



MUSEUM EXHIBIT DESIGN CHALLENGE for HUMAN BODY SYSTEMS

Challenge: PLAN and Develop a MUSEUM EXHIBIT and DESIGN AN ANALOGOUS DEVICE

This unit begins with a brief introduction on how the body is organized from cells>tissues>organs>organ systems. Students learn how their selected system functions and how it adds to/helps the whole body. In the process, they set up a museum display for a new *Homo sapiens* wing in the Museum of Natural History devoted to the fields of anatomy, physiology, and development. The exhibit should include written information, diagrams, charts, graphs, and an analogous model in order to engage the visitor in a variety of experiences. In addition, each group of students will write five multiple choice and five true/false questions about their body system to cover the state standards and course objectives. The museum is opening soon, and they need your help with the displays.

Grade Level: 7th

Educational Outcomes:

1. Students will design and build a working, analogous model of some aspect of their chosen body system.
2. Students will demonstrate this model and explain the analogy between their model and the body system.
3. Students will write short expository pieces to include in their museum display to demonstrate how this body system functions and how it is an integral part of the whole body.
4. Students will demonstrate knowledge of the science standards incorporated in this study by 1) writing 5 true/false and 5 multiple choice test questions that cover the standards and 2) making sure the answers to those questions can be found in their exhibits.
5. Students will present their information and demonstrate their displays to their class.

NOTES

1. This unit is designed to utilize both the Internet and any state approved 7th grade science textbook.
2. Some students will need help with what an analogous device is. Remind them of analogies they've discussed in literature, and point out that they are making an analogy of some aspect of their body system (**Note:** analogies can lead to misconceptions. Make sure to guide students in their development of their analogy and "push" their thinking so that their analogy is as accurate as possible).
3. Many students will need help with the idea of an analogous model. It helps if you tell them to brainstorm all the functions of their body system and then to brainstorm all the things they can think of in the world around them that do the same functions.
In this unit, students will gain an understanding of how structures within the human body are related to their functions and how all the functions together determine the health of the body. Thus, in groups, students will explore various aspects of the human body systems.
4. Teams need to keep **ALL** design ideas and brainstorms to put in a packet with D.C. Reflections or a journal; all to be turned in at the end.
5. Remind students they will need an introduction and a conclusion for their presentations.

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SCENARIO:

The Museum of Natural History is opening its new wing devoted to *Homo sapiens*-- their anatomy, physiology and development. They need exhibits for this new wing, and they want these exhibits to be as interactive and "hands-on" as possible in order to enhance the visitor's learning experience. The museum is opening soon, and they need your help with the display development.

CHALLENGE:

Design and create a museum exhibit/display that includes "labels" (articles written by your group) and an analogous device/model of some aspect of your body system to engage visitors and to help them learn the science of the human body. The group must also write 5 true/false test questions PLUS 5 multiple choice test questions that address the state standards and the objectives. The answers to your questions must be found in the "labels", pictures, diagrams, etc in your display.

CONSTRAINTS:

1. Your device must have at least **1** moveable part and be able to withstand repeated but gentle use by other students.
2. You must make a drawing of your device and have it approved by your teacher before you start to build it.
3. The prototyping of your analogous of device will occur on _____.
4. You may include materials on display in the classroom, and you may bring materials from home. **However, you may not include pre-built parts or devices.**
5. Only 2 hot glue sticks will be provided per team.

6. You will need space to store projects organized by class. Try to set aside areas that are separated. (Sometimes kids are not careful of unknown kids' work.)

7. My class periods are 50 minutes.

8. Be sure all topics are covered by at least one class. Students who want to work as a group of 4 or the one group of 5 get first choice of those topics.

9. I allow students to group themselves with 1-4 per group and use "Rocks, Paper, Scissors" if there is more than one group that wants a particular topic. I also start with the topics for groups of 4/5 first, and those that want to work as a group of 4 get first choice.

10. I have tool boxes set up for each table that include: pliers, needle nose pliers, changeable head screw driver, tape measure, 3 C clamps, saw, hammer, miter box, various screws & nails. At my desk, I also have glue, sand paper, nuts and bolts, 3 or 4 tin snips, adjustable wrenches, awls, hand drills and bits, Xacto knives and awls that students must ask for and return.

