ATEP ONLINE MEDIA DEVELOPMENT TEMPLATE

DOMAIN: Biological and Chemical Technologies
MODULE TITLE: Biotechnology
MEDIA FORMAT: Simulation/Culminating Assessment
BRIEF SCENARIO: Stage 1: Technology Park entry, student enters the Biotechnology Research Facility (3D and 2D view?) Stage 2: Passes through security to Changing Room. Selects and dons white coat, picks up Security Pass (3D/2D?) Stage 3: enters work place via secure doors (uses pass to enter) (again using a 3D with 2D floor plan showing location?) [the workplace could have reference materials that we might make active as we develop this approach] Stage 4: Turns on computer, monitor flashes "Top Priority Project – click to learn more" Stage 5: On click, the Student is presented with the "need for insulin" challenge" [NB: the teacher control panel will allow a teacher to select the number and level of review questions that will be used. They will also have control over the actions in the event that a student does not meet the required standard set by the teacher] [if turned on in Control panel] Stage 6: Prior to entering the research lab, the student is reminded that they do need to know some biology concepts before they start the research phase. Stage 6a: Student enters a review process: upon success, they move to Stage 7, upon failure, they move to 6b [controlled by Control Panel] Stage 6b: Remediation via branching tables to existing content, or to new content Stage 7: Student now sees a message that they now have access to the Research Lab … [NB: there will be a need for some form of note taking facility built in – perhaps a clickable button that brings up a 'yellow pad" Stage 8: Student enters Research Lab, and turns on lab computer … it will show the first experiment to be carried out on extracting insulin. The expt. Will be open ended, and will allow the student to make missteps as they go through the process. [The expt. will be developed in detail by the writing team.] Stage 9: They will need to complete a lab report ..[the steps would be selected by the writing team]

NEW MULTIMEDIA SECTION

Screen Tab Title: Research and Development Lab			
On Screen Text:	**Text in Graphics/Animations:**	**Visual support:**	**Interactivity:**
Welcome to the Research and Development Lab. We are going to undertake a series of experiments to determine the most efficient and safe method by which insulin can be produced. **Once you have completed the experiments, you will have an opportunity to select one of the methods for large scale production.** **But first we need to learn more about insulin. Click NEXT when ready**			
PHASE 1 Let's learn about the role of insulin … [**Jim**] Please use the animation below showing how insulin unlocks for glucose absorption in normal and diabetic person http://youtu.be/MGL6km1NBWE			[**Jim:** maybe we can have the three phases shown on the screen as choices [Phase 1, Phase 2, Phase 3] but only Phase 1 is selectable when they first arrive at this section]
Learning Outcome Assessment			
Assessment questions: [Brian will add a few questions]			

Simulation Notes:

[Jim: We do need some form of navigation control – Control Panel? – to allow access the following:

ATEP-Wiki so they can research information on the fly – Needs to be searchable and Browsable.

The Electronic Lab Report (ELR) they record all their work in (this will have a framework created in advance somewhat like the Student Activity Guide format where the writing team would have set out the prompts sequentially. The student would need to be able to navigate to the various sections of the ELR.

Lab Procedure Manual (LPM)] – this needs to be contextual (opens at the step or procedure being explored, and also have an INDEX to allow navigation to other topics.

(Maybe we could use a second monitor with the resources that is available when they are using the first monitor for information retrieval … or perhaps the idea of a pup out Control Panel makes more sense …)

To see how some of the above is dealt with in an animated context, see what Brian has been doing at
http://aristotle.learningmate.com/jws47/Virtual%20Labs/lab_mass_spectrometry/index.html

… you will see the LPM (the book in the example opens in a contextually appropriate manner when clicked on – in our case, it also needs to have a link that is titled INDEX that would open up to the full list of steps in the LPM. The student could then click on any step to learn more about that process.

