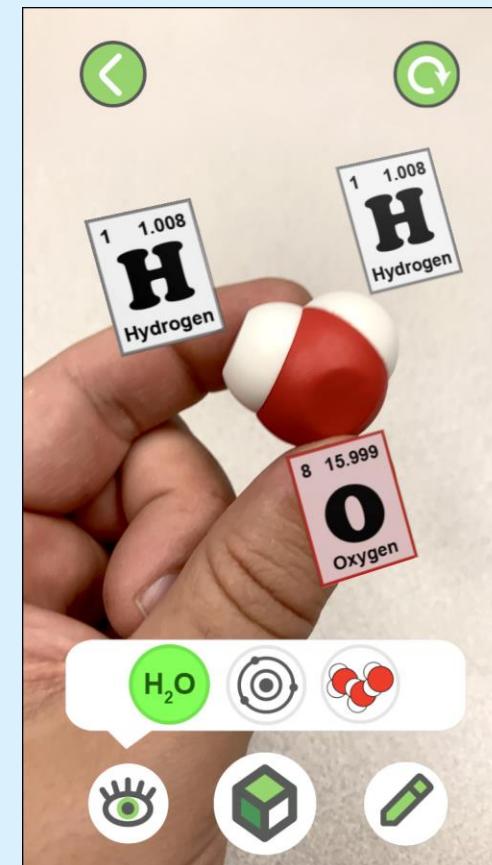


AR Field Test Training

Heather Ryan
Mark Hoelzer
Ruth Hutson

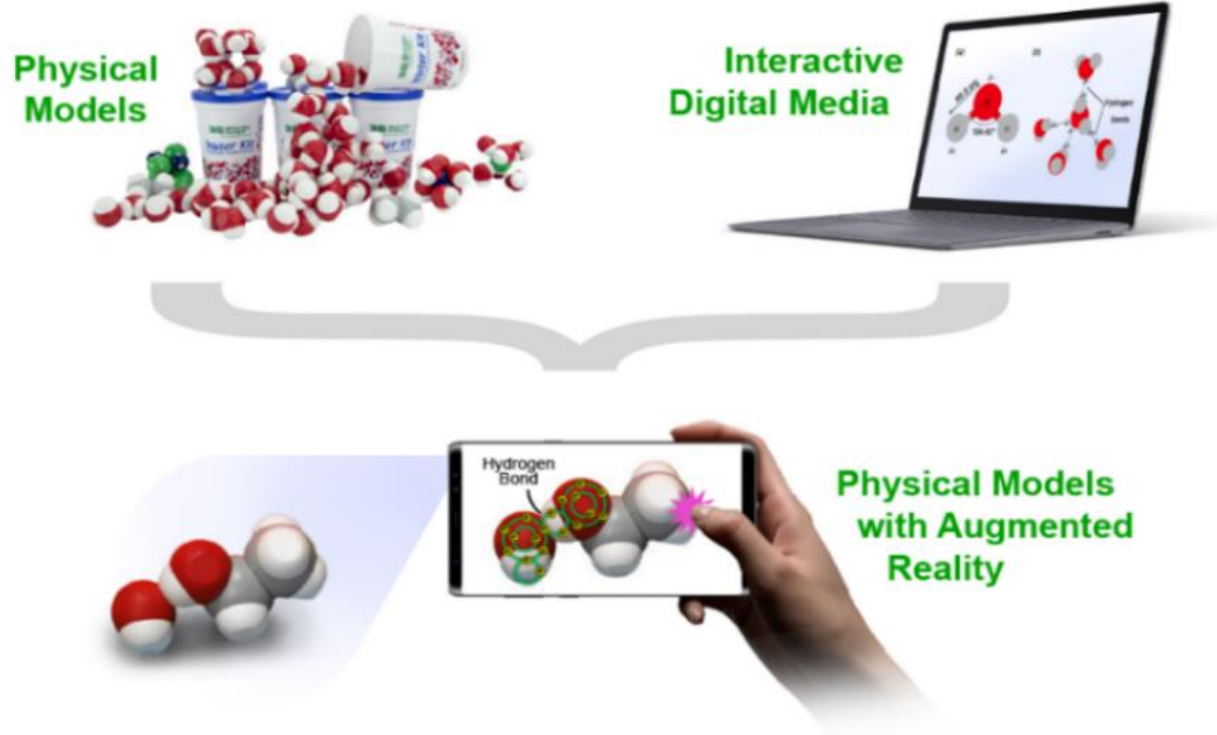


Meeting Agenda

- Project Overview
- Consent Forms
- Usability Test
 - App Installation
 - Training Activities
 - Student & Teacher Surveys
- Education Tests
 - Activity List & Schedule
 - Pre & Post Tests
 - Teacher Survey
- Questions & Feedback



Project Overview - *Goals*



Project Overview – *Testing*

Usability Test

- Mid-August – Mid-September
- Testing the usability of the app and the ability of student phones to detect 3DMD parts
- Post-activity surveys
- Teacher Surveys

Education Test

- October – March
- Evaluating the learning gains from students using the app in addition to regular instruction
- Pre & post-tests
- Teacher Surveys

Consent for Research Participation

Title: **3DMD AR Field Test**

Investigator/Researcher(s): **Heather Ryan, MPA & Mark Hoelzer, MFA**

Investigator/Researcher Contact Information: **414-774-6562**

Sponsor: **3D Molecular Designs, LLC**

KEY INFORMATION FOR YOU TO CONSIDER:

We (the researchers) are asking if you would like to be in a research study. Some key information is provided in the boxes below to help you decide if you want to participate or not. Read the entire form and ask questions before you decide. The researchers will go over this form with you and you can ask any questions.

What is the purpose of this research?	The main purpose of this study is to assess the usability and learning gains of a high school biology focused augmented reality (AR) application. This study will help us determine how easy it is for people like you and your students to use the app and how easy it is to use mobile devices to enhance your teaching with our models.
What will happen to you during the study?	You are being asked to facilitate your students in using the application and completing a series of short activities. These activities include an AR training activity, training activity survey, digital AR educational activities, and pre-test/post-test. Before facilitating this field test, you will receive basic training in how to access the training activity and survey, as well as how to properly facilitate student participation. You will learn how to explain the study to students, how to notify students of their option to not participate, and how to provide non-participating students with alternative activities. After completing the tasks, you will be asked to provide feedback by responding to survey and open-ended questions. For the educational field test, you will be randomly assigned to either the control or treatment group. If you are assigned to the control group, you will conduct your typical educational activities with your students on the topics being assessed. You will administer the pre- and post-tests around your normal instruction. If you are assigned to the treatment group, you will administer the pre-test, conduct your

Educator Consent Form

	typical educational activities in addition to having your students complete the AR activities, and then will administer the post-test. Researchers might observe and may ask you and your students to speak aloud your thought process while using the application.
How long will you be in the research?	Your participation will take about 120 minutes split between the two tests.
Could being in this research harm you?	This research is no more than minimal risk. The level of risk is expected to be the same as risks of daily life.
Will being in this study help you in any way?	You will not benefit beyond getting an introduction to a product that you may find beneficial for classroom use. We hope that the people in this study will help us develop an easy-to-use application that will be used to help students learn molecular bioscience concepts in the future.
Are there any costs to participate?	It does not cost anything to be in the study.
How do researchers protect your information?	No personally identifiable information will be collected in this study. All observations, surveys and interview data will be recorded without linking them to an individual.

