- Question about “Logbook”: Is this worth maintaining? (Is it used much?)
- Direct answer to Sudha’s question (“Is the main page for the ‘Data’ button OK?”) Answer: yes; all language pertaining to calibration has been removed, and the former calibration studies have been placed under “exploration” heading.
- In general: we suggest putting the “in your logbook” instructions directly below the milestone rather than halfway down the pages.

1. **The “Basics (Optional)” Loop:**
    a. Within the “Plots/Graphs…” button, the “text” and “excel” links are broken. (see below)

Milestone: Plots, Graphs and Charts.

Scientists use plots, graphs and charts to show their data visually.

Background on plots/graphs

To Learn More:

Scatter Plots - Create the most basic scatter plot, from Inter*activate* at Shodor.

Graphing Exponential Equations, lessons from*Purplemath*.

Histogram, all about histograms with an interactive example from Inter*activate* at Shodor. Choose "My Data" and try copying this penny data (text or excel) into Shodor's histogram tool to see how the weights vary. Can you see the two peaks? Look at the Penny Study to learn more about this data.

2. **The “Get Started” Loop:**
    a. Within the “Ask the Big Questions” (first stop) move the words

Existing language:

Milestone: Describe physics questions that CMS is designed to address.

Scientific research involves observing nature to learn new facts or test applications of theories to known facts. Scientists begin with carefully refined questions that shape their investigations.

This is the dawn of an exciting age of new discovery. The current theoretical framework of the fundamental nature of matter, known as the Standard Model, explains much, but leaves many unanswered questions. The CMS experiment at the Large Hadron Collider (LHC) holds the potential to answer these questions.

LHC Physics - US/LHC's list of the big questions the LHC will address.

CMS Physics - Discussion of the physics questions from the CMS website.

In your logbook:

- Briefly describe three or more physics questions CMS scientists hope to answer.
-
- Describe at least one way the physics questions shape the CMS experiment.

To Learn More:

Be persistent! In some cases, you will have to chase a link or two deeper than the first site to find what you need.

CMS - Description of the detector with links to Higgs, extra dimensions and dark matter from the CMS website
How was CMS designed? - How questions influenced design from the CMS website

Proposed order:

Milestone: Describe physics questions that CMS is designed to address.

Scientific research involves observing nature to learn new facts or test applications of theories to known facts. Scientists begin with carefully refined questions that shape their investigations.

In your logbook:

- Briefly describe three or more physics questions CMS scientists hope to answer.
-
- Describe at least one way the physics questions shape the CMS experiment.

To Learn More:

This is the dawn of an exciting age of new discovery. The current theoretical framework of the fundamental nature of matter, known as the Standard Model, explains much, but leaves many unanswered questions. The Compact Muon Solenoid (CMS) experiment at the Large Hadron Collider (LHC) holds the potential to answer some of these questions.

(insert a video link instead of the LHC Physics Link - such as this one perhaps? https://www.youtube.com/watch?v=m2sr6n6JWhc)

CMS Physics - Discussion of the physics questions from the CMS website.
(Be persistent! In some cases, you will have to chase a link or two deeper than the first site to find what you need.)

CMS - Description of the detector with links to Higgs, extra dimensions and dark matter from the CMS website
How was CMS designed? - How questions influenced design from the CMS website.

Keep the other links that are present.

b. Know your detector stop

Move the last link (links to particle adventure) to the top of the link list so that the information goes from general to very specific.

c. Describe the particle stop

In the student view (or guest view the width of the reading pane needs to be increased or it needs to be made adjustable. Some of the words are cut off.

“What is the world made of? - Building blocks, forces, antimatter and the Standard Model from Fermilab's *Inquiring Minds”* This section needs to be cut. The web page is from 2004; the information is duplicated in other links; and the video that is connected is not accessible with today’s computers.

In the “Intro to Feynman Diagram” link there is a video link
https://www.youtube.com/watch?v=HaWhWeBxQRQ

Either make this its own link on the page or find a newer version of this video. Also add a better resource such as the Quantum Diaries series on Feynman Diagrams:
http://www.quantumdiaries.org/2010/02/14/lets-draw-feynman-diagams/

Order of links…..Quarks and Leptons……CMS Primary Collisions…..Feynman Diagram Video….Intro to Feynman Diagram

d. “Interpret Data” stop

- Within the “single event” link, the link to the 3D event display program needs to be updated to the new ispy page, as well as the screencasts showing how it works. (which Sudha already noticed)

e. Apply Conservation Laws

- Lorentz is spelled with a “t” if we are talking about he of the transformations and relativity.
- Major overhaul needed. Almost all the links on this page are unnecessary (we have to assume the students know what a vector is) or misleading (viz. “Relativistic mass increase”). The first link on the page (“mass, energy and momentum at CMS”) is at a much higher level than many of the others, and is clunky.

f. Choose a Study

3. **The “Figure it Out” Loop:**

The “Select Data” stop:
Milestone: Select appropriate data from the data set.
Scientists need data to answer their research questions.
Physicists filter the data so they can look at specific event types (e.g., events with two muons).
Your study question will guide the data you choose.
Click on ~~"Calibration"~~ “Exploration” under "Data" in the navigation bar to select your data.

