Instructor Specific

- **NEW** Build UI and system for instructors to be able to turn certain simulations on and off, based on their course needs.

Gameboard

- Start button - “Begin Here”
- Include zoom out button
- Instructions that briefly tell the user how to use the site when you hit the start button.
- Token should stay full once it is completed. Don’t have it be half done…
- Under “objective,” put points in that you have to get to pass.
- **NEW** Change the left nav to be more like a node map...like the one Mike drew on the board. Add bridges as people succeed at sims. Use Mike C’s diagram as a guide.
- Nucleus artwork changing under Mike’s direction
- **NEW** Add in a well/lab in the gameboard image.
- **NEW** Work with the Macmillan media group to put the appropriate code (using Adam’s already created API) into the current sims in order to communicate with launchpad.

General Sim Notes

- Include score in the nav bar
- Make all fonts/instructions like CRISPR
- **NEW** Include “repeat sim” and “page back” functionality.
- There should be no penalty for dragging something and dropping it.
- Firefox drag/drop issues
- Fix images where they are too blurry.

Nucleotides

- Instructions should say “build DNA and RNA 5’ monophosphate nucleotides.
- Fix the word exercise.
- Instructions should say “4 different DNA + RNA nucleosides

DNA/RNA Structure

- Separate out sugar pucker and B/A images. Have them be two separate pages.
- Need congratulations message as well as a pausing mechanism for the movie.
- Label DNA movie.
- BRCA, Not BRAC
- No point deduction when dropping nucleotide that does not formed hydrogen bonds

Polymerase

- The section where you click on the “electrophile,” should say electrophile, not molecule.
- Change the mechanism arrow to curved.
- Arrow from P to O should come from the bond, not the atom (this is true for multiple sims)
- Fix the A-T angle and generally make the angles look better.

- Steps of poly sim will be different
    - First, you input two correct ones.
    - Then, input an incorrect one
    - Third, input a final correct one (after fixing the third one)
- **NEW** Every mechanism page will have the exonuclease on it. The exonuclease reaction will also have a water molecule sitting there to act as a proofreading nucleophile
- Remove proofread button.
- Remove the word “primer” from the instructions (this may be for a different sim...not sure which instructions). Just say two nucleotides, not two primer nucleotides.
- Do not show base pairing when the incorrect base is added, just show the phosphodiester bond.
- **NEW** Don’t just have polymerase translocate, actually have the student grab it and move it themselves.
- To shorten mechanism animation time, have the arrows flash at the same time.
- DNA POL in image, not just POL
- Say “DNA polymerase” in the instructions as well

DNA Replication

- Remove the “no helicase” sim
- Remove specularity.
- Leading strand DNA is wrong-handed.
- **NEW** Construct sim in different way
    - Intially they put it together.
    - Then they label everything
    - Then they are given scenarios that they have to build in order to make things go wrong.
- Original sim
    - RNA primer being created in wrong direction
    - **NEW** Move primase as primer is being created. It will shift back and forth.
    - Clamps should touch clamp loader.
    - Clamps should touch polymerase.
- No left poly
    - Leading red strand will move off the screen. Fork should be moving.
- No helicase (not to be included)
    - Clamp loader will not load.
    - Clamp won’t be moved
- No primase
    - Clamp loader will not load.
    - Clamp won’t be moved
    - Lagging strand should be all single stranded at the end.
    - Fork should not be stopped.
- No right polys

    - Lagging strand will be completely single stranded at the end. SSBs should be present all along the single strand.

mRNA Processing

- Need new molecule for polA polymerase.
- Label polA polymerase
- Giant purple thing needs to go over AAUAAA and should go behind it to give room for the endonuclease.
- Make sure to mention that the normal poly a tail is really long. The one shown here is very short.

PCR

- At the end, ask the question "How many molecules of DNA would be formed in a 5th cycle?"
- **NEW** Have the student manipulate temperature differences. Also have them place the appropriate reagents in the appropriate tube for the thermal cycler.
- **NEW** Have the background colors change based on heat.
- **NEW** Change exon to Exon 3.
- **NEW** Possibly just have the blue part exon show without letters in the sim.
- Change the way the ladder works (there will only be three outcomes based on the three different exons 4, 5, 7) Although if we're not doing three exons there will only be one ladder outcome.
- **NEW** Add random single mutations to the exon and ask students about it.
- Primer costs are too high. Lower them.

