HUMAN Sample Experiment
High Altitude Simulation
(a one variable experiment)
(version 18 Aug., 2011)

All *web*-HUMAN experiments, like their wet lab counterparts, involve changing one or more parameters and monitoring the response of relevant physiological variables. In the least complex design, only one parameter is changed. This is illustrated below via creating a high altitude challenge.

Students wish to simulate an ascent to the summit of Mount Mckinley (12,500 ft.), perhaps to compare the simulated data with actual data from a published experiment. The approximate barometric pressure at this height is 480 mmHg.

1) To begin

To set up HUMAN to run a physiological experiment, at the opening screen (see below)

web-Human Physiology Teaching Simulation
(Physiology in Health, Disease and During Treatment)

One click Experiments

You must login to use the One click Experiments.

Login for Personalized Features

Your login name:

Your password:

(Login)

No account? Register for a free personal account.

Start a Physiology Experiment

or

Run a HUMAN Patient.

Welcome to web-Human Version 9.

Resources

About HUMAN- 1st time users

How To - introductory tutorial

Contact Roy Meyers

Credits.

Click

- **Start a Physiology Experiment** (see above, middle)

- * always remember that if you wish to Save your experiment you must log in first (above, top)

This results in the typical opening *web*-HUMAN experiment screen seen in section 2 below. The model is now ready for an experiment to be set up and then run.

2) To set up your experiment

HUMAN is now ready to be set up at <u>high altitude</u> for a <u>6 day experiment</u> while tracking the

<u>respiratory</u> and <u>blood gas responses</u> in its tables. The *setup* for this experiment is shown in the figure below and *the steps* involved in this setup are then described individually.

DAY/HR	AP	COL	O2DEBT	MFLOL	VENT	EXER
1-12:00 AM	99.78	5.438	0.000	1.100	5.675	0.000
1-12:10 AM	99.69	5.425	0.000	1.089	5.673	0.000

View Output:

PO2A	PCO2A	O2DEBT	VENT	BICARB	BAROP
as: graph	graph	graph	✓ text / graph	graph	text

Experiment Controls

Change Variable	Enter New Value	Info on Variable
BAROP	480	760 mmHg
Choose		

Run Experiment:
for 6D minutes at 12H minute intervals.

Go   Start Over

Help

Help info on: Choose
Tips: How Do I?

View
Variable Value: Choose
Patient Charts or Lab tests:
Choose One

Graph Style   Size: 600
Normalized, one graph

a) To <u>change the barometric pressure</u> (BAROP) from sea level value (760 mmHg) to 12,500 ft. value (480 mmHg).

Under **Change Variable** scroll down to BAROP and enter the new desired value (480).

b) To <u>change the output table columns</u> to read out ventilation and blood gas variables.

Under **View Output:** (first row) mouse columns 1 (AP) through 6 (EXER) to obtain output variable names for

HUMAN Variable	Physiologic variable*
PO2A	Alveolar partial pressure O2 (mmHg)
	Alveolar partial pressure CO2

PCO2A	(mmHg)
PH	Arterial blood pH
VENT	Lung ventilation (Liters/min.)
BICARB	Plasma bicarbonate (meq./Liter)
BAROP	Barometric pressure (mmHg)

* Use Help info on: <choose> for more info on any of these variables

c) To <u>set up the graph</u> to plot all 6 of these variables (be certain your browser popup blocking is off!)

   1) Under **View Output as:** (upper left, 2nd row)

   change each variable to as: **graph** from its default as:**text** (see VENT as an example)
   (This will result in output *both* as a Table and as a Graph)

   2) Under **Graph Style** (lower right) simply retain the default choices of

   - a <u>normalized plot</u> (values will be shown as change from baseline control values) and
   - <u>one graph</u> (all 6 values will be shown on one single plot)

d) To<u> setup to gather data</u> for 6 days at 12 hour intervals

   Under **Run Experiment**

   o for <u>experiment duration</u> type in 6D (default is minutes, D = days, H= hours)
   o for <u>printout intervals</u> type in 12H to yield printouts every half day

e) **Click** on **<Go>**
- this runs the experiment resulting in a tabular and a graphic output window.