ADDITIONAL DETAILED INFORMATION:

How many people will participate in this research study?

The researchers hope to enroll up to 100 teachers in this study.

Who can you talk to about the research?

Contact the researchers listed on the first page if you have questions, concerns, complaints, or get hurt.

Pearl Institutional Review Board (IRB) oversees this research. You may call (317) 899-9341 to speak to the IRB for any reason, such as:

- You have questions about your rights.
- Your questions, concerns, or complaints are not being answered by the research team.
- You cannot reach the research team.

Educator Consent Form

- You want to talk to someone besides the research team.
- You want to get more information.
- You want to provide your input about this research.

Will you receive anything for being in the research?

You will receive the following for your participation: \$100.00 Amazon Gift Card or \$150.00 in 3D Molecular Designs products.

SIGNATURES:

You have read this document and were told of the risks and benefits and a member of the research team answered questions to your satisfaction. A member of the research team will answer any future questions. You voluntarily agree to join the study and know that you can withdraw from the study at any time without penalty. You do not waive any legal rights by signing this form.

You will receive a signed copy of this document.

_____	_____	_____
Print the Name of the Adult Research Participant (18 years of age or older)	Signature of the <u>Adult</u> Research Participant	Date Signed
Completed by the Investigator obtaining informed consent: ☒ In addition to advising the person authorizing the research about any appropriate alternatives to research participation, I have offered an opportunity for further explanation of the risks and discomforts which are, or may be, associated with this research, and to answer any further questions. ☐ Check to confirm participant agreed to participate in the study <u>and</u> signed the informed consent form(s) <u>and</u> all questions were answered. Check options pertaining to remote consent if applicable: ☒ Check if remote consent (conference call or video conference). ☐ Check if the informed consent document was not retained, due to contamination of the document by infectious material. ☒ Check to confirm participant was asked to mail, fax, or e-mail a copy of the signed consent to the research team.		
Heather Ryan	<i>Heather Ryan</i>	8/15/23
Print Name of Investigator Obtaining Informed Consent	Signature of Investigator Obtaining Informed Consent	Date Signed

Educator Consent Form

1. Check email from adobesign@adobesign.com
2. Read the document carefully
3. Contact Heather with questions
 - a) Heather.ryan@3dmoleculardesigns.com
 - b) 414-774-6562
4. Complete Name & Date fields
5. Sign the Signature field
6. Save a copy for your records

Teacher Cohort Number

Each educator will be issued a cohort number after submitting the consent form to de-identify our data.

Nick Salvaggio (nick.salvaggio@3dmoleculardesigns.com) will maintain the contact list with cohort numbers. Mark, Ruth & Heather will not have access to that list.

Emails with cohort numbers and website links will be sent Thursday, August 17th.

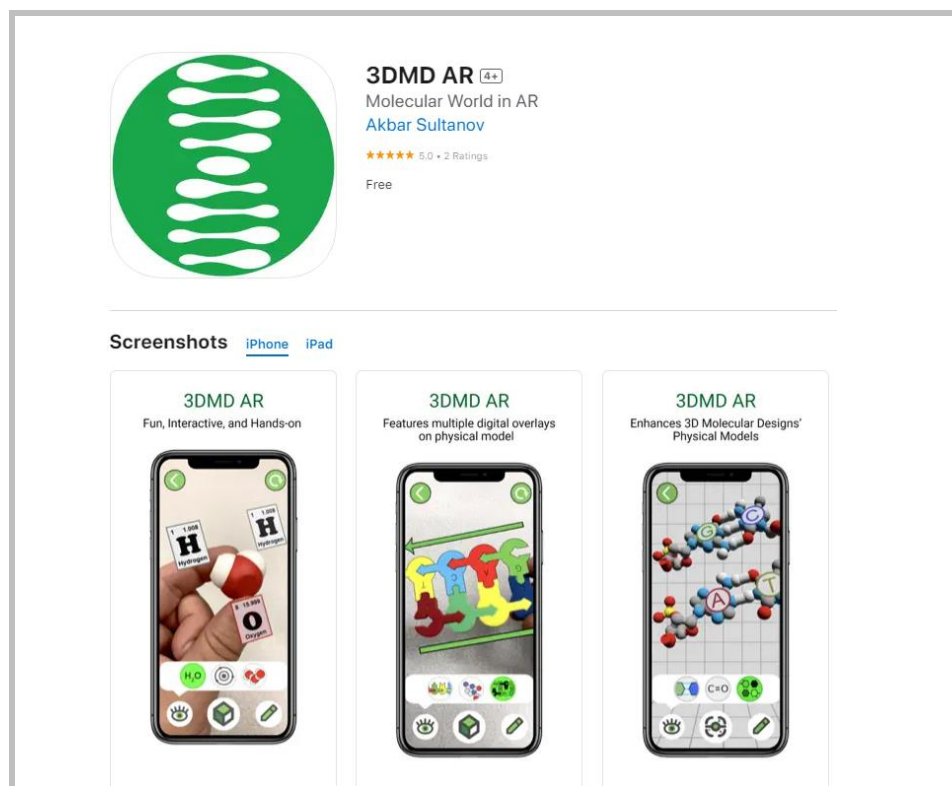
Usability Test



Usability Test - *Installing the Application*

Apple App Store (iPhone/iPad)