This screencast demo shows how to use the analysis tool. This screencast needs to be updated. Currently it shows how to do a calibration study, which is not possible in the development site.
Keep track of data appropriate for your inquiry in your logbook. Exploring the available data may lead you to refine or revise your study.
The "Choose Analysis Tools" Stop:

- In the development site, you don't have to click "apply" to zoom in on the data.
- There currently is no animation option on the development site.
- A description (action and utility) for "Correlated Charts" would be useful in the development site.
    - Example: "*If you select more than one parameter to plot, selecting "Correlated Charts" will allow you to examine possible relationships between parameters."*

The "Assess Results" Stop:

- Broken Link:

The "PDG Live" link should be updated to point to: http://pdglive.lbl.gov/Viewer.action

- **This link/resource adds little (if anything) to the content...**Thinking through your results -

The "Tell Others" Loop:
OK

Sudha's comments (8/12/16):

- Direct answer to Sudha's question ("Is the main page for the 'Data' button OK?") Answer: yes; all language pertaining to calibration has been removed, and the former calibration studies have been placed under "exploration" heading. In dev, I see that 'Calibration Studies' has been removed from the Analysis section. I presume the former calibration studies are now in the dropdown menu under 'Exploration'?
- In general: we suggest putting the "in your logbook" instructions directly below the milestone rather than halfway down the pages. I'm not sure what this means.
- **The "Basics (Optional)" Loop:**
    - Within the "Plots/Graphs…" button, the "text" and "excel" links are broken. (see below) In prod, the 'text' and 'excel' links are broken for student login, but teacher login is fine. I have fixed this in dev. It will go into prod tonight.
- **The "Get Started" Loop:**
    - Within the "Ask the Big Questions": words moved, LHC Physics Link added.
    - Know your detector: Particle Adventure moved to top.
    - Describe the particle: i.) "What is the world made of? - Building blocks, forces, antimatter and the Standard Model from Fermilab's *Inquiring Minds"* section cut. ii.) Intro to Feynman Diagrams: I reworked the text and tried to make it more readable. J-psi.png picture doesn't exist. I don't know where to get the picture from. iii.) Made https://www.youtube.com/watch?v=HaWhWeBxQRQ its own

link. iv.) Added link for Quantum Diaries series on Feynman Diagrams: http://www.quantumdiaries.org/2010/02/14/lets-draw-feynman-diagams. v.) In student/guest view, I still need to increase the width of the reading pane.

- **"Interpret Data:** Nothing done yet.
- Apply Conservation Laws: Lorentz is now spelled with a "t". No major overhaul done.
- Choose a study: This needs work. Calibration is no longer a choice to click.
- Select Data: Screencast not updated. File exploration-menu.png created and Calibration changed to Exploration in References_cms_data_selection.html.
- Choose Analysis Tools: Nothing done yet.
- Assessment Results: Link deleted: Thinking through your results. "PDG Live" link fixed and now points to: http://pdglive.lbl.gov/Viewer.action.

Sudha's comments (8/18/16):

a. "Interpret Data" stop

- Within the "single event" link, the link to the 3D event display program needs to be updated to the new ispy page, as well as the screencasts showing how it works. (which Sudha already noticed)This has been put in dev. New 3-D ispy image: https://www.i2u2.org/elab/cms/ispy-webgl. New 3-D screencast: https://www.youtube.com/watch?v=Cnf2cBSgS8M&feature=youtu.be

The "Choose Analysis Tools" Stop:

- In the development site, you don't have to click "apply" to zoom in on the data.

This now reads: Zoom in on parts of the plot by dragging across a selection.

- There currently is no animation option on the development site.

Got rid of: Build the plot event-by-event with the animation tool.

- A description (action and utility) for "Correlated Charts" would be useful in the development site.
  - Example: "*If you select more than one parameter to plot, selecting "Correlated Charts" will allow you to examine possible relationships between parameters."*

Added this text near the end: *If you select more than one parameter to plot, selecting "Correlated Charts" will allow you to examine possible relationships between parameters.*

Sudha's comments (8/18/16):

b. Describe the particle stop

In the student view (or guest view the width of the reading pane needs to be increased or it needs to be made adjustable. Some of the words are cut off. Fixed this in Reference_describe_particles.html, Reference_deterctor_geom.html, and Reference_interpret_data.html. Changed table width from 300 to 275.