Sanger

- Arrow needs to come from the bond, not from the atom
- Don't allow as many nucleotides (cap it at 2 or 3)
- **NEW** The pentose needs to be flipped (not correct in the art, we need to fix it in the figure)
- Instructions need to be clarified (for instance, the amount of time required to do the reaction needs to be made clearer)
- 10 seconds should be the time required for the reaction
- Integrate new text from Mike for instructions.
- Primers should not be floating around at the end...they should go through the tube attached to the new strand
- **NEW** Put reaction sequence on screen while the reaction is happening.
- Make sim box at the end a little bigger so it's not as cramped.
- Sanger token needs to be blue, not green.
- **NEW** Change chromatogram and sequence. We should use the short sequence from exon 5, and include the same sequence every time, but add a mutation.
- **NEW** The mutation base should look different in the chromatogram, should be a double peak.

- **NEW** Number the chromatogram, allow the question “what position is the mutant base?” to be asked.

Transcription

- Make abortive initiation more obvious (red “abortive initiation’ message).
- Make abortive initiation happen less frequently.
- Remove the “transcribed gene” sequence at the end.
- Old +1 is still there when sim aborts.
- Rho protein doesn’t go into the polymerase
- Change verbiage to “the protein encoding gene”
- Move the hairpin to the right, shouldn’t be right next to the gene.

Translation

- **NEW** Change shine delgarno sequence piece of RNA. Should look more like a ledge. Get rid of purple thing from book.
- RNA should be in front of the ribosome.
- Figure out a better way to do scrolling, maybe make the drag and drop area bigger so we don’t need it.
- Provide genetic code chart.
- Clarify that we are dealing with bacteria translation (ask a question right up front as we are seeing the polysome for the first time, translating and transcribing at the same time).
- Specificity of hot spots needs to decrease.
- Put message up saying that “the small subunit of the ribosome needs factors before you can drag it.”
- rf molecule should say “This is a collection of rf factors.”
- Put 3’ on the left of the anti codon, and 5’ on the right of the text box.
- Put peptide bond formation image in...static, and after you click on an “i.”
- **NEW** 18-27 GTP first, then GDP. Book image is wrong.

CRISPR

- Make initial gene injection more obvious
- “Cutting Enzyme” label for scissors.
- Each spacer needs to be a different color
- Have the scissors only cut off one piece of the bacteriophage strand
- Don’t replace the purple strand, instead a new spacer and crispr repeat gets added in.
- Say “Immunity is established! The bacteria survived the first round…” This should happen right after the bacteriophage dna is incorporated.
- If they don’t get it, give a hint that they need to drop the bacteriophage chunk on the first spacer…not covered in book.
- Call this process CRISPR expansion.
- Call the cas protein “cas 9.” Need to make sure that this protein and the protein in the second half of the sim look the same.
- Change the RNA guide so that it looks the same as the image Jennifer sent along.

- When the new bacteriophage DNA gets cut, don't have it explode, rather have it cut in half.
- **NEW** Instead of immediate genetic change, show the new litter of mice after a month…
- **NEW** Instead of obesity in mice, use the coat color images we received from Jennifer (permission needs to be acquired for these photos)

Mutation and Repair

- Yellow things are DNA lesions, don't call them mutations until after the fork passes.
- **NEW** Redesign the way the forks work, they shouldn't move at all...be situated in the nucleoid like Mike drew on the board. DNA should come out of them as it is being replicated. The lesions should get pulled through the forks and should change to mutations as they are pulled through.
- Say "bacteria" not "bacterial"
- The way to complete the sim is to get through everything, both forks and mutation repair
- Once you complete something, you never see it again in this sim.
- Cytosine Deamination
    - Letters need to be put into the figures, or at least letters for the pair that need fixing.
- Double strand break repair
    - Either helicase or recombinase will work for branch migration
    - The blue line shouldn't get longer in the second image, that would imply we are making new DNA, we're not.
    - Holliday intermediate uses resolvase
    - Resolvase will do the cutting and then ligase will finish the deal.
- Mismatch repair
    - Show the template strand. Then add the nucleotides, don't just show both at once.
    - Spell out mismatch repair. Not MMR
    - Don't worry about methylated adenine, we discussed it here, but we are not going to include.
    - mutH should be on the sequence, then it makes a nick. Bottom half of the nick should stay connected. Degrade the strand all the way back past the mismatch.
    - Mutation should be on top strand.
    - Exonuclease and helicase does the degradation.
    - Put "next" button in, or continue...don't just have instructions and mutation go away after you are done with it. That happens too quickly.
    - Top blue strand doesn't come down until branch migration (not sure where this goes)
- UV
    - Sunlight can go anywhere...just click the sun and a ray of light goes to the appropriate part.
    - Place the photolyase down near the reaction.
- **NEW** Nucleotide Excision Repair

- This needs to be added to the sim
- Use figures in the book