Life Support Team
Mission Day Instructions

Overview
Space Station Alpha's Environmental Control and Life Support (ECLS) system ensures that the mixture of atmospheric gases stays within a normal range and that the air is free of contaminants. A disruption to any part of the ECLS system could result in a dangerous situation.

You will receive real-time atmospheric data from an instrument called the Major Constituent Analyzer. Your team is responsible for graphing the data and making calculations. Communicate with the other teams and recommend ways to protect the space station and the crew.

Mission Day Materials
- One computer for real-time data
- Life Support Reference Guide
- Mission Day Materials (one per team member):
  - Mission Day Instructions
  - Life Support Data Graphs and Instructions
  - Life Support Data Tracking Tables
- Print and cut 7 Blank Report Forms on colored paper (blue would be best) to deliver to the Communications Team
- Rulers for plotting data on graphs
- Calculators

Your Task
By the time the mission starts, the Life Support Team should be able to:
- Analyze real-time data, record it, graph it, and make calculations.
- Monitor all changes in the atmosphere of the station and report the effects that any changes might have upon the astronauts.
- Use the Life Support Reference Guide to understand hypoxia and carbon dioxide poisoning.
- Recommend options and adjustments to avoid a dangerous situation.

Team Tasks
These tasks are listed in priority order. Next to each task, assign a team member. Depending on the size of your team, you may need to assign two tasks to one person.

_____ **Crisis Management**: Makes sure all data is analyzed every five minutes. Determines priority level, whether there are any concerns, and helps team decide on any recommendations.

_____ **Data Graphing**: Records real-time data on graphs and predicts which way the trend is moving. Uses a ruler to make predictions. May be combined with Data Analysis tasks (below).

_____ **Data Analysis (O2)**: Records real-time data in Data Tracking Tables and conducts analyses. Completes Report Forms about every five minutes or as needed.

_____ **Data Analysis (CO2)**: Records real-time data in Data Tracking Tables and conducts analyses. Completes Report Forms about every five minutes or as needed.

_____ **Crisis Management Helper/ Data Runner**: Gathers report forms every five to six minutes. Prioritizes any urgent recommendations. Writes down all questions from Mission Control and responds with written notes given to the Comm Data Officer. This may be combined with Crisis Management Tasks.

_____ **Data Recording**: Records real-time data from the computer. The data will be accessed and downloaded after the start of the mission. May be combined with other tasks

_____ **(optional) Research and Reference**: Reads and understands information provided in the Reference Guide to make recommendations to Mission Control. May be combined with other tasks above.

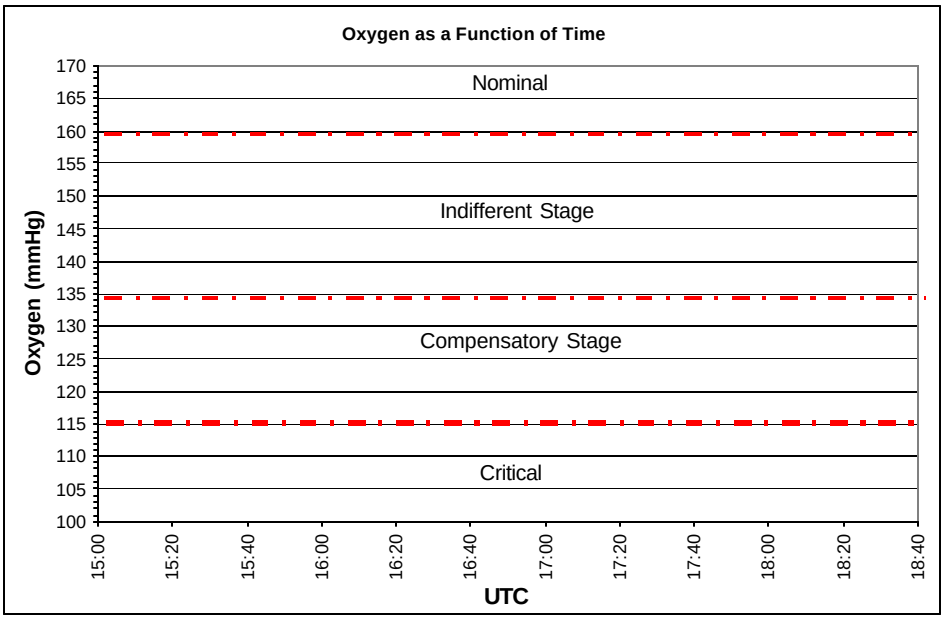
_____ **(optional) Reporter/ Graphic Organizer**: Takes notes during the mission like a reporter from a newspaper. Writes down all the emergencies, options, choices, and successes. May want to use a "graphic organizer" like a white board or chalkboard posted on the wall that is visible to all teams.