- <u>Click on the Tabular window</u> to bring it to the foreground as shown in the "**Output From Web-HUMAN Physiology Simulation**" below.

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3) The output of your experiment

- The output of the high altitude experiment, beginning on Day 1 at 12:10 a.m. (column #1)

```
 DAY/HR       AP          COL         O2DEBT      MFLOL       VENT        EXER
1-12:00 AM   99.78       5.438       0.000       1.100       5.675       0.000
1-12:10 AM   99.69       5.425       0.000       1.089       5.673       0.000
 Barometric Pressure (760. mmHg)                           =   760.00
 Barometric Pressure (760. mmHg)                           =   480.00
 6.00000      Days    are     8640.00      Minutes
 12.0000      Hours   are      720.000     Minutes
 DAY/HR       PO2A        PCO2A        PH          VENT        BICARB      BAROP
1-12:10 AM   97.34       38.27       7.410       5.673       23.69       480.0
1-12:10 PM   64.68       22.67       7.584       6.916       21.87       480.0
2-12:10 AM   61.91       22.15       7.596       6.316       21.45       480.0
2-12:10 PM   61.88       22.67       7.581       6.352       21.25       480.0
3-12:10 AM   62.19       22.26       7.580       6.429       20.96       480.0
3-12:10 PM   62.24       22.24       7.576       6.467       20.70       480.0
4-12:10 AM   62.39       22.19       7.571       6.533       20.45       480.0
4-12:10 PM   62.60       21.99       7.568       6.579       20.19       480.0
5-12:10 AM   62.78       21.81       7.565       6.617       19.92       480.0
5-12:10 PM   62.97       21.61       7.561       6.664       19.66       480.0
6-12:10 AM   63.17       21.43       7.557       6.710       19.36       480.0
6-12:10 PM   63.36       21.26       7.553       6.761       19.06       480.0
7-12:10 AM   63.57       21.09       7.549       6.815       18.75       480.0
```

shows

- an immediate hypoxia (drop in PO2A-column 2) due to the drop in BAROP.
- an increase in ventilation (VENT-column 5) in an attempt to compensate for the PO2 drop.
- a hypocapnia (PCO2A drops- column 3) due to the hyperventilation
- an increase in pH (column 4) indicating a respiratory alkalosis as a result of the PCO2 drop
- a plasma HCO3- drop, at least initially due to the hypocapnic hyperventilation.

Click on the graph to bring it to the foreground. It appears as shown below.