6. Your “initial concept” (i.e. rough display) display must be ready to exchange with another group for input by _____.
7. You will need to use some kind of display board or partitioning device to display your information and to keep your display separate from others. You must also set up a way to display your information and your model in a 2.5' x 2' space that would be acceptable to a museum. Your exhibit/display must include the model, the objectives and standards, and informative “labels.” The “labels” must include the answers to your test questions. The display could also include pictures, graphs, diagrams, etc. copied from the Internet. BE SURE ANY COPIED PICTURES, ETC. INCLUDE THE URL OR OTHER CITING (as you have learned to do in your language arts class).
8. Everyone on the team must contribute to the exhibit/display and turn in all the research notes and “Design Idea” worksheets with a DESIGN CHALLENGE REFLECTION, completed by each team member, stapled on top of the packet. This is DUE THE DAY AFTER THE TEST.
9. All articles must be written in your own words. **Do not plagiarize.**
10. You must create 10 test questions (5 multiple choice and 5 true/false) that test one’s knowledge of the objectives. The display must incorporate the answers. The word-processed questions and answer key must be given to the teacher by **DAY 10.**
11. DO NOT include written copies of either the standards or objectives in your display

MATERIALS AND RESOURCES:

1. Various art and construction supplies from the classroom or from home. (No Pre-built models are allowed.)
2. Computers with Internet access.
3. Life science text and other books in the class or ones you find outside of class.

Scilinks at www.scilinks.org is a good web site to use with the Holt science text. Register as a "Guest." Get the code number from the text in the "Chapter Highlights" from the chapter(s) on the body systems.

11. I have the students put their questions on one of the computers in the class or email them from home to me. Then I put all the questions, by body system, indicating to which display they refer, on a multi page handout for each student. Students will use these questions as they study.

12. Put a blank piece of paper at each display for questions the group wrote but did not answer in their display. The groups should check their displays daily for these questions, and they can leave the answer written on the same sheet or state that the answer is in the display.

13. I save the demonstrations for the next to last day; otherwise, the displays do not last for the duration.

14. Another idea for testing that I plan to try next time I teach this unit is to give a short test on each body system to the specific group that studied it, about 18-20 questions.

15. I provide my students with a variety of supplies such as hot glue sticks, white glue, wood glue, various types of tape, screws, nails, nuts & bolts, craft sticks, doweling, small, odd sized pieces of wood, and lots of odds & ends from RAFT, a store devoted primarily to teachers, which offers materials donated by various companies including office, medical, and industrial parts and pieces.

16. The vocabulary is specific to the Holt text. It may be adjusted to reflect your own textbook.

Overview and Estimated Time:

This project is designed for science teachers with multiple classes. Allow eighteen to twenty class periods (50 min each) from start to finish.

Time Schedule:

Day 1: Go over the Student Packet in class. (packet follows)

Day 2: Choose teams (up to 4 students per group) and pick body systems. Teams should start reading in their text and answering questions about their system.

Day 3-4: Review Brainstorming Guidelines, and have students brainstorm ideas for their model. Go over Design Idea of _____ System (worksheet) and how you want students to use it. Once their design idea has been approved and you've initialed it, they may begin construction.

Day 5: **Go over** how to use tools and safety issues, including using goggles with students before they start construction. Many have already had shop. Explain how to use a miter box and saw, change a drill bit, and check out awls, knives, and any other sharp tools they need to use. During construction, those in the group not working on the device should be working on writing up the "labels" for the display and writing the questions. Remind them to review the standards and to make sure the answers to their questions are in their "labels."

Day 8 or 9: Introduce a few basic principles of exhibit design: contrast, repetition, alignment, and proximity, to help students with their layouts. The Nondesigner's Design Book by Robin Williams is great for this. I made overhead copies of one good and one poor example of each of the above principles and briefly went over them. I also have a Grumbacher Color Computer available for students to refer to. It can be purchased at art supply stores for about \$6.00 and helps students with harmonizing colors to be used in their displays

Day 11: For their initial concept review: groups will lay out their display, device and test questions then trade with another group. Study the other group's layout. Write **positive** suggestions or questions for

improving their layout and leave the suggestions there. Return to your own layout.

Day 12: Adjust and finalize your display. Finalize your device prototype based on feedback received from other students. The ten questions are due in one of the class computers today. The answers must be on a separate page and also in the computer in the SAVE file. (I have them save them under one person's name in each group).

Day 13: Have students take time to just look through the displays and take notes.