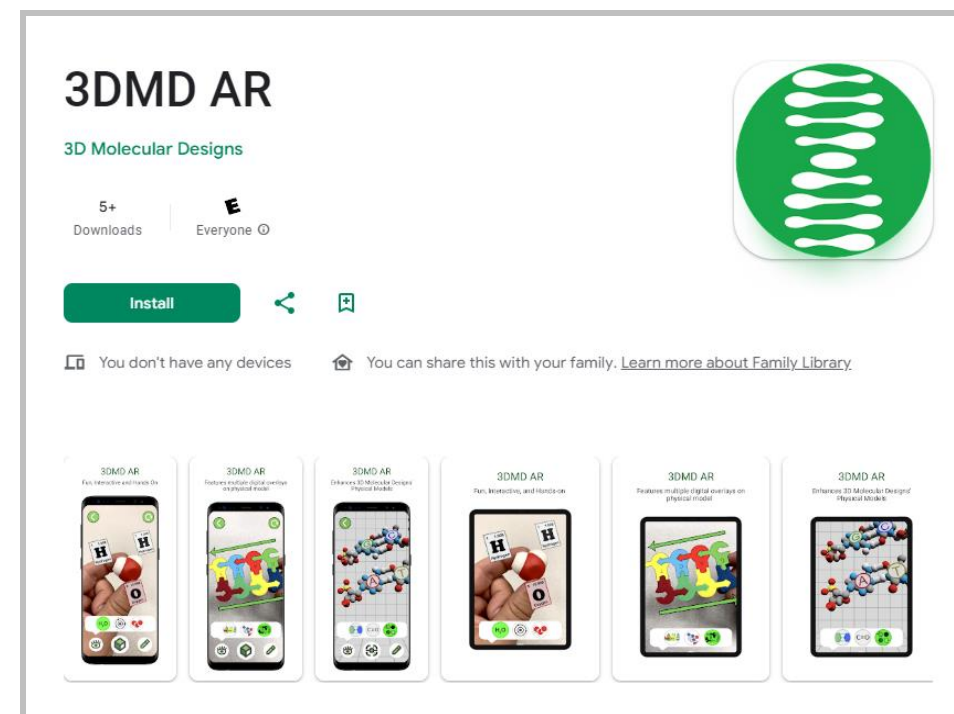
<https://apps.apple.com/us/app/3dmd-ar/id6450119774>



Google Play Store (Android)

[https://play.google.com/store/apps/details?](https://play.google.com/store/apps/details?id=com.ThreeDMolecularDesigns.ThreeDMDAR)

[id=com.ThreeDMolecularDesigns.ThreeDMDAR](https://play.google.com/store/apps/details?id=com.ThreeDMolecularDesigns.ThreeDMDAR)



Usability Test - *Installing the Application*

Apple App Store (iPhone/iPad)

<https://apps.apple.com/us/app/3dmd-ar/id6450119774>

- Device has a working forward-facing camera
- Apple 8 Device (2017) or newer (may work back to earlier phones. . . but still testing!)
- Devices from past 5x years should work!

Google Play Store (Android)

<https://play.google.com/store/apps/details?id=com.ThreeDMolecularDesigns.ThreeDMDAR>

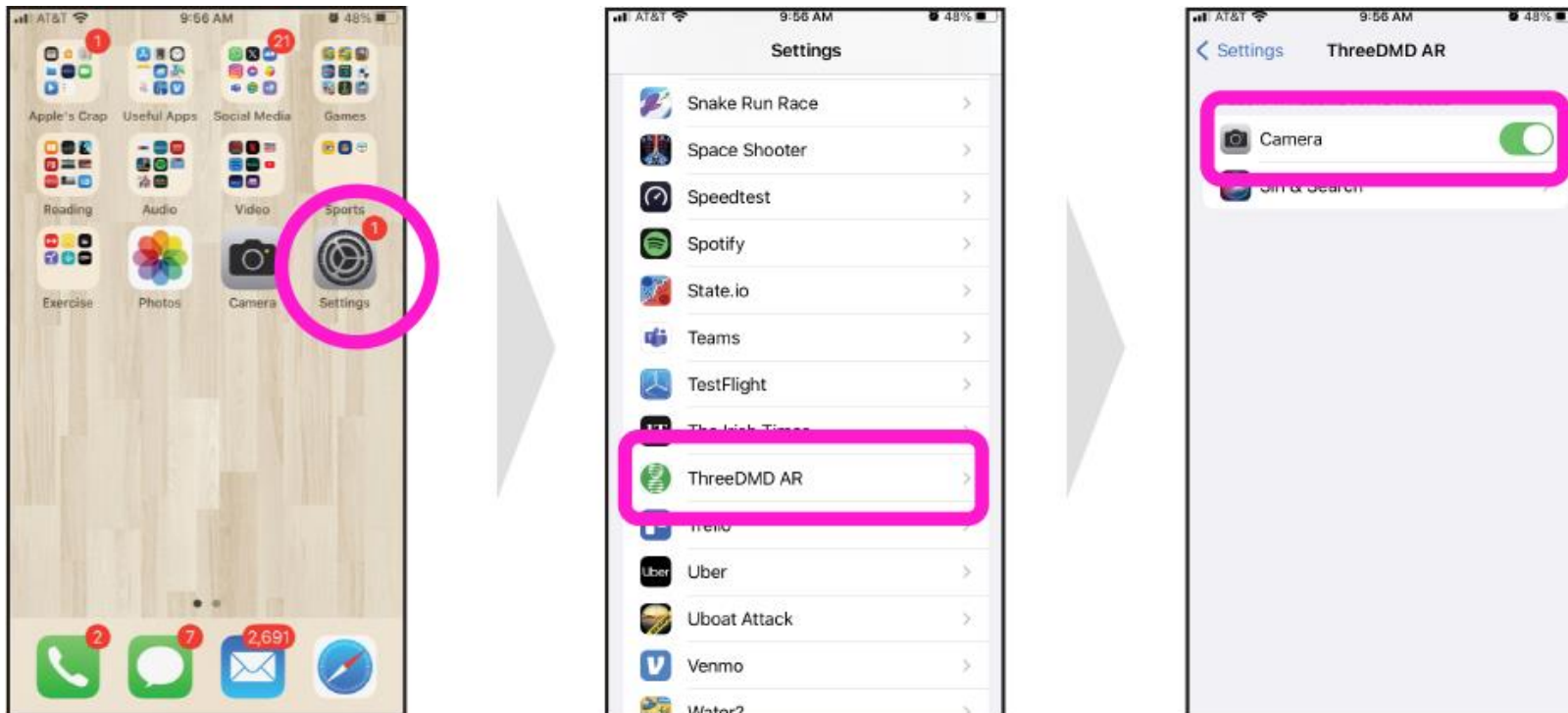
- Device has a working forward-facing camera
- Android OS Version 9.0 or newer (may work back to Android 5.0. . . but still testing!)
- Target API 22 or newer
- Devices from past 5x years should work!

