**Understanding By Design – Backwards Design Process**

(Developed by Grant Wiggins and Jay McTighe, 2002)

**Bubble in a Tube Activity**

\*\*\*See materials and construction notes at the end of this document.

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| **Stage 1 – Desired Results** | |
| **Content Standard(s):**   * Motion in one dimension * Nature of Science | |
| **Understanding (s)/goals**  Students will understand that:   * Constant velocity is a calculated quantity using displacement and time inputs. * Using graphs to visualize data sets is a useful tool in understanding a phenomena. | **Essential Question(s):**   * What is the relationship between the speed of a bubble in a clear tube and the angle that the tube is inclined? |
| **Student objectives (outcomes):**  Students will be able to:   * Calculate velocity (average / constant) using displacement and time. * Use a graph to assemble a picture or visualize data in order to describe a phenomena. | |
| **Stage 2 – Assessment Evidence** | |
| **Performance Task(s):**   * Assemble a data table with velocity and angle data. * Upload data into iSENSE for data visualization, analysis, and comparison with other groups. | **Other Evidence:**   * Answer questions based on observations and learning outcomes. |
| **Stage 3 – Learning Plan** | |
| **Learning Activities:**  This is an introductory lesson for grades 6-12 physical science or physics classes. Depending on class level and previous student experience, the teacher may choose to pre-teach the concept of velocity and how it is calculated. For many students an understanding of velocity can be developed or reinforced without pre-teaching; this activity can facilitate a student-centered approach to this.   * Demonstrate the operation of the apparatus:   + The bubble can be “locked” into the short end of the tube by closing the valve. This allows students the time to establish initial conditions before initiating the test.   + The angle of inclination can be adjusted using a variety of readily available lab equipment.     - One idea is to use two inch spring clamps to affix the tube to a dynamics track, which usually has associated hardware for adjusting inclination.     - Another method is to use a burette clamp, however this method is least preferred as it is possible for the tube to accidentally fall out of the burette clamp and crack. * Lab stations should be supplied with stopwatches and meter sticks for velocity calculations. * Hand out lab sheet with guiding and follow-up questions. This can be done electronically if possible, with student inputs required in the blue boxes. | |
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Materials needed to construct the bubble in a tube apparatus are readily available from most hardware stores with the exception of the clear PVC ¾” tubing, which is available from online suppliers such as US Plastics Corp:

http://www.usplastic.com/catalog/item.aspx?itemid=24353&catid=592

**Bill of Materials for one apparatus:**

1. Six linear feet (one five-foot piece and one one-foot piece) of ¾” Harvel clear PVC tubing ~ about $14. (including shipping)
2. One ¾” PVC ball valve (slip/solvent connections) ~ about $2.50
3. Two ¾” PVC caps (slip/solvent connections) ~ about $0.50
4. One can of PVC primer (clear, not purple) and one can of PVC cement

One foot clear PVC “bubble trap”

Five foot clear PVC, filled with “unkown”

valve

cap

cap