Day 14-16: Students study the displays and answer the questions in the handout which you have compiled from ALL the sets of ten questions.

Day 18: Each group will demonstrate their device, explain its analogy, and present their display and the information. Then all continue their individual reviews of the museum. If there's time, they can carefully try other classes' devices. Warn them that the devices will not stand a lot of punishment, to be respectful of others' things, and to try them only once so others can try them too.

Day 19: Administer test on the Body Systems compiled from a subset of the questions your students have written.

ADDITIONAL NOTES & RECOMMENDATIONS:

1. Be sure that students have studied their body system before they try to design an analogous model.
2. Require that they get their model initialed by you before they begin construction of their model. Some will try to make a model of the body system instead of an analogy.
3. I had some concerns initially about this analogous model, but I found that they had to have a good grasp of the system in order to design an analogy.
4. For those in the Silicon Valley area: I have 5 classes. The first time I shopped for a challenge, I bought only enough materials for about two classes; so go to RAFT (the Resource Area for Teachers

- <http://www.raft.net>). RAFT provides teachers and community groups with creative tools and very low cost materials to promote hands-on learning in science, math, technology, and art. Buy at least twice the amount of materials that you think you will need. I also use the coupon for Michael's each week from the San Jose Mercury News to get hot glue sticks, craft sticks and other supplies not available at RAFT.
5. If you have students put their questions on a computer, you can send all the questions to your computer at the end of the day. This makes it much easier to assemble a complete set of all the questions from all the classes/groups so that each student can have a full set of questions. (With my five classes, I have ten+ double-sided pages.)
 6. In the student packet on pages 6-18 have students fill in the blanks with specifics dates according to your time schedule.
 7. Each student must complete the Design Challenge Reflection section. The groups' reflections must be stapled together with all their Design Ideas sheets and turned in the day after the test.
 8. Use the students' questions to write your test on the unit.
 9. There is a wonderful book, The Non-Designer's Design Book, by Robin Williams with information on contrast, repetition, alignment, and proximity; I made some overheads to give the students examples of both good and bad examples of the above.

STUDENT PACKET

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8. Everyone on the team must contribute to the exhibit/display and turn in all the research notes and "Design Idea" worksheets with a DESIGN CHALLENGE REFLECTION, completed by each team member, stapled on top of the packet. This is DUE THE DAY AFTER THE TEST.
9. All articles must be written in your own words. **Do not plagiarize.**
10. You must create 10 test questions (5 multiple choice and 5 true/false) that test one's knowledge of the objectives. The display must incorporate the answers. The word-processed questions and answer key must be given to the teacher by **DAY 10.**
11. DO NOT include written copies of either the standards or objectives in your display

MATERIALS AND RESOURCES:

4. Various art and construction supplies from the classroom or from home. (No Pre-built models are allowed.)
5. Computers with Internet access.
6. Life science text and other books in the class or ones you find outside of class.
7. Scilinks at www.scilinks.org is a good web site to use with the Holt science text. Register as a "Guest." Get the code number from the text in the "Chapter Highlights" from the chapter(s) on the body systems.

Time Schedule

- DAY 1** Hand out packet and go over.
- DAY 2** Choose teams and pick/assign topics. Begin reading about your body system in the text and answering any pertinent workbook questions.
- Day 3-4** Discuss types of questions to be written by team members. Review Brainstorming Guidelines, and brainstorm ideas for the analogous model. Submit completed Design Idea page to the teacher for approval.
- Days 5-10** Go over use of tools. Construct the prototype of your device/model, write the “articles” for the display, and write the test questions.
- DAY 8 or 9** Go over layout and use of color for the display.
- DAY 11** Initial Concept Review. Lay out the display with the articles, device and questions. Trade with another group and write out positive feedback (ideas for improving their display). Turn in the test questions today.
- DAY 12** Make any adjustments to your display and finalize it.
- DAY 13** Look through the displays without touching and take notes.
- DAY 14-16** Go through the displays without touching and find the answers to the questions
- DAY 18** Demonstrate your device to your class, explain its analogy, and present your display. Be sure to cover the objectives and standards. After demonstrations, you may **carefully** try other devices.
- Day 19** Test on Body Systems using the student’s questions.

TOPICS

The students may choose to work **alone** or in groups of up to **5** students.