***** We Will Provide Recommended Devices *****

Usability Test - *Camera Permissions*

Apple App Store (iPhone/iPad)

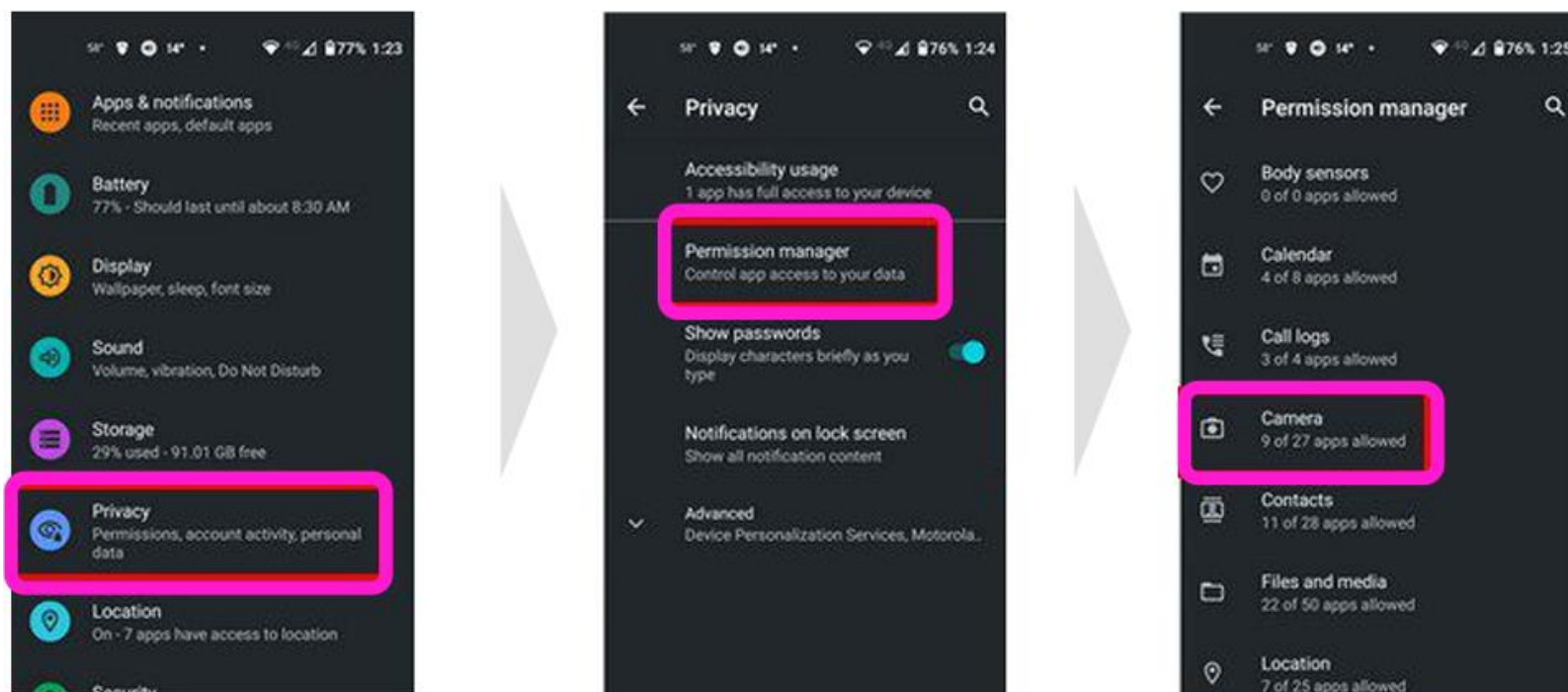
<https://apps.apple.com/us/app/3dmd-ar/id6450119774>



Usability Test - *Camera Permissions*

Google Play Store (Android)

<https://play.google.com/store/apps/details?id=com.ThreeDMolecularDesigns.ThreeDMDAR>



Usability Test - *Additional Devices*

Chromebooks. . . surfaces. . . and more?



Accessories sold separately.

Usability Test - *Education Prompts*

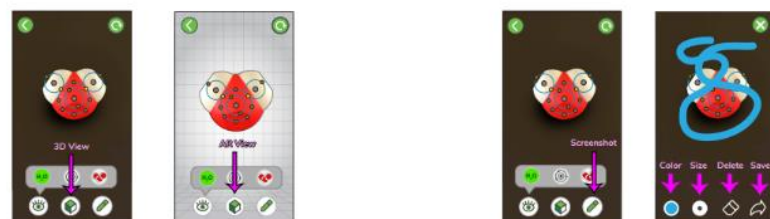


- 1 Open the app and select the water molecule
- 2 Line up your model with the white guide. Open the targeting help menu if having trouble.
- 3 Click to switch between each of the different AR overlays

What atoms make up water? _____

How many electrons are associated with each atom? _____

How do multiple water molecules interact? _____



- 4 Click the central button to toggle between AR view and 3D view. It may be easier to see the details of an overlay using 3D view. Click and drag to rotate in 3D view. Pinch and pull to zoom in 3D view.
- 5 Click the pencil button to take a screenshot, then click and drag to draw. Buttons at the bottom will change the drawing color and size, erase all work to start again and save the screenshot.

Take a screenshot and draw where you think partial charges (either positive or negative) may exist on a water molecule.

Complete the survey at: https://milwaukee.qualtrics.com/jfe/form/SV_6rNoQQbZGf7YAgC



- 1 Open the app and select the adenine (A)
- 2 Line up your model with the white guide. Open the targeting help menu if having trouble.
- 3 Click to switch between each of the different AR overlays

What are the components of the backbone? _____

How many bonds form between the adenine and thymine? _____

How do the bonds between adenine and thymine & guanine and cytosine differ? _____



- 4 Click the central button to toggle between AR view and 3D view. It may be easier to see the details of an overlay using 3D view. Click and drag to rotate in 3D view. Pinch and pull to zoom in 3D view.
- 5 Click the pencil button to take a screenshot, then click and drag to draw. Buttons at the bottom will change the drawing color and size, erase all work to start again and save the screenshot.

Take a screenshot and draw the differences in base pairing between the four DNA nucleotides.

Complete the survey at: https://milwaukee.qualtrics.com/jfe/form/SV_6rNoQQbZGf7YAgC

Usability Test - *Education Prompts*

Training Activity: Amino Acid Sidechain Chart



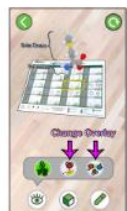
Participant Number:



- 1 Open the app and select the Amino Acid Sidechain Chart



- 2 Line up your model with the white guide. Open the targeting help menu if having trouble.



- 3 Click to switch between each of the different AR overlays

What do you notice about the structure of methionine? How does it differ from the plastic cysteine side chain model?

How does this amino acid interact with water?

What was removed when the peptide bond was formed?



- 4 Click the central button to toggle between AR view and 3D view. It may be easier to see the details of an overlay using 3D view. Click and drag to rotate in 3D view. Pinch and pull to zoom in 3D view.



- 5 Click the pencil button to take a screenshot, then click and drag to draw. Buttons at the bottom will change the drawing color and size, erase all work to start again and save the screenshot.



