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Health Education: Health Care Perspectives For Teachers
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Create a diet for extended space missions

1. TARGET AUDIENCE. "Name" your audience (ie, 3rd graders)
11-12th grade Astronomy and Space Science Students

2. IDENTIFY A REAL-WORLD PROBLEM (A NEED, A GAP). This is a description of "current reality"—what exists, what's happening. This can be done in one or two sentences, no more than a short paragraph.
Current missions to the international space station must plan for months of dietary needs for astronauts. How much food, and of what type, should be shipped to astronauts? How does this compare to ordinary "earthbound" dietary needs?

3. PURPOSE OF THE INSTRUCTION. Make a statement of, or describe, the reality that you want to create--what "should be".
Students will be able to critique an existing dietary plan and create a balanced dietary plan for ordinary earthbound people and for astronauts in extended low earth orbit.

4. CONTENT STANDARDS. Does the purpose of instruction "fit" health content standards? Which ones?

The purpose of this lesson fits well within standards related to the creation of balanced diet and nutrition, such as these listed from the MCREL compendium:

A. From the MCREL standards compendium on Health[i], Standard 6, "Understands essential concepts about nutrition and diet," Level 4 (Grades 9-12) #1: Understands how nutrient and energy needs vary in relation to gender, activity level, and stage of life cycle."
B. From the MCREL standards compendium on Health[ii], Standard 2, "Knows environmental and external factors that affect individual and community health", Level 4 (Grades 9-12) #6: Understands how cultural diversity enriches and challenges health behaviors (e.g., various food sources of nutrients available in different cultural and ethnic cuisines, influence of cultural factors on the treatment of diseases)

5. *LEARNER CHARACTERISTICS. What do you know about your students that makes them different from the norm? What entry skills must each student have before he/she begins new learning?*

There are several things I would need to know about students before we could begin implementing this unit. Since this unit will be an integrated health topic taught out of the context of a regular health class, I would not have any background information from previous assignments regarding students' knowledge of good nutrition. Therefore, a needs assessment must be created to find out what students know and what I need to

provide for them by way of content. Also, this material is not covered in our textbook and all resources must be considered supplements to the regular resources at our disposal.

The needs assessment will consist of basic questions about understanding what is in a balanced diet (the food pyramid, for example) and the particular needs for long-term travelers such as sailors and astronauts (preventing scurvy and other vitamin-based illnesses). Also, it will be useful to know if they understand that being a full-time astronaut in orbit requires a considerable amount of energy despite the weightlessness (more calories required per day). Finally, there needs to be some understanding of the value of taste, texture, and variety in foods because astronauts who are bored with their diets will be less likely to follow good habits of nutrition. This includes accommodating cultural and ethnic background needs for the individual astronauts.

Entry skills include the ability to find out nutrition information on food labels, basic arithmetical skills for multiplying factors based on number of days and number of astronauts, and the ability to find out nutrition information for foods for which they do not have a handy reference. Being able to coordinate multiple variables (amount of food, amount of vitamins, requirements of food pyramid, etc.) is basic to this assignment.

6. TOPIC OUTLINE. Begin reading on the subject and develop a reference list (for this assignment 3 or 4 references). Then, develop a topic outline of the content (not the specific activities/methods that you will use to teach the content) that you will have to present in order for students to achieve the reality you want to create.

Reference List (annotated):

"A History of Food in Space," http://inventors.about.com/library/inventors/blfrdrfood1.htm ; A short history of the development of food for consumption in space. From the About.com web site, accessed September 1, 2001. No author noted, except "Information Provided by NASA."

Calorie Control Council, http://www.caloriescount.com/cgi-bin/Enhanced_calcalc/enhanced_calcalc.cgi ; An interactive calorie counter based on the number and types of servings you select. Also provides fat grams. Accessed September 2, 2001.

Hall, Rick. "Food Find," http://nutrition.about.com/library/foodfind/blfoodfind.htm ;An indexed guide to the nutrient composition of hundreds of foods. From the About.com web site. Accessed September 2, 2001.