1. Skeletal System (team of 3-4)

VOCABULARY:

- | | | |
|--------------------|--------------|-------------------------|
| 1. Skeletal system | 4. Cartilage | 7. Mechanical advantage |
| 2. Compact bone | 5. Joint | |
| 3. Spongy bone | 6. Ligament | |

OBJECTIVES:

1. Identify the major organs of the skeletal system.
2. Describe the functions of bones.
3. Illustrate the internal structure of bones.
4. Compare (and contrast) 3 types of joints.
5. Discuss how bones function as levers.

2. Muscular System (team of 3-4)

VOCABULARY:

1. Muscular system
2. Smooth muscle
3. Cardiac muscle
4. Skeletal muscle
5. Tendon
6. Flexor
7. Extensor

OBJECTIVES:

1. List the major parts of the muscular system.
2. Describe the different types of muscle.
3. Describe how skeletal muscles move bones.
4. Compare (and contrast) aerobic exercise with resistance exercise.

3. Integumentary System (team of 1-3)

VOCABULARY:

- | | | |
|-------------------------|--------------|------------------|
| 1. integumentary system | 3. Melanin | 5. Dermis |
| 2. Sweat glands | 4. Epidermis | 6. Hair follicle |

OBJECTIVES:

1. Describe the major functions of the integumentary system.
2. List the major parts of the skin, and discuss their functions.
3. Describe the structure and function of hair and nails.
4. Describe some common types of damage that can affect skin.

4. The Cardiovascular System (team of 3-4)

VOCABULARY:

- | | | |
|--------------------------|----------------|---------------------------|
| 1. Cardiovascular system | 5. Atrium | 9. Veins |
| 2. Blood | 6. Ventricle | 10. Pulmonary circulation |
| 3. Plasma | 7. Arteries | 11. Systemic circulation |
| 4. Platelet | 8. Capillaries | 12. Blood pressure |

OBJECTIVES:

1. Describe the functions of the cardiovascular system.
2. Compare and contrast the 3 types of blood vessels.
3. Describe the path that blood travels as it circulates through the body.
4. Distinguish between blood types.

5. The Lymphatic System (teams of 1-2)

VOCABULARY:

- | | | |
|----------------------|----------------------|------------|
| 1. Lymphatic system | 4. Lymphatic vessels | 7. Spleen |
| 2. Lymph capillaries | 5. Lymph nodes | 8. Tonsils |
| 3. Lymph | 6. Thymus | |

OBJECTIVES:

1. Discuss the functions of the lymphatic system.
2. Identify the relationship between lymph and blood.
3. Describe the organs of the lymphatic system.

6. The Respiratory System (teams of 2-3)

VOCABULARY:

- | | | |
|-----------------------|------------|-------------------------|
| 1. Respiration | 4. Larynx | 7. Alveoli |
| 2. Respiratory system | 5. Trachea | 8. Diaphragm |
| 3. Pharynx | 6. Bronchi | 9. Cellular respiration |

OBJECTIVES:

1. Describe the flow of air through the respiratory system including cellular respiration.
2. Discuss the relationship between the respiratory system and circulatory system.
3. Identify respiratory disorders.

7. The Nervous System (team of 2-4)

VOCABULARY:

- | | | |
|------------------------------|-------------------|----------------|
| 1. Nervous system | 7. Axon | 13. Cerebrum |
| 2. Central nervous system | 8. Sensory neuron | 14. Cerebellum |
| 3. Peripheral nervous system | 9. Receptor | 15. Medulla |
| 4. Neuron | 10. Motor neuron | 16. Reflex |
| 5. Impulse | 11. Nerve | |
| 6. Dendrite | 12. Brain | |

OBJECTIVES:

1. Explain how neurons in the nervous system work together.
2. Compare and contrast the central nervous system and the peripheral nervous system.
3. Describe the major functions of the four parts of the brain and the spinal cord.

8. Five Senses--a part of the nervous system (team of 2- 4)

VOCABULARY:

- | | | |
|-------------------|----------------|------------|
| 1. Retina | 4. Cones | 7. Lens |
| 2. Photoreceptors | 5. Optic nerve | 8. Cochlea |
| 3. rods | 6. Iris | |

OBJECTIVES:

1. Describe the 3 sensations that are detected by receptors in the skin.
2. Describe how light relates to vision and explain the functions of the rods and cones.
3. Explain how the ear works.
4. Explain how taste and smell are connected.