*[**Jim:** regarding the **note taking ability** in the ELR, we do need some way to allow students write notes in a structured (word processing type) manner. As mentioned above, Brian will help with the headings so that we have a framework to work with .The student will see a number of "submission" buttons, whereby they have to click to have the lab report review/graded by the teacher. Using LTI, this should return the document to Moodle for grading (the teacher will know from whom it came that way!). The Lab Report should also be exportable in xml, doc or rtf so they can also use it outside of Moodle.*

*[**Jim:** We need a glossary feature .. maybe we add that via hot-linked terms (as per Moodle) Brian has provided the terms for a lot of the items already in the script, and will add more in due course. Look for terms in **green** for hot linking]*

[Students return to the Sim from Moodle after completing laboratory bio-processing section, and have satisfactorily passed the assessment to this point in the sim]

[on screen] Now you have learned about insulin therapy, we now need to learn about how therapeutic insulin is made.

[In this phase of the simulation, we are looking to have the students enter a research lab environment and undertake two distinct experiments: the first to harvest insulin from cattle pancreas, and the second, to use the Genetically Modified Organism Method of producing insulin. Once they have used both approaches, they are to compare and contrast the methods and make a recommendation in the form of a quantified lab report using data from their experiments.]

[Jim: Lab Facility: Pancreatic production of insulin: the lab would be set out in advance so they will access the lab with the equipment set out in a sequentially appropriate manner. Brian will provide a sketch of a typical layout]

[Brian: we will need to look at the various steps in the following procedures and sketch out what a lab looks like, with particular attention being paid to the placement of the various pieces of equipment, their size in relation to each other, and the likely location of control equipment.]

Screen Tab Title: Research and Development

On Screen Text:	Text in Graphics/Animations:	Visual support:	Interactivity:
PHASE4: Extracting Insulin from Cattle Pancreas In this phase, you will be able to undertake the process of extracting insulin from a cow pancreas. This will require that you go through the entire lab based process, step by step. When you have finished the process, you will be able to measure the output of insulin from a cow's pancreas, and be able to calculate how many cattle pancreases would be need to provide sufficient insulin for one adult and the for the diabetic population of the US for one day.			***[Jim:** this information can either be revealed on the screen or it could be a spoken message – maybe a call phone call?]* ***[Jim** – we will need access somehow to the ATEP-Wiki so they can research information on the fly, as well as the Electronic Lab Report (ELR) and the Lab Procedure*

			Manual (LPM) – Floating Control Panel?]

[on screen] Since this is a laboratory, you must wear protective clothing for this lab. Go to the Safety Cabinet and obtain the safety items needed for a hands-on lab experiment … you can learn more about the items you need from the Lab Procedure Manual … also please make sure that you record the items you plan to use in your Electronic Lab Report

[**Brian:** we will need to have a section in the ELR that is headed "Safety Equipment" – Brian: the LPM will need to briefly reference the MSDS used in this lab procedure]

***[Jim**: they will need to be able to navigate to a safety cabinet –there should be all the normal items clearly visible: gloves, goggles, lab apron … maybe we have some other items that are not needed*

***T**hey will have to select the correct items [googles, gloves and apron] and then the sim should make it appear that these items are being donned by the student.*

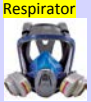
***[Jim:** If they fail to put on all the necessary equipment, if they try and navigate away from the cabinet … a message will need to pop up telling them that they do not have not collected all the necessary items … try again. They will not be able to proceed until they have the correct items]*

[Jim: they can select a distracter … the same message will pop up alerting them that they have selected an inappropriate item]

[Jim: The student must be able to access the Control Panel]

*[**Brian:**we need to develop the procedures for the LPM]*

Comment [BRS1]: Distractors:
Respirator



http://i21.geccdn.net/site/images/n-picgroup/MWY_10041139.jpg
Hair net

https://encrypted-tbn0.google.com/images?q=tbn:ANd9GcSUo4s4l0S0cDFfl_YAhaUAx7GbKa-lhYLJA8B0rB73sMZFIR86
Hard hat (like in construction)
Colored vest

http://www.facilitiesbuyer.com/shop/images/PPE001.jpg

Comment [BRS2]: We need hearing protection when using the machinery

On Screen Text:	Animation Notes:
Step 1: Obtain a pancreas from the freezer 	**Students will navigate to the freezer (see above note about locating equipment). They will open the door and remove a frozen pancreas** **They will need to unwrap it and place in the dish There would be a clock and a thaw button. When pressed the clock would advance 4 hours and the pancreas would flow out somewhat and become more red (as per image].**
GLOSSARY DEFINITIONS	**LPM - Process Preparation Sheet – Step 1**
	Safety Equipment: Google, Apron, Rubber Gloves **Equipment Needed:** Freezer, Stainless steel cutting table, scalpel **Materials and Supplies:** 400g pancreas **Process Overview** The pancreas is typically in a brown cardboard packing box with a USDA label or comparable signage. We typically removed the organs and placed on a steel cutting table like found in a restaurant kitchen. The frozen pancreas is dark brown once the opaque covering is peeled off. The pancreas needs to be thawed before processing. **Standard Operating Process (SOP) Steps**