Harvey, Dr. Simon, et. al., "What are Vitamins and Carotenoids and What Are the Adverse Effects of Deficiences and Overdose?"; Nidus Information Services, Inc. Well-Connected Report: Vitamins and Other Nutrients. June 1999. (Online at http://my.webmd.com/content/dmk/dmk_article_5462458) Accessed September 2, 2001.

Krsulic, Chris. "Vitamin Deficiencies and Signs of Excess," http://www.seflin.org/vitamins/vitamins.3.html; A list of common vitamins and effects of having too little or too much of each. Accessed September 2, 2001.

Page, Randy M. and Page, Tana S. “Fostering Emotional Well-Being in the Classroom.”:119-121. Basic food pyramid and calorie requirements information for children and teens.

Scala, James, Class presentation. Mr. Scala is President of Mount Diablo Astronomical Society and a specialist in long-term exploration nutrition, having worked on the spacesuit food for Apollo astronauts and the meals consumed by Dick Rutan and crew on the around-the-world flight of the self-powered Voyager aircraft. Mr. Scala has been a guest speaker for my classes in the past.

“What do Astronauts Eat in Space?”, http://www.spacetoday.org/SpcShtls/AstronautsEat.html ; A list of personal favorites of astronauts for their meal plans; aimed at younger readers but good for ideas for increasing the variety in the diets of astronauts. Accessed September 1, 2001. No author attributed.

“What utensils do astronauts use to eat in space? How are they different?”, http://www.hq.nasa.gov/osf/qanda.html#10 ; NASA’s Office of Space Flight (OSF), general FAQ about living in space, accessed September 1, 2001. Contains a good general description of what kinds of food are best for orbit, and how food for astronauts is different than food for normal “ground-based” diets.

TOPIC OUTLINE

1) Basic Nutrition
   a) Calories and Energy Content of Food
      i) Measurement of calories by combustion
      ii) Calorie counting
   b) Food Pyramid
   c) Basic concept of food groups
      i) Number of servings per day
         (1) Vitamins
         (2) USDA Recommendations
         (3) Effects of overdose
         (4) Effects of deficiency
   d) Calorie requirements for normal “earthbound” adults
2) Space Nutrition: Requirements of Astronauts
   a) Nutritional needs of active adults
      i) Gender differences
      ii) Increased energy needs
      iii) Effects of weightlessness
         (1) Calcium loss
         (2) Redistribution of fluids
         (3) Losses of certain vitamins
         (4) Changes in muscle mass
         (5) Fluid buildup in nasal cavities
         (6) Decreased sense of taste
   b) Food Preparation
      i) Eating in zero g

ii) Variety is the spice of life
iii) Foods which cannot be eaten in space
    (1) Fresh vegetables
    (2) Carbonated drinks
    (3) Percolated coffee (requires gravity)
    (4) "Loose" foods such as crumbly cakes

7. ACHIEVEMENT-BASED OBJECTIVES.
List specifically what the learner will do (psychomotor activity) with the content they are learning. Achievement-based activities must be measurable. For examples, refer to the achievement-based objectives for this course found in your course syllabus. Self-contained objectives must also include the conditions under which the behavior is to be performed and the minimally acceptable performance standard.

For the unit on space nutrition, students will:

Design a menu for astronauts on extended space missions which will meet their nutritional needs over the course of a three month period. (MCREL Health, Standard 6, Level 4 #1) The students, working in groups during class time, will provide documented evidence that each condition has been met in the form of tabulated data compiled in a spreadsheet. . The menu will meet the following criteria, which will serve as the basis for the scoring template for the assignment.

- Provides balance among the food groups described in the food pyramid.
- Accomodates specific differences due to gender and age of the astronaut.
- Provides enough energy for an active astronaut in weightlessness.
- Provides necessary and sufficient vitamins required to avoid the effects of long-term deficiency or overdose.
- Provides sufficient variety that astronauts are not bored with what they will eat and accommodates ethnic or cultural expectations. (MCREL Health, Standard 2, Level 4 #6)
- Meets the mechanical requirements of foods for consumption in space.
- Meets the mission parameters for storage and weight limitations imposed on shipments to an orbiting space station.