Web-HUMAN Physiology Simulation

Chart legend:
- PO2A (——+——
- Ventilation Rate (6. L/Min) ——□——
- Arterial CO2 Tension (40. mmHg) ——✳——
- Plasma Bicarbonate (24. mMol/L) ——◆——
- Blood pH (7.4 pH units) ——✳——
- Barometric Pressure (760. mmHg) ——▲——
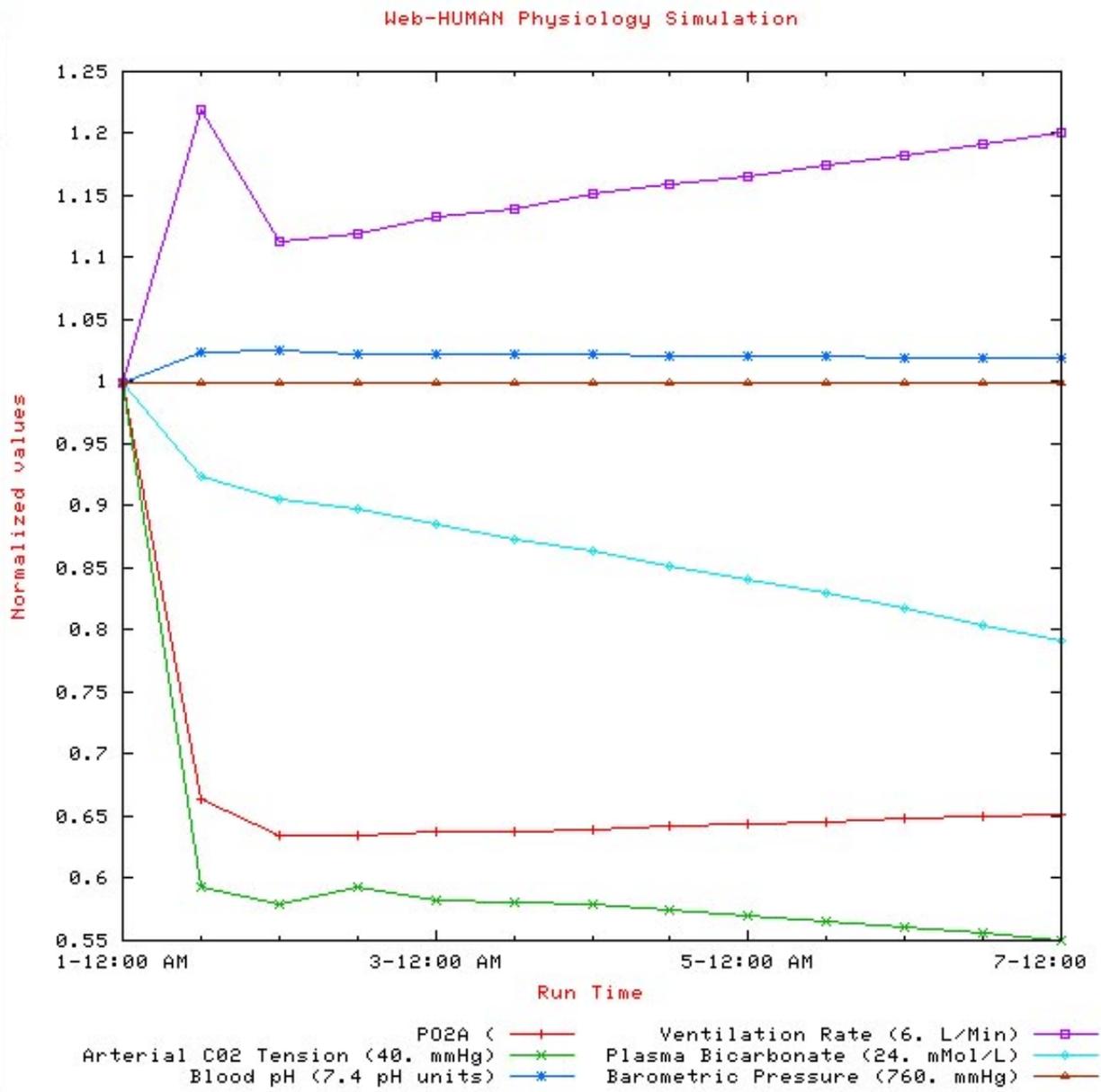
The graphic output (above) also clearly illustrates each of these trends.

Note, for example, the large increase in Ventilation (purple squares top) and the marked almost mirror image decrease in Arterial (blood) CO2 tension (green x, bottom).

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4) Some other possibilities

a) <u>observations in this data</u>- the beginnings of a compensatory kidney-induced ('metabolic') acidosis

b) <u>observations by setting up new tables</u> (i.e. observing other variables)

- To peruse all available variables, use Help info on: <choose> for any variable and on the newly appeared Help screen select View summary of all

- select appropriate variables to track the developing polycythemia, increased hemoglobin, increased red cell production and increased blood viscosity.

c) <u>new variations on the experimental design</u>

- can the high altitude hypoxia be fully relieved by breathing 100% O2 (FO2AT) [fraction of O2 in atmosphere]?

- how compromised is the model's exercise endurance on Mckinley as compared to sea level (adjust EXER and XERMIN, testing in each environment at comparable exercise levels).