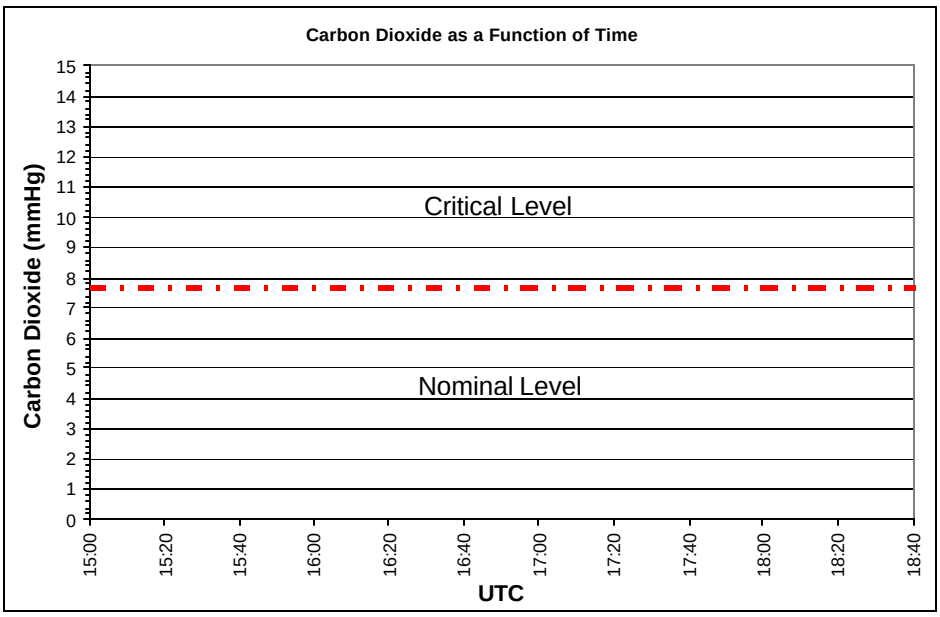
Life Support Team
Graphs and Instructions

Instructions for Graphing the Data

The Life Support Team will be responsible for creating two graphs. Use the data from **Column C** on each Data Tracking Table for the y-axis values and plot them along the x-axis according to the correct UTC time.

To determine whether or not the changes in partial pressure are a concern, you must use this line graph. You will need to work closely with the person in charge of the data analysis to help them fill in Column F on their Data Tracking Table. To do so, examine the slope of the line between the data points for the current reading and the last reading. You may want to use a ruler to do this. Is the slope of the line showing a trend moving **toward** or **away** from the area of criticality? If the current data point is within the area of criticality, tell them to mark "**critical**" in Column F.

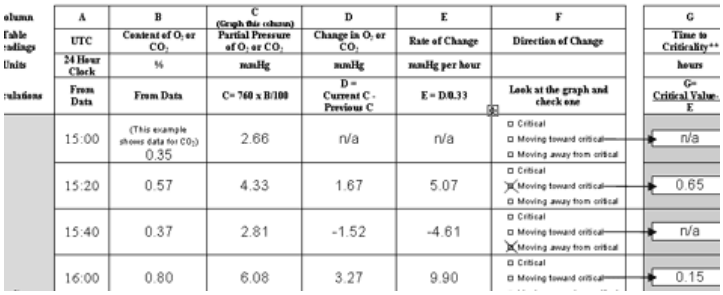




Life Support Team
Data Analysis Instructions

You will be receiving real-time data about every five minutes from the Major Constituent Analyzer on board the station. The data concerns oxygen (O_2) and carbon dioxide (CO_2) levels. Other components such as water vapor (H_2O) and trace contaminants may also be mentioned. Your team should be able to analyze this data quickly. **It is strongly recommended that you complete the practice worksheets and practice graphs before mission day.** Use the instructions below and the attached Data Tracking Table.