Take a screenshot and draw how the methionine amino acid interacts with water, summarizing its properties

Complete the survey at: https://milwaukee.qualtrics.com/jfe/form/SV_6rNaOQbZGf7YAgC

Training Activity: Foam Nucleotides (AGTC)



Participant Number:



- 1 Open the app and select Foam Nucleotides (AGTC)



- 2 Line up your model with the white guide. Open the targeting help menu if having trouble.



- 3 Click to switch between each of the different AR overlays

How are the 3' and 5' carbons oriented in the single strand of DNA molecule?

How do the bases on the same strand bind to the sugar-phosphate backbone?

Which complementary bases bind together?



- 4 Click the central button to toggle between AR view and 3D view. It may be easier to see the details of an overlay using 3D view. Click and drag to rotate in 3D view. Pinch and pull to zoom in 3D view.



- 5 Click the pencil button to take a screenshot, then click and drag to draw. Buttons at the bottom will change the drawing color and size, erase all work to start again and save the screenshot.



Take a screenshot and draw one way the four nucleotides are each different and one way they are all the same.

Complete the survey at: https://milwaukee.qualtrics.com/jfe/form/SV_6rNaOQbZGf7YAgC

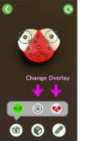
Usability Test – *Student Survey*

- Students should complete the survey after **each** activity
- Students could complete the survey up to **four** times
- The same survey is completed each time

Training Activity: Water Molecule



Participant Number: _____

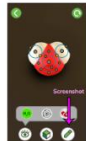
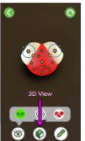


1. Open the app and select the water molecule
2. Line up your model with the white guide. Open the targeting help menu if having trouble.
3. Click to switch between each of the different AR overlays

What atoms make up water? _____

How many electrons are associated with each atom? _____

How do multiple water molecules interact? _____



4. Click the central button to toggle between AR view and 3D view. It may be easier to see the details of an overlay using 3D view.
Click and drag to rotate in 3D view. Pinch and pull to zoom in 3D view.
5. Click the pencil button to take a screenshot, then click and drag to draw. Buttons at the bottom will change the drawing color and size, erase all work to start again and save the screenshot.

Take a screenshot and draw where you think partial charges (either positive or negative) may exist on a water molecule.

Complete the survey at: https://milwaukee.qualtrics.com/jfe/form/SV_6rNo0b2G7V9qC

- Access the survey from the QR Code or URL
- Students may complete the survey on their phones, Chromebook, or computer

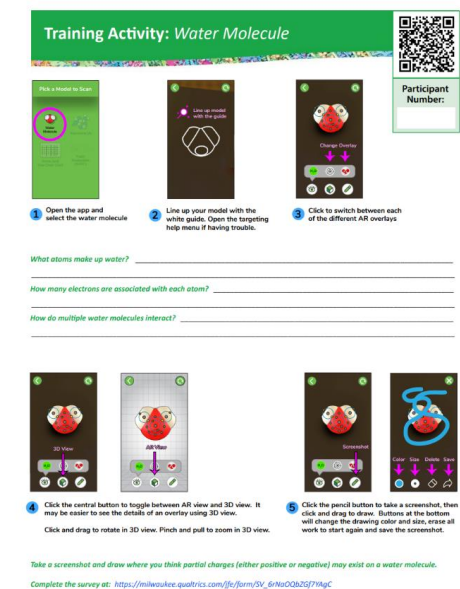
Cohort & Student Numbering Systems

Training Activity Survey

This survey is intended to be completed after the completion of each training module. You may complete it up to four times, once for each training module.

What is your participant number listed on the top right of your exercise handouts?

What is your teacher and class period code?



Training Activity: Water Molecule

Participant Number: _____

1. Open the app and select the water molecule.

2. Line up your model with the white guide. Open the targeting help menu if having trouble.

3. Click to switch between each of the different AR overlays.

4. Click the central button to toggle between AR view and 3D view. It may be easier to see the details of an overlay using 3D view. Click and drag to rotate in 3D view. Pinch and pull to zoom in 3D view.

5. Click the pencil button to take a screenshot, then click and drag to draw. Buttons at the bottom will change the drawing color and size, or you can work to start again and save the screenshot.

Take a screenshot and draw where you think partial charges (either positive or negative) may exist on a water molecule.

Complete the survey at: https://milkshake.quattrics.com/jfr/jurn/SV_6rNo020271hgC

Please provide your students with the numbers they should use in the survey.

Your cohort number should be the basis of the “teacher and class period code.”

Cohort & Student Numbering Systems

Suggested Teacher & Class Period numbering system:

- CohortNumber.ClassPeriod
 - 1234.1, 1234.2

Potential Student Participant Numbering Systems

- Write numbers on printed worksheets and hand them out as students enter class
- Write numbers on sticky notes and place them at lab tables
- Use a class or school numbering system as long as you do not share the key with us



Usability Test – *Teacher Survey*

- Teacher submits survey after each class finishes an activity.
- [Qualtrics Survey | Qualtrics Experience Management](#)
- The link to the survey can be also be found on the field test landing page.
- The survey should take five to ten minutes to complete.
 - Multiple choice and some free response

Education Tests



Education Tests - *Installing the Application*

Apple App Store (iPhone/iPad)

Link coming soon!



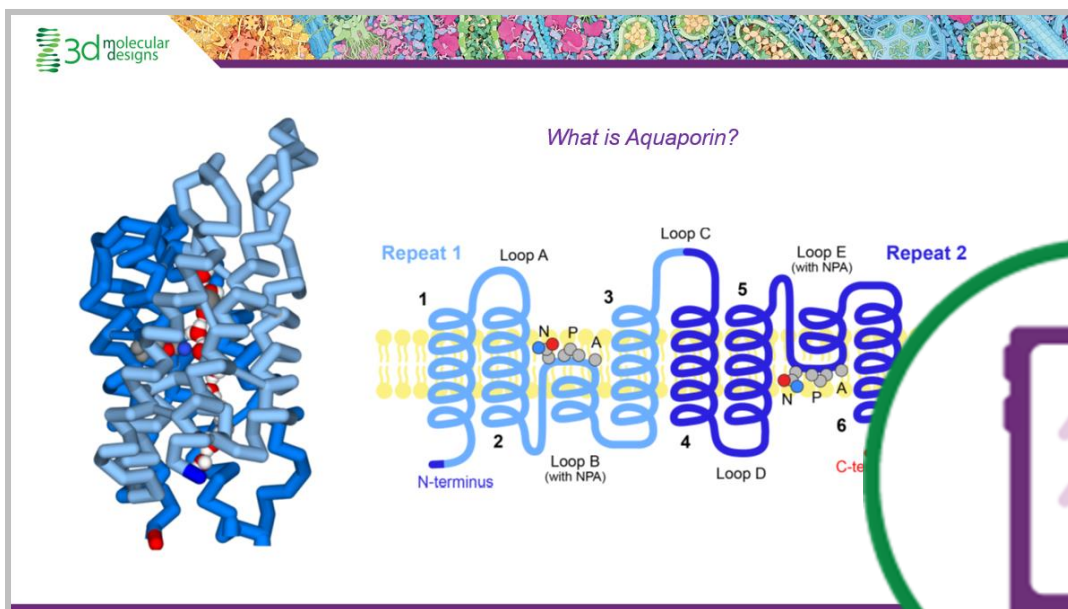
Google Play Store (Android)

Link coming soon!

