Applying the Learning Cycle to Data Labs

	Seasonal Variability in the Mixed Layer
Invitation How will it get learners interested in learning about the topic and access their prior knowledge?	Display images showing where most ocean productivity occurs to set up the importance and relevance of understanding the dynamics of the surface layers. Display a video clip of high sea state in the N. Atlantic to raise interest in the activity. Use a demo or a YouTube video to illustrate mechanical wind mixing on the mixed layer, and show an animation of seasonal changes in Chl-a in the N. Atlantic; have students wonder about & discuss what they think is happening in both cases and why.
Exploration How will it provide learners with observations to help them ask & answer questions, & make sense of the topic?	Students examine a map of the location of the Irminger Sea array and explore the associated physical and climatic features of the area for context. They use the **Exploration Widget** to examine stacked wind, solar irradiation, and time series of water temperature data from the N. Atlantic to identify seasonal patterns and make predictions about the interactions between the atmosphere, and the temperature structure and mixing of the surface ocean.
Concept Invention How will learners be encouraged to struggle with their understanding and negotiate their ideas with others?	Students use the **Concept Invention Widget** to investigate the same data as before to determine what the patterns they identified reveal about the seasonal mixed layer dynamics, and the overall water column stratification, using evidence from the widgets. Partners draw depth profiles and use the widget to scroll the time series to see the accompanying depth profile (an optional worksheet is available). They summarize the relationship between wind and irradiance, and temperature and mixed layer depth using words or a conceptual diagram (model) of the mixing processes. They discuss their ideas with peers and then in whole group as the instructor encourages them to cite evidence from the visualization and to elaborate and clarify their understanding.
Application How will learners authentically use what they've learned and apply it to a new situation or context?	Two **Application Widgets** task students to apply what they learned from their investigation of the N. Atlantic array as they look for patterns and make connections between the various parameters in a new location (N. Pacific). In Application #1, they examine the same parameters as before, apply their conceptual model, and test their predictions about temperature patterns at different depths. Correlations between these variables, and differences between locations are discussed. In Application #2 they examine a time-series of Chl-a concentration from the Irminger Sea, and the previous time series widgets to look for seasonal patterns and correlations. They integrate primary production into their conceptual model to determine how it might be controlled by the physical interaction of wind and solar irradiance, and their interactions with the surface of the ocean.
Reflection How will learners think back on how they learned - to reinforce understandings & make them better learners in the future?	Students reflect on what they personally learned about the ocean as they examined the interaction of the atmosphere (wind), and external forcing (solar energy) with water properties (temperature). They respond to prompts regarding what skills and concepts they needed to learn, and what new connections they made in order to make sense of the interactions. Students reflect on what was the most difficult part of the exercise for them and what helped them to figure it out.