First, find the spreadsheet labeled "Life Support Team- Data Tracking Table". Make one copy of this for the O_2 calculations and one for the CO_2 calculations.



	A	B	C (Graph this column)	D	E	F	G
olumn							
Table	UTC	Content of O_2 or CO_2	Partial Pressure of O_2 or CO_2	Change in O_2 or CO_2	Rate of Change	Direction of Change	Time to Criticality**
adings							
Units	24 Hour Clock	%	mmHg	mmHg	mmHg per hour		hours
ulations	From Data	From Data	C= 760 x B/100	D = Current C - Previous C	E = D/0.33	Look at the graph and check one	G= Critical Value - E
	15:00	(This example shows data for CO_2) 0.35	2.66	n/a	n/a	☐ Critical ☐ Moving toward critical ☐ Moving away from critical	n/a
	15:20	0.57	4.33	1.67	5.07	☐ Critical ☒ Moving toward critical ☐ Moving away from critical	0.65
	15:40	0.37	2.81	-1.52	-4.61	☐ Critical ☐ Moving toward critical ☒ Moving away from critical	n/a
	16:00	0.80	6.08	3.27	9.90	☐ Critical ☐ Moving toward critical	0.15

Column A: Coordinated Universal Time (UTC)

UTC is a universal standard in which time is given on a 24-hour clock with no "am" or "pm". For example, one o'clock in the morning is 01:00. Four-twenty in the afternoon is 16:20. Eleven-fifteen at night is 23:15, etc.

Column B: Real-Time Data

Record the current reading from the data for the gas you are tracking (O_2, or CO_2) in column B.

You will receive data for each component as a percentage, for example O_2 = 25%. This indicates what percentage of the air inside the station is made up of oxygen.

Column C: Conversion to Partial Pressure

Column C= 760 mmHg X Column B divided by 100

We need to know the partial pressure to know how safe or dangerous the situation is. To convert from percent into millimeters of Mercury (mmHg), take the Total Atmospheric Pressure of 760 mmHg and multiply it by the current reading from Column B and divide by 100.

Your result will be in mmHg. Measuring in millimeters of Mercury is a common standard which scientists use when analyzing atmospheric components.

Column D: Change in Partial Pressure

Column D = Current reading from Column C minus the previous reading from Column C

We are interested in knowing how much the readings are fluctuating. To get the change in partial pressure over the past two readings, subtract the previous reading from Column C from the current reading in Column C. Your result will be in mmHg.

Column E: Rate of Change

$$\textit{Column E} = \frac{\textit{Column D (mmHg)}}{\textit{Time elapsed (hours)}}$$

To determine how fast things are changing, you will need to find the rate of change. To do this, you need to take the result from Column D and divide by the amount of time that has elapsed between the two readings (20 minutes = 0.33 hours). This gives a rate of change in mmHg per hour.

Column F: Direction of Change

Column F= Look at the graph and check one of the three choices in Column F

To determine whether or not the changes in partial pressure are a concern, you must use the line graph. Examine the slope of the line between the data points for the current reading and the last reading. You may want to use a ruler to do this. Is the slope of the line showing a trend moving **toward** or **away** from the area of criticality? If the current data point is within the area of criticality, mark "**critical**".

If the direction of change is toward critical, then you must complete Column G.

Column G: Time to Criticality

$$\textit{Column G} = \frac{\textit{Critical value} - \textit{Column C}}{\textit{Column E}}$$

In order to find the amount of time to criticality, take the critical value (see below) and subtract from it the current reading from Column C. Divide this answer by the rate of change you calculated in Column E. This is the amount of time the crew members have before they enter into dangerous levels.