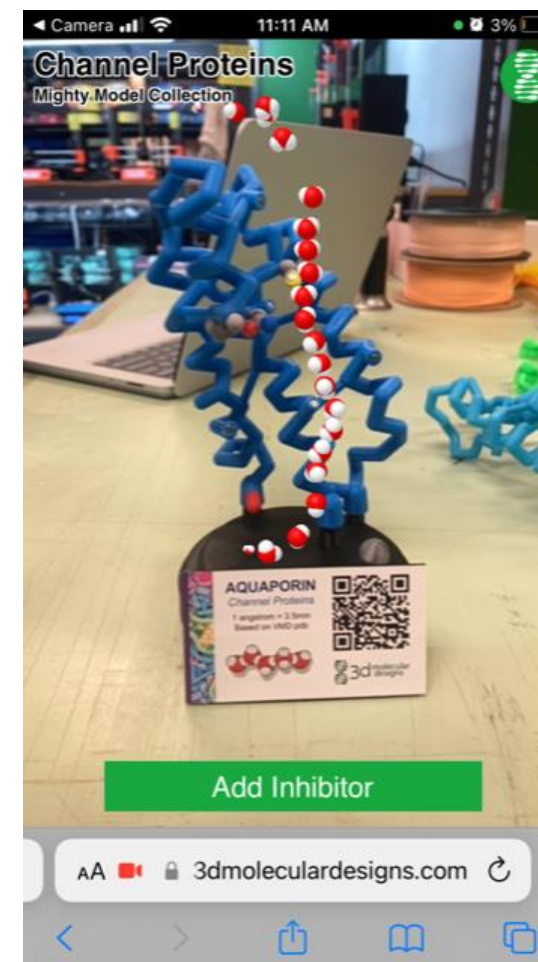


***** Password Required to View Activity Content *****

Education Tests - *Activity Format*



Slide Deck

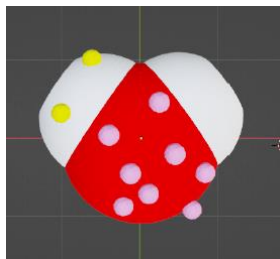
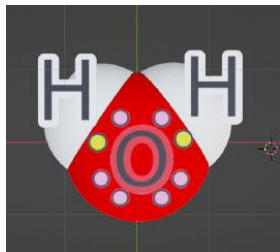


AR Application

Education Tests - *Water Kit*

Activity 1: Discovering Polarity

- Covalent bonding
- Water Molecule Polarity
- Hydrogen bonding



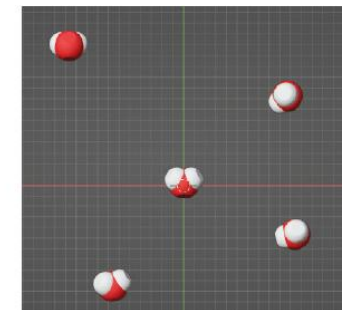
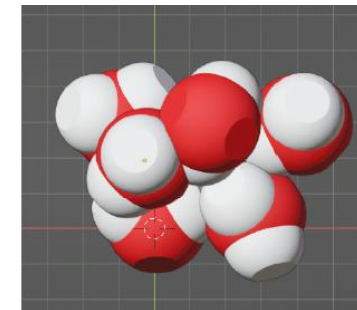
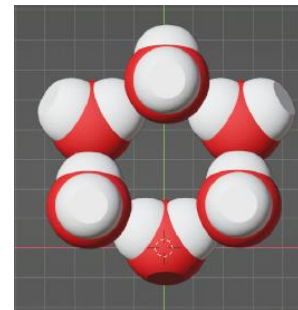
Discovering Polarity
Water Kit AR Activity

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	Hydrogen 1	Hydrogen 2	Oxygen
Expected Average Electron Distribution:	1.0	1.0	8.0
Test 1:	0	0	10
Test 2:	1	0	9
Test 3:	0	1	9
Test 4:	2	1	7
Test 5:	2	0	6
Test 6:	0	0	10
Test 7:	0	2	6
Test 8:	0	0	10
Test 9:	1	1	6
Test 10:	1	2	7
Actual Average Electron Distribution:	0.7	0.7	6.6

Activity 2: States of Matter

- States of Matter
- Impact of temperature
- Density



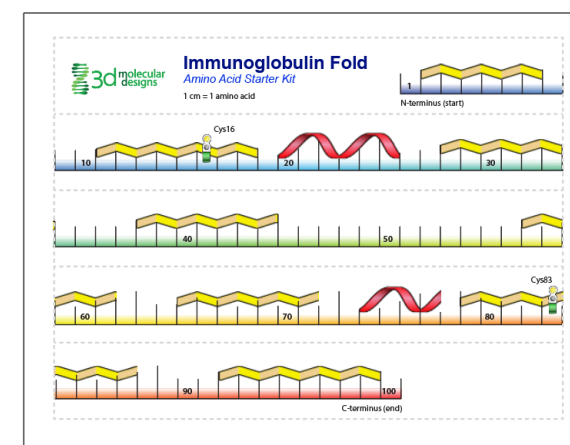
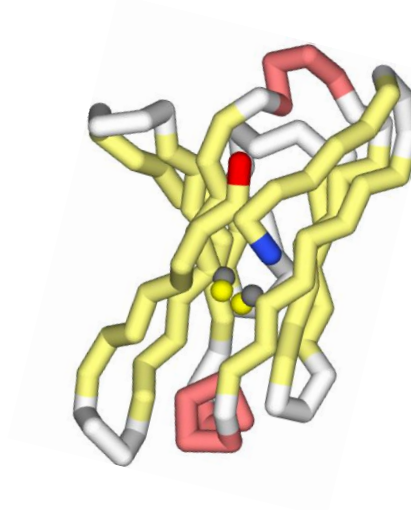
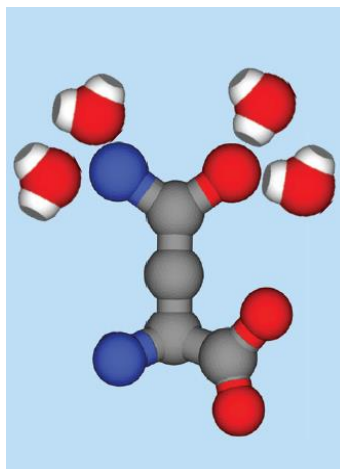
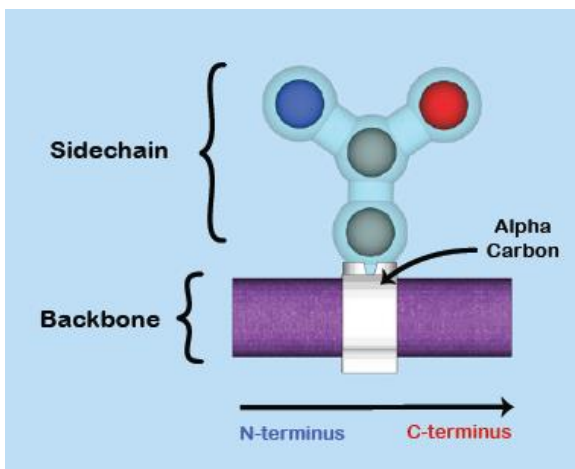
Education Tests - *Amino Acid Starter Kit*

