LESSON: ET

Title: ET   **Submitted:** June 30, 2008
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Lesson Overview:

The External Tank (ET) console monitors the flow of liquid oxygen and liquid hydrogen to the main engines. The ET is the largest of the three main parts of the Shuttle system. When fully loaded, it becomes the heaviest element of the Shuttle as well.

The ET lesson has potential to offer some basic computation activities such as scientific notation, measurement, rounding, and working with large numbers. As well, the lesson could be expanded to address some very high-level computation activities involving gases, changing states, and flow rates. The ET Activity set will allow you to choose the right assessment path for this lesson with a little customization on your part. The additional readings have some great resources for those interested in learning even more about this amazing Shuttle structure.

Suggested Classroom Time: 120-180 minutes   **Grade Levels:** 6-10

KLASS Module: 1-Training   **Topic/Console:** ET Console

Materials Needed:

Activity	Documents	Other Materials
1	Basic Explanation of ET and KLASS Console: RDG_ET.doc RDG_ET-Additional (Folder of documents) http://spaceflight1.nasa.gov/shuttle/reference/shutref/et/ http://science.ksc.nasa.gov/shuttle/technology/sts-newsref/et.html#et http://www.nasa.gov/returntoflight/system/system_ET.html (with video)	Demonstration computer with projection and printed handouts
2	ACT_ET.doc KEY_ ET.doc ACT_ET-Console.doc (for use with console)	KLASS software for ACT_ET.doc

National Standards/Objectives:

Discipline	Standard	Objective
Science	B. Physical Science	Students understand properties and changes of properties in matter.
Science	E. Science and Technology	Students understand the abilities of technological design.
Technology	Technology problem-solving and decision-making tools	Students use technology resources for solving problems and making informed decisions.
Math	Representation	Students create and use representations to organize, record, and communicate mathematical ideas.
Math	Data Analysis & Probability	Students select and use appropriate statistical methods to analyze data.

Desired Results:

Students will be able to answer these essential questions
- How does the ET work and what is its function?
- What will I need to know as a member of the KLASS Shuttle launch team that monitors and controls the ET systems?
- How can I contribute to a larger group within a complex operation such as the External Tank?

Students will know
- The basic responsibilities of the ET KLASS engineers.
- How to record a sequence of ET data from the KLASS console.
- The three parts of the ET and the basic function of its components.

Students will be able to
- Record accurate observations while observing a variety of data feeds by the KLASS ET console.
- Assimilate into the role of ET/cryogenics engineer by monitoring, correcting, and communicating data to the larger launch team.

Learning Plan/Activities:

1. **Introducing the Lesson.**
   Start this lesson by viewing a quick video on how the ET works.
   http://www.nasa.gov/mission_pages/shuttle/vehicle/ （Contains a link to How Stuff Works video with closed captioning.)

   Review the lesson documents and help students understand what the ET does. There is an ET reading document (RDG_ET.doc), and that provides an overview of the components along with an explanation of the ET console. Visit any websites with your class you believe are appropriate to help it better understand this awesome system. There are a lot of great photos available that the future rocket scientists will think are a gas!

2. **Observing, Labeling, and Recording.**
   Based on the *ET* reading document (RDG_ET.doc), have the students work through the problems and label the ET diagram. Next, help the students start the ET console and get used to reading and recording the data. A worksheet has been provided for this purpose (ACT-ET-Console.doc). Depending on how much you would like them to record, you may want to adjust the worksheet. Note that there are 2 different data sets requested on each of the two pages, so you could divide this task among two teams or two individuals.

3. **Evaluating the Lesson.**
   During the above activities, students should be making the connection between the real ET and the KLASS ET. Follow up this activity by reinforcing the key roles that will be needed for the KLASS simulation. Revisit the KLASS_Shuttle-Launch-Team-Roles handout, paying attention to the ET description of responsibilities.

Assessment Evidence:

Performance Tasks
1. Students will be able to piece together the orbiter's ET by completing the activities, but they do not need to completely understand what each component means.
2. Students should begin to understand the function of the ET KLASS module and the data that is referenced and used during the simulation.

Extensions and Going Further Resources:

The following NASA sites have great information regarding the ET.

- http://www.nasa.gov/returntoflight/system/system_ET.html

- http://www.nasa.gov/mpg/107909main_ET.mpg (video)

- http://shuttle.msfc.nasa.gov/ET.cfm

- http://science.ksc.nasa.gov/shuttle/technology/sts-newsref/et.html

- http://www.nasa.gov/returntoflight/system/LOX_feedline_bellows.html

- http://www.nasa.gov/news/highlights/extank_media.html

- http://www.nasa.gov/mission_pages/shuttle/vehicle/ （Contains a link to How Stuff Works video with closed captioning.)

- http://www.nasa.gov/centers/marshall/multimedia/photogallery/photos/photogallery/shuttle/shuttle.html

- Lockheed Martin's information pages: http://www.lockheedmartin.com/ssc/michoud/ExternalTank/

- Be sure to check for student opportunities, additional educational resources and more at: http://www.nasa.gov/education