	1. Navigate to freezer. 2. Remove USDA labeled carton with one 400g pancreas 3. Navigate to steel cutting table. 4. Click the thaw timer to allow the pancreas to thaw completely 5. Remove packaging 6. Record your activities in the ELR 7. Move to the next step …

Step 2: Now skin the pancreas	**There should be a meat cutting knife nearby on the lab table. When they mouse over it, it will be picked up. As they mouse the knife over the pancreas, it will appear to be skinned.**
GLOSSARY DEFINITIONS	**LPM - Process Preparation Sheet – Step 2**
	Safety Equipment **Equipment Needed** **Materials and Supplies** **Process Overview** **Standard Operating Process (SOP) Steps**
Step 3: Now cut the pancreas into 4-6 smaller segments	**The meat cutting knife will then appear to section the pancreas as they mouse over it into 4 to 6 segments.**
GLOSSARY DEFINITIONS	**LPM - Process Preparation Sheet – Step 3**
	Process Preparation Sheet **Safety Equipment** **Equipment Needed** **Materials and Supplies** **Process Overview** **Standard Operating Process (SOP) Steps**

Step 4: Now place the pancreas segments into the Grinder. **Once placed in the grinder, turn on the grinder to reduce the segments into a finely ground form.** 	**Navigate to the grinder, and place the segments into the top (it is a hinged top … maybe have an OPEN – CLOSE button they press?).** **Once the segments are in the grinder, then have them turn on the grinder. It will run for 10 seconds (use grinder type sound).** **The ground output will ooze out of the Grinder output spout into a dish as the grinding takes place.**
GLOSSARY DEFINITIONS	**LPM - Process Preparation Sheet – Step 4**
	Process Preparation Sheet **Safety Equipment** **Equipment Needed** **Materials and Supplies** **Process Overview** **Standard Operating Process (SOP) Steps**

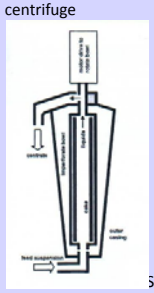
Step 5: Now place the ground pancreas into a mixer. **Once placed in the mixer, add buffer solution to the mixer. Once filled, you will be able to turn on the mixer.**  **Allow the mixture to be fully blended … this will take some time.** **Once complete, pump the mixture into a holding tank A.**	**Navigate to the mixer. They mixer looks like it has a top that is clamped by several thumb screw fixtures … maybe we once again have a ON—CLOSE button that ill allows the top to open and the ground output to be put in the mixer.** **The vessel should have a window in the side that allows the user to see it fill.** **Have a valve nearby that is labeled Buffer Solution. When they mouse over it, it will fill the vessel to 2/3rds full automatically.** **Have a Mixer ON-OFF control nearby. This will not operate until the ground pancreas and buffer solution are in the vessel.** **Have a clock image on the screen when it runs … it will run for an hour, so speed up the process!** **Once the hour is up, they will have to operate a button labeled "Holding Tank Pump" this will move the solution into a translucent plastic holding tank.** 
GLOSSARY DEFINITIONS	**LPM - Process Preparation Sheet – Step 5**
	Process Preparation Sheet **Safety Equipment** **Equipment Needed** **Materials and Supplies** **Process Overview** **Standard Operating Process (SOP) Steps**