Activity 1: Sorting Sidechains

- Amino Acid Structure
- Amino Acid Chemical Properties
- Principles that Drive Protein Folding

Activity 2: Folding Real Proteins

- Protein Structure/Function
- Principles that Drive Protein Folding
- Secondary Structures



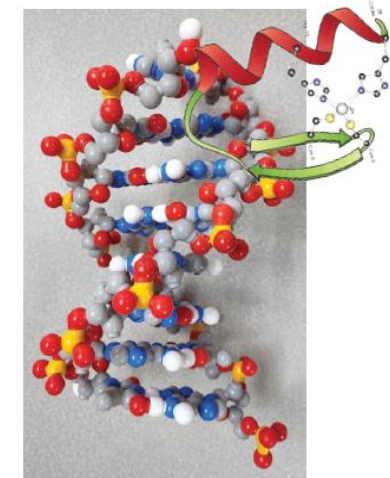
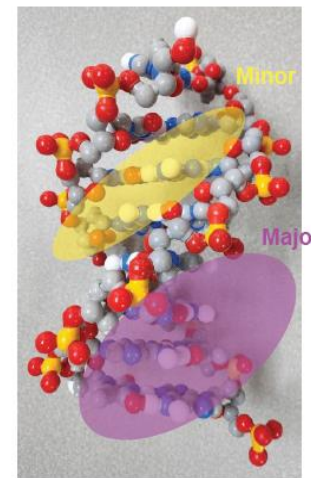
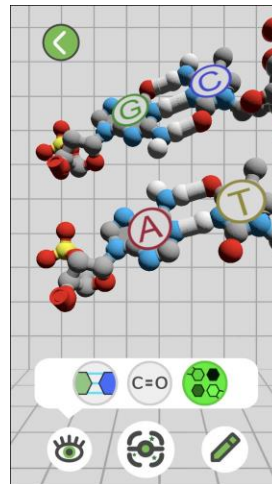
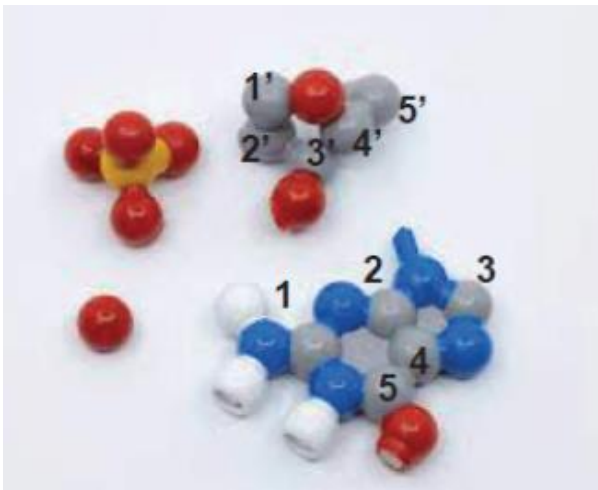
Education Tests - *Dynamic DNA Kit*

Activity 1: Nucleotide Structure

- RNA and DNA
- Backbone Directionality
- Base Pairing and Hydrogens
- ATGC Differences/Modifications

Activity 2: Protein Binding

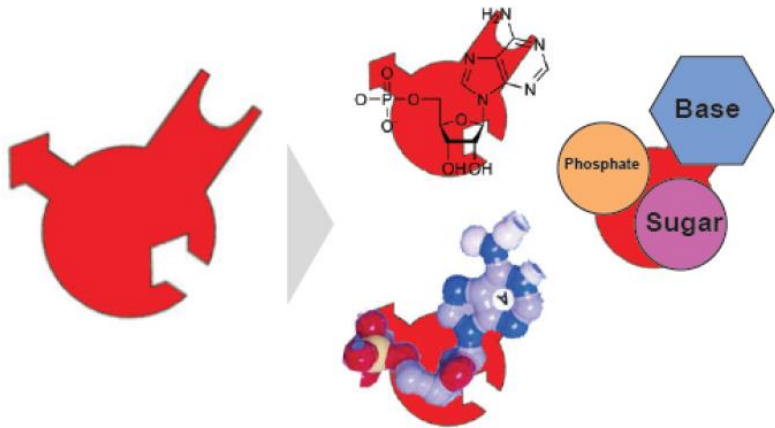
- Shape: Major/Minor Groove
- Chemical Properties: Backbone/Base Pair
- DNA storage/regulation



Education Tests - *Flow of Genetic Information Kit*

Activity 1: Nucleotide Structure

- Nucleotide Structure
- Base Pairing
- Double-stranded DNA



Activity 2: When the Flow of Genetic Information Stops Flowing

- Flow of Genetic Information
- Inhibition/Antibiotics/Antibiotic Resistance
- Structure/Function



Education Tests - Release Schedule

Water Kit: Sept. 15th

- *Discovering Polarity*
- *States of Matter*

Amino Acid Starter Kit: Sept. 30th

- *Sorting Sidechains*
- *Folding Real Proteins*

Dynamic DNA Kit: Oct. 15th

- *Nucleotide Structure*
- *Protein Binding*

Flow of Genetic Information Kit: Oct. 31st

- *Nucleotide Structure*
- *When the Flow of Genetic Information Stops Flowing*

Education Tests - *Treatment or Control Group*

All Educators will be in the treatment group for at least one kit/activity and the control group for at least one kit/activity. These blind assignments could be partially based on the timing of topics in your classes.