The critical value for O2 is 115 mmHg and for CO2 is 7.6 mmHg.

Life Support Team – Data Tracking Table

Examples and Practice

Circle One: Oxygen (O^2) **Carbon Dioxide (CO^2)**

Column	A	B	C (Graph this column)	D	E	F	G
Table Headings	UTC	Content of O_2 or CO_2	Partial Pressure of O_2 or CO_2	Change in O_2 or CO_2	Rate	Direction of Change	Time to Criticality**
Units	24 Hour Clock	%	mmHg	mmHg	mmHg per hour		hours
Calculations	From Data	From Data	C= 760 x B/100	D = Current C - Previous C	E = D/0.33	Look at the graph and check one	G = Critical Value-C / E
Examples and Practice	15:00	(This example shows data for CO_2) 0.35	2.66	n/a	n/a	? Critical ? Moving toward critical ? Moving away from critical	n/a
	15:20	0.57	4.33	1.67	5.06	? Critical X Moving toward critical ? Moving away from critical	0.65
	15:40	0.37	2.81	-1.52	-4.61	? Critical ? Moving toward critical X Moving away from critical	n/a
	16:00	0.80	6.08	3.27	9.91	? Critical X Moving toward critical ? Moving away from critical	0.15
	16:20	1.20	9.12	3.04	9.21	X Critical ? Moving toward critical ? Moving away from critical	n/a
	16:40	1.40				? Critical ? Moving toward critical ? Moving away from critical	
	17:00	0.90				? Critical ? Moving toward critical ? Moving away from critical	
	17:20	1.80				? Critical ? Moving toward critical ? Moving away from critical	
	17:40	0.95				? Critical ? Moving toward critical ? Moving away from critical	
	18:00	0.74				? Critical ? Moving toward critical ? Moving away from critical	
	18:20	0.51				? Critical ? Moving toward critical ? Moving away from critical	

Note: Round all calculations to two decimal places. Critical Value for O2 is 115 mmHg. Critical Value for CO2 is 7.6 mmHg.

For additional practice, use these values for O_2: You will need to print out the next page to use as a worksheet for this.

UTC	Content of O_2
15:00	21.70
15:20	21.42
15:40	21.75

16:00	19.80
16:20	18.45
16:40	20.15
17:00	19.50

17:20	18.65
17:40	21.33
18:00	21.56
18:20	21.60

Life Support Team – Data Tracking Table

For the Mission

Circle One: **Oxygen (O^2)** **Carbon Dioxide (CO^2)**

Column	A	B	C (Graph this column)	D	E	F	G
Table Headings	UTC	Content of O_2 or CO_2	Partial Pressure of O_2 or CO_2	Change in O_2 or CO_2	Rate	Direction of Change	Time to Criticality**
Units	24 Hour Clock	%	mmHg	mmHg	mmHg per hour		hours
Calculations	From Data	From Data	C= 760 x B/100	D = Current C - Previous C	E = D/0.33	Look at the graph and check one	G = Critical Value-C / E
For the Mission	15:00			n/a	n/a	? Critical ? Moving toward critical ? Moving away from critical	n/a
	15:20					? Critical ? Moving toward critical ? Moving away from critical	
	15:40					? Critical ? Moving toward critical ? Moving away from critical	
	16:00					? Critical ? Moving toward critical ? Moving away from critical	
	16:20					? Critical ? Moving toward critical ? Moving away from critical	
	16:40					? Critical ? Moving toward critical ? Moving away from critical	
	17:00					? Critical ? Moving toward critical ? Moving away from critical	
	17:20					? Critical ? Moving toward critical ? Moving away from critical	
	17:40					? Critical ? Moving toward critical ? Moving away from critical	
	18:00					? Critical ? Moving toward critical ? Moving away from critical	
	18:20					? Critical ? Moving toward critical ? Moving away from critical	
	18:40					? Critical ? Moving toward critical ? Moving away from critical	

Note: Round all calculations to two decimal places. Critical Value for O2 is 115 mmHg. Critical Value for CO2 is 7.6 mmHg.