Create a single "spaceworthy" meal at home (working singly, not in groups) for consumption during class which meets the following criteria. (MCREL Health, Standard 6, Level 4, #1.)

- Meets mechanical requirements for food consumed in space.
- Balances requirements of the food guide pyramid.
- Includes extra spices as appropriate to allow for reduced sensation of taste.

8. INTERVENTION PACKAGE--List the methods you will employ in our instructional intervention package.

For this unit of study, I will be utilizing lecture, group research, lab activity with written reports, pre and post test-surveys, a written personal diet plan and a collaborative project.

Information will be provided via the class web site, the internet, and student presentations regarding the menus they prepared. A guest speaker will provide historical background.

9. MATERIALS NEEDED--List the materials you will have to have to present instruction.

- Calorimeters, thermometers, water source, matches, bunsen burners, hoses, gas supplies,.metric balances.
- Worksheet with calorie and vitamin content of common foods for training.
- Internet ready computers with links available to research sites.
- "Space food" from science museum.

10. ANTICIPATORY SET--You must entice them before you can deliver the message.
The presentation of the unit will begin by a presentation by Dr. James Scala, who helped prepare food for the Apollo astronauts while they were on their missions. Considering that spacwalking is a high-energy activity, not to mention the excitement and energy required just being on the moon, and you will see it was impractical for astronauts to return to the spacecraft every couple of hours just to eat or drink. They ate without hands, inside the helmets. How was this accomplished? This is the anticipatory "hook" that will drive the initial curiosity about the subject. Dr. Scala will also discuss the biochemical studies done for the missions and the work done on the around-the-world flight of the Voyager aircraft with Dick Rutan.

11. TEACHING and LEARNING ACTIVITIES--Briefly describe the activities that you will employ to deliver content and promote learning.

A **pre-test survey of knowledge and attitudes** regarding dietary planning will help establish the sources I must acquire for students to be successful with research. A **lecture** on the dietary needs of astronauts will be supplemented by Powerpoint presentation notes and made available in print and in an online version. This should assist verbal and auditory listeners in getting the initial information.
An **initial research assignment** to obtain data about the energy and nutrition content of foods on a worksheet will serve as training on how to obtain the necessary data to balance the meal. This activity will be a group collaboration done in my classroom on the internet.
The energy content of foods will be determined by doing a **calorimeter experiment** on burning some simple foods such as breads or nuts to determine their total caloric content.
Finally, the group project to design a menu for an extended mission will be done as a sort of **science-fair style competition**, with menus that meet the criteria in the rubric rated "flightworthy" and those which are not rated "ready to recycle." This will be in the larger context of our preparation of a simulated mission to Mars, including flight plans, launch windows, landing site selections, and scientific experimental objectives. This will be in the larger context of our preparation of a simulated mission to Mars, including flight plans, launch windows, landing site selections, and scientific experimental objectives.
Part of the **evaluation rubric**, developed in collaboration with the students, will be a simple preference for foods across the cross section of the class.
A **party** will be held at the end as part of the closure of the activity where we will eat the meals students provide and discuss the implications of the lesson for personal diet

planning (even for non-astronauts). This planning will lead to a **dietary contract with parents** at home intended to encourage application of the dietary analysis information learned in class as relevant to the student's daily lives.