Step 6: Now Process the Mixture in the Centrifuge **When you turn on the Centrifuge, the solution will be begin to be automatically pumped from the holding tank A into the Centrifuge.** **It will take some time for the solution to be processed through the centrifuge.**  **The output of the Centrifuge will be pumped automatically into holding tank B.**	**Navigate to the Centrifuge. Have a clear ON-OFF button. When turned on, the liquid from the first holding tank will begin to flow through the centrifuge. After a few seconds, the output will flow into another holding tank.** **The process is actually a continuous process from here on, but for our purposes, we might want to break ti stages by using a holding tank between each step [Brian: thoughts?]** **Show Holding Tank B nearby so the students see the liquid flowing from A to the Centrifuge and then on to Tank B.** **[Brian: where are the hose connections on the centrifuge?]** **[Also, we might want to allow students to "see" what is happening in the centrifuge whereby large particles being removed by rapidly spinning the solution – maybe a Spy Glass or if not a zoom-able window on the outside of the centrifuge vessel? Brian: thoughts?]** **This will take an hour so once again using accelerate time clock.**
GLOSSARY DEFINITIONS	**LPM - Process Preparation Sheet – Step 6**
	Process Preparation Sheet **Safety Equipment**

Comment [BRS3]: Yes, use a holding tank thank be moved on wheels to different parts of the lab. This is vary common when working with equipment bolted to the floor in a production facility.

http://www.labtrader.com/images/holding-tank-on-wheels.jpg

Comment [BRS4]: See below image of similar centrifuge



See bigger image at http://www.lenntech.com/images/Tubular%20bowl.JPG

Comment [BRS5]: I would love to see a cut-away. See above image in BRS24 comment.

	Equipment Needed **Materials and Supplies** **Process Overview** **Standard Operating Process (SOP) Steps**

Step 7: Process the solution through a Filter Press **When you turn on the filter press, the solution will be pumped under pressure though the filter medium.**  **The output from the Filter Press will place in holding tank C.**	**Navigate to the Filter Press. Have ON-OFF button nearby that will run a pump that will move the liquid from tank B through the press to tank C.** **This will take an hour so accelerate time.**
GLOSSARY DEFINITIONS	**LPM - Process Preparation Sheet – Step 7**
	Process Preparation Sheet **Safety Equipment** **Equipment Needed** **Materials and Supplies** **Process Overview** **Standard Operating Process (SOP) Steps**

Step 8: Process the Solution through a Chromatography Column

The solution in Holding Tank C will have to be processed through a Chromatography Column when you press the ON button to start the high pressure pump.

The output from through the column into the collecting section is simulated for you showing the various molecules passing through the micro filtration element.

You will see three colors of molecules, yellow, red and blue. The yellow and blue are not wanted. Insulin is represented by the red molecules.

As you want the process, you will see the smaller yellow molecules passing though the system. You can press the EXPEL button at any time to move the unwanted molecules into a waste vessel. As the RED molecules start to appear, you need to quick EXPEL the yellow waste liquid, and allow the insulin to collect. When you see the larger blue molecules starting to appear, you need to press the SAVE button to move the liquid collected into a graduated cylinder.

Once you have collected the insulin, you turn the system OFF.

Navigate to the Chromatography Column. Have a ON-OFF button located nearby.

The liquid will flow into the column from above and will start to flow through the membrane into the lower chamber.

It would be really neat if we could represent the collection of the insulin molecules as it really happens: the initial output is smaller waste molecules, followed by insulin, followed by larger waste molecules (I've added a section to the onscreen view to that end).

We would need a EXPELL button that would empty waste into a holding tank, and a SAVE button that moves the insulin molecules into a graduated cylinder.

We would need for the students to be able to turn of the system when finished.

This is a time accelerated process lasting an hour.

[Brian: please feel free to edit to improve the process or the instructions!]

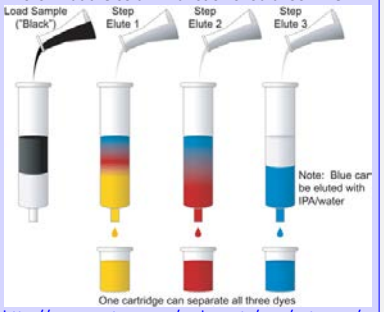
GLOSSARY DEFINITIONS

LPM - Process Preparation Sheet – Step 8

Comment [BRS8]: Maybe include a fraction collector that students can start and stop to catch sample: Make a scale-up of unit below that automatically rotates and students then pool together the best samples of insulin (red)

http://img.hisupplier.com/var/userImages/2011-12%2F22%2F115501708903.jpg

Comment [BRS9]:
This is what the column function should look like:



http://www.waters.com/webassets/cms/category/media/other_images/primer_d_%20solidphase.jpg

Comment [BRS6]: Add, typically the molecules in the mixture and clear and that fractions are collected over time and tested to identify the insulin.