9. Endocrine System (team of 1-3)

VOCABULARY:

- | | | | |
|---------------------|---------------------|--------------------|-------------------|
| 1. Endocrine system | 3. Hormone | 5. Pituitary gland | 7. Pancreas |
| 2. Gland glands | 4. Feedback control | 6. Thyroid gland | 8. Adrenal glands |
| | | | 9. Ovary/testis |

OBJECTIVES:

1. Explain the function of the endocrine system.
2. Illustrate the locations of the endocrine glands in the body and list their functions.
3. Describe how feedback controls stop and start hormone release.

10. Human Reproduction and Development (team of 3-5)

VOCABULARY:

- | | | |
|---------------------------|------------------|----------------------------------|
| 1. Sexual reproduction | 10. epididymis | 19. Fallopian tubes |
| 2. Egg | 11. Vas deferens | 20. Uterus |
| 3. Sperm | 12. Semen | 21. Vagina |
| 4. Zygote | 13. Puberty | 22. Menstruation |
| 5. Internal fertilization | 14. Urethra | 23. Infertile |
| 6. Placental mammal | 15. Penis | 24. Sexually transmitted disease |
| 8. Testes | 16. Ovaries | 25. Embryo |
| 9. Scrotum | 17. Ovulation | 26. Implantation |
| 10. somniferous tubules | 18. Fetus | 27. Placenta |
| | | 28. Umbilical cord |

OBJECTIVES:

1. Distinguish between: a) external and internal fertilization plus b) asexual and sexual fertilization.
12. Describe the 3 different types of mammalian development.
13. Describe the functions of the male and female reproductive systems and summarize the process of fertilization and implantation.
4. Describe the course of human development.

Brainstorming Guidelines for Teams

Brainstorming is a method of shared thinking, where everyone in a group quickly calls out their idea for a solution or possible answer.

Some basic rules will help the brainstorming sessions be effective:

- No criticism allowed: all ideas are welcome. Do not judge ideas at this stage.
- Work for quantity: the more ideas, the better. Write them all down.
- Hitchhiking is welcome: people can often build on (modify, expand) each other's ideas.
- Outrageous ideas are encouraged: often those crazy ideas have some hint that will help solve the problem.

SCAMPER¹ is another technique that can help teams come up with new ideas or modify those they already have. Use these words to come up with questions that can help you to brainstorm ideas. For example, "Is there a way that we can combine this idea with that idea to come up with a better idea?"

Substitute: Have a person or thing act or serve in place of another. What can you substitute? What material or process can you use instead?

Combine: Bring things together. What can be blended, mixed, included? What ideas or parts can you combine?

Adapt: Adjust something in order to suit a specific condition or purpose. What should I copy? How can this be modified for other uses?

Modify/Magnify/Minify: What can you make bigger or smaller? How can you make it longer, stronger, heavier, lighter, etc?

Put to other uses: Use something for purposes other than originally intended. Does its shape, form, or material suggest other uses?

Eliminate: What can we do without? What if we left out certain parts?

Reverse: What if you reverse it? Turn it upside down? Turn it inside out?

The team should always have someone taking notes during a brainstorming session. These notes should be kept in the design journal. You never know when you might want to look at them again!

¹ 1 Modified from <http://www.eng.buffalo.edu/Courses/mae451/EdPettitt-Creative.ppt>



Name _____

Teacher _____

Period _____ Science

Date _____

DESIGN IDEA of _____ system

Explain Analogy of this Design

Pros: construction & analogy

Cons: construction & analogy



Rubric for Museum Exhibit Design Challenge

Group members: _____ Body System: _____

	1 Point	2 Points	3 Points	4 Points	5 Points
Relationship between structure and function as demonstrated by the exhibit	Included none of the relationship between structure and function from the text.	Included very little of the relationship between structure and function from the text	Defined some of the basic relation-ship between structure and function from the text.	Includes most of the basic structure and functions from the text.	Clearly demonstrates the relationship between the structures and their functions from the text
Objectives from Textbook	Display did not explain the objective & had little or no other information.	Display did not explain the objectives but covered other information.	Display explains only some of the objectives.	Display explained all of the objectives clearly.	Display explained all the objectives clearly and gave additional information.
Model shows a clear analogy with at least 1 moveable part	It has a dubious analogy, no moveable part, and imparts little information	It has a dubious analogy, one moveable part and imparts minimal information	It has one moveable part, a moderate analogy that imparts general information.	