In this collection of activities we see **cognitive learning** inherent in fact-based content necessary to provide a balanced meal, expressed through scoring rubrics for the menu design assignment.
We also have **affective learning** because there is a certain personal risk of failure driving the motivation to be successful in the public review of the meals. The discussion of what is valuable vs. what is necessary should drive the point of the lesson home. There are also the aesthetic and artistic qualities inherent in the art of meal preparation. In the closure activity the application of these ideas to a personal food plan will hopefully drive the real point of the assignment home: food is not just a pleasurable sensation, it is fuel; the amount of food should be equivalent to the amount of fuel required by lifestyle. This is the "aha" moment we are seeking to reach in the lesson.
Finally, **pyschomotor skills** are involved in the presentation of the food for the class party, because the foods must be flightworthy; that is, they may need to be processed to be sticky or to remove crumbs so as not to endanger the space flight. This involves both the imagining of the physical situation and the act of constructing the meal and its container(s). Hopefully parents will be involved in the discussion and preparation of the flightworthy meal. The lab activity requires students to make direct physical measurements of the quantities involved, involving several skills in the psychomotor domain.

12. CLOSURE--Summarizes what has been accomplished and what is going to happen next (hint: personal goal setting!)
After the academic lesson, and introduced by the party activity, students will be asked to make a personal assessment of their regular diets, and to write an essay or plan detailing what changes in their diets will be driven by what they have learned. The nine-step process will be presented, and they will be asked to **complete a dietary contract** with parents and have it signed by parents. This may involve a change or in the case of students who are already conducting a healthy lifestyle, a pledge to continue.

13. INDEPENDENT PRACTICE--Always include a guided activity where students have an opportunity to practice problem-solving, decision-making, and goal-setting.

Initial practice in diet analysis will come in form of a worksheet with limited choices, to illustrate the difficulty in providing a balanced meal in a fixed-resource environment such as a space capsule. The main project will involve determining the criteria for evaluation in a group discussion and then attempting to meet that criteria.

The first nine-step process will be modified for having students evaluate and revise their first menu proposals in the following way: Before beginning to write the menu plan for the small work groups, groups must complete an action plan which is turned in at the beginning of the project, just after groups are assigned.

6. *The Nine Step Planning Process*[iii]*:*
   1.In one sentence, WRITE a goal that is specific, measurable, positive, stated in the present tense, and is within a time frame.
   This goal will be set by the assignment: "We are designing a varied menu suitable for long-duration space missions and meeting the criteria presented in class for nutrition, energy, and personal preferences."

   2. Make of list of all the benefits when you achieve your goal. After you have developed a "subjective" list, research the topic more thoroughly. Document your "benefits" with scientific findings and provide three or four references . Be sure to properly cite resources from the Internet.
   Students will be asked to do research on two main topics: General dietary requirements for good health, and specific dietary requirements for space missions. They will have to document the analysis of the menus they prepare.

   3. You now know how YOU will benefit from achieving your goal. The next step is to describe at least two things (called ACTIVITY COMMITMENTS) that you must do to achieve your goal. For example, if your goal is that you are spending Saturday morning with your children, then one activity commitment is to develop a time management calendar. A second activity commitment might be to discuss your goal with your children so that all of you understand what will be happening. Got it?

   Aside from the usual fluff about wanting to get a good grade, how can this research project help you improve your life? If you actually learned something that might change your behavior, would you do it? List examples.

   4. Now, think about all of the things that could possibly keep you from achieving your goal. List these barriers to goal achievement.

   What could prevent you from getting a perfect score on this assignment? This analysis will help us design the scoring rubric the class will use for the assignment.

   5. This is the creative part. For each and every barrier that you listed in #3, PREPLAN an effective action. Let me give you an example. If your goal is that you are walking for 45 minutes per day, rainy weather would be a very realistic barrier. An action preplan is "If it rains, I will do a low impact exercise video (lasting 45 minutes) at home."

   State how you will ensure you will not do the things listed in the previous step. This is similar to the experimental design process of identifying interfering variables and then planning the control of the variable in the experiment protocol so that it does not interfere.

6. Your goal must be CONTINUALLY kept in your AWARENESS. How will you do this? Personally, I post notes on my mirror with little reminders and motivational sayings. Some people wear their watch on the opposite wrist so that everytime they check the time (and feel awkward) they are reminded of their goal commitment. Describe your strategy(s) for keeping you goal continually present in your awareness.

How will you remember to do the things you committed to do for your groups during the time between classes? Will you form a phone tree, use a planner, or check the class web site daily?