Comment [BRS7]: See Comment BRS28 about the automated collector.

	Process Preparation Sheet **Safety Equipment** **Equipment Needed** **Materials and Supplies** **Process Overview** **Standard Operating Process (SOP) Steps**

Step 9: Test and Measure Your Insulin Output **Now you have extracted insulin from the cow pancreas, we need to determine if it is high quality and also determine the yield.** **Zoom in on your graduated cylinder, and measure the number of International Units of Insulin gathered.** **You will need to use your lab notebook for the following questions … start it now!** **Q1. You started with a 400gm pancreas, so what is the % insulin per gm yield in International Insulin Units/per gram of pancreas?** **Q2. On average, an adult weighing 150lbs needs approximately 36 units per day. How many cow pancreases would be needed to provide sufficient insulin for one year? (round the number up to a whole number.)** **Q3. If there are 1.3 million adult diabetics in the US, how many cow pancreases would be need to fulfill their needs?**	[**Brian:** I'm guessing that since they can "select" the gathered period by operating the EXPEL or SAVE buttons, we could have a situation whereby the gathered liquid isn't entirely insulin (it will a blend of yellow, red and blue balls in a liquid. How is that tested in the lab, and should we build in a quality control step? Also, if they have saved a lot of yellow, red and blue molecules, how do we add the above QC process to what happens: do we save "Sample Failed" start over (or Sample Failed: try the Chromatography column step again? I've suggested that the output be in a graduated cylinder … is that the case?] [Jim: the yield will vary from 2-4 units per gm (800-2000 units in total). Please build in some form of randomizer that will vary the yield per student between those figures. We will need them to be able to call up a calculator from within their lab notetaking system so they can answer the questions. The internal calculations within the sim would need to be based on the random figure given above, and then used to check the student calculations. We would need to build in some latitude for the calculations (say 10% either side of the target figure). In the event that they are wrong, do we ask them to recalculate once more (I'd say yes – Brian: yes or no?)
GLOSSARY DEFINITIONS	**LPM - Process Preparation Sheet – Step 9**
	Process Preparation Sheet **Safety Equipment** **Equipment Needed** **Materials and Supplies** **Process Overview** **Standard Operating Process (SOP) Steps**

Comment [BRS10]: See the collector information in Comment BRS 28. The students pool together the best samples (purist) of insulin in a large cylinder (like graduated cylinder). They should be told to avoid samples that may be contaminated with the other colors – this can be shown by tinting the red to have partial coloration with yellow or blue.

Comment [BRS11]: Yes, tell them they are wrong and make them recalculate. Maybe give them a formula after two unsuccessful tries.

Step 10: Well done, you have now completed the laboratory work needed to determine how efficiently you can extract insulin from the pancreas of cattle. **Now we move on to another method altogether … don't forget to save you calculations and your answers from your lab notebook since you will need them when we complete the next phase of the process.**	**[Jim:** is there a way to check if they have saved the data recorded?]
GLOSSARY DEFINITIONS	**LPM - Process Preparation Sheet – Step 10**
	Process Preparation Sheet **Safety Equipment** **Equipment Needed** **Materials and Supplies** **Process Overview** **Standard Operating Process (SOP) Steps**
Learning Outcome Assessment	
Assessment questions: [Brian will add questions]	

GMO SECTION [TO BE DEVELOPED]

[Lab Facility: **STANDARD** - The lab would be set out in advance so they will access the lab with the equipment set out in a sequentially appropriate manner.

ADVANCED – The students would have to select the equipment, and be able to place in sequence. [We will need to look at the development of lab equipment room where the student could select the items they want (maybe they can hover over the item and it will show its name, with a link that might give more information on the item) and the sequence in which they are used … maybe they use some form of checklist that they identify the item and the sequence that they will be used … then they might click the submit button and the lab is then created "magically" for them …