Water Kit: Sept. 15th

- *Discovering Polarity*
- *States of Matter*

Dynamic DNA Kit: Oct. 15th

- *Nucleotide Structure*
- *Protein Binding*

Amino Acid Starter Kit: Sept. 30th

- *Sorting Sidechains*
- *Folding Real Proteins*

Flow of Genetic Information Kit: Oct. 31st

- *Nucleotide Structure*
- *When the Flow of Genetic Information Stops Flowing*



Education Tests – *Student Survey*

- Students will complete a pre-test and post-test for each education activity
- Teachers pre-assign participant number of each pretest and post-test
- ***IMPORTANT*** — Give each student the same number for both pre-test and post-test
- The link to the pre-test/post-test will be available on the field test landing page after the usability portion is complete.



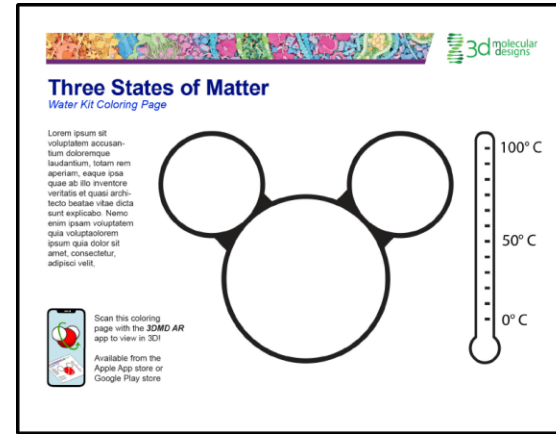
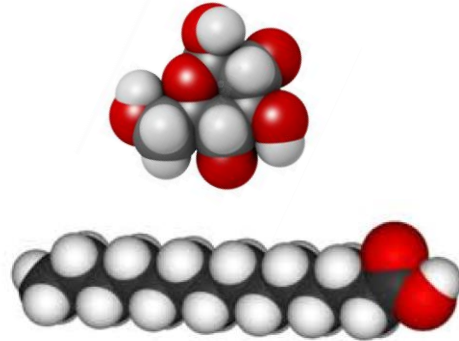
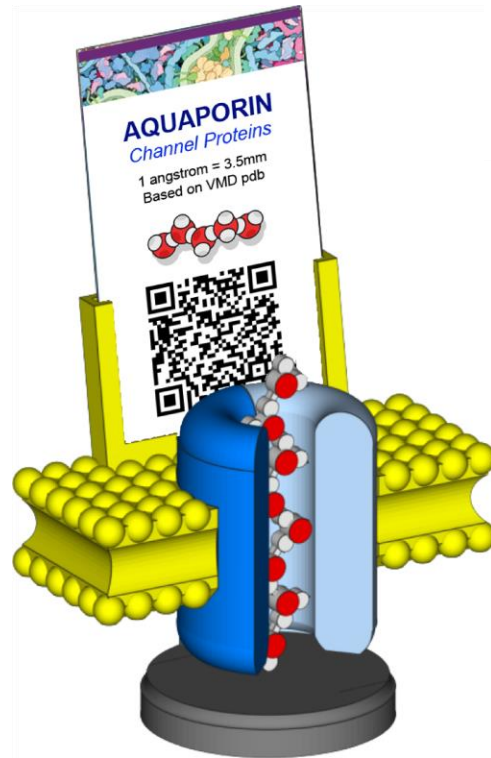
Education Tests – *Teacher Survey*

The purpose of the Teacher survey is to identify:

- Activities and/or instruction on these topics in addition to, or outside of the app
- Technical problems your students experience in the app
- Misconceptions or other education-related problems generated by the app and/or activity
- Positive effects of the app and/or activity
- Recommendations for improvement or additional activities

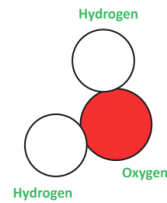
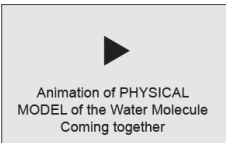


Beyond the Two Formal Tests

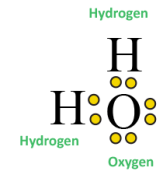


Assembling the MONOMER:

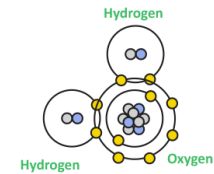
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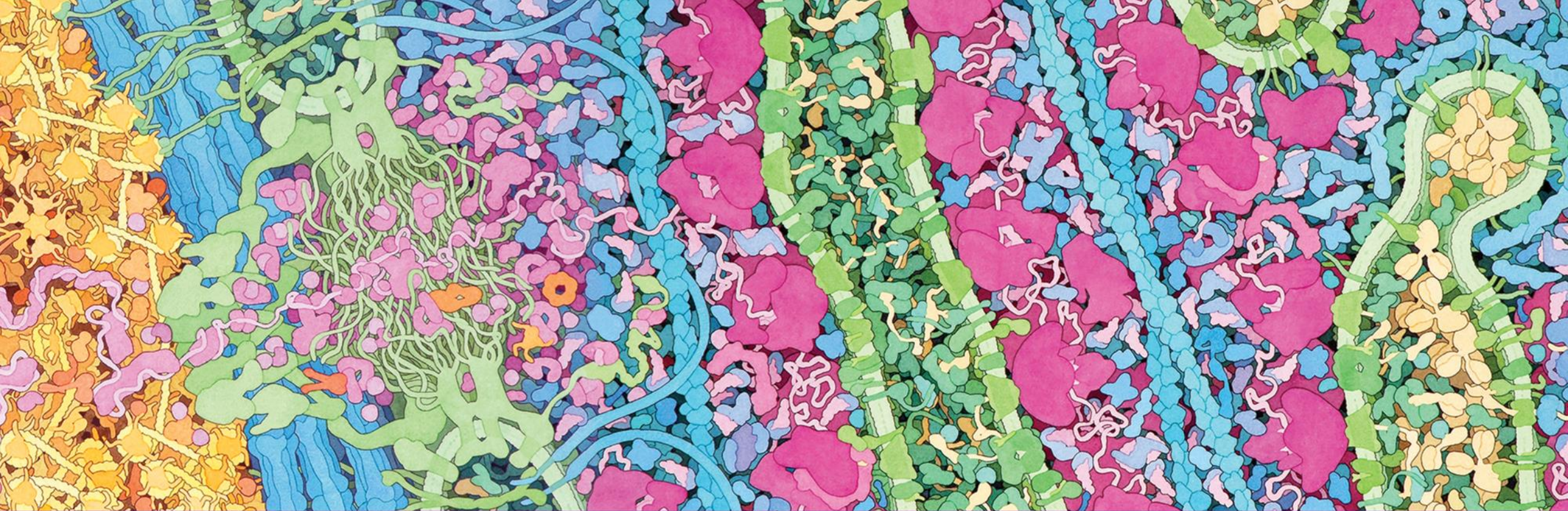
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