7. Write a CONTRACT and have it witnessed. Having support is extremely important. It's even better if you and a friend share the same lifestyle change goal.

The contract for completing the assignment should be completed with your classmates. This contract states job responsibilities and due dates. A template will be provided.

8. Identify BENCHMARKS to monitor your progress. How will you know if your plans are working? If you wrote a "measurable" goal, this step should be pretty easy. Let's use the exercise goal. A benchmark would be a record of your exercise—a simple calendar would show if you indeed walked everyday for 45 minutes. A more subjective benchmark would be "I will write down how I feel about my walking program and reflect on these feelings. "

What do you expect to have completed each day? This should be a part of your initial planning when the group is formed.

9. This process is guaranteed to work if you do all nine steps. This last one is to EVALUATE your plan and REVISE it if necessary. Use a short-term timeframe. If you see that you are not able to adhere to your plan, analyze it to determine "why". It might be that there is a barrier for which you did not preplan an effective action. Revise your plan and start again. You are becoming successful at determining what does and does not work!

Look over your plan for completing the menu assignment and revise as necessary using the word processor. Turn in your plan to begin work. Will it be completed on time? Do you need resources not currently available? Will the work plan fit within the schedules of the participants?

14. ASSESSMENT FOR KNOWLEDGE, ATTITUDE CHANGE, AND BEHAVIOR CHANGE--Authentic, project-based assessment allows us to assess learning in all three domains.

A pre-assessment survey will determine the level of background knowledge and attitudes toward dietary analysis from the individual students.

To the student:
The primary criterion for any project based assignment is that it must function; it must do its job. For example, when we built the sundials, the primary criterion was that it told the correct time.

As a result of our discussions in the planning process we listed criteria for the successful completion of the space menu project. These criteria are summarized below (with new criteria added by students to be added to the list after the discussion).

I. The menu plan provides **sufficient calories** for active astronauts. (Knowledge Domain)
II. The menu plan provides **vitamin and mineral needs** to prevent over- or under-dosing of crucial dietary needs (such as prevention of scurvy). (Knowledge Domain)
III. The menu plan provides **a balanced meal set** compatible with the food pyramid, especially over time periods measured in weeks. (Knowledge Domain)
IV. The menu plan provides **sufficient variety** that astronauts will not be tempted to skip meals or alter the menu in flight out of boredom, thus putting themselves at risk later in the flight due to some nutritional deficiency. (Affective Domain)
V. The in-class meal requires the use of various **skills associated with food preparation**; measurement, following directions, etc. (Psychomotor Domain).

Each criteria must have a measurable, quantifiable scoring rubric so the project will be evaluated. As a result of our group discussions, we will listen to proposals for scoring guides and reach mutual agreement on how to evaluate the projects and how to assign points for each scorable attribute.

The **lab report** will detail the actions taken, measurements, and interpretation of the data in terms of the equivalency of food and energy. (content: Cognitive domain. Implications: Affective Domain.)

Students will be asked to use a **generic scoring rubric** as a guide in discussing the specific rubrics for each criterion.

Also, the criterion for the party meals must be that they fit into the meal plan in some way, are flightworthy, and must be completely consumed (in order to maintain good nutritional balance for the duration of the flight).

The **individual menu planning contract assignment** will be used as an indicator of whether or not the lesson has effected **behavioral change** in the student.

A post-assessment survey will be given to see if **attitudes about dietary decisions** have been influenced by the project.

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[i] http://www.mcrel.org/compendium/outputSQL.asp?Subject=17&Standard=6&Level=4&Benchmark=2, MCREL Compendium of Standards /Health, Standard 6, Level 4, Benchmark 2; accessed September 1, 2001.

[ii] http://www.mcrel.org/compendium/Benchmark.asp?SubjectID=17&StandardID=2, MCREL Compendium of Standards /Health, Standard 2, Level 4, Benchmark 6; accesed September 1, 2001.

[iii] Nelson, Dr. Lin. Presented in Heath Education for Teachers class as a technique for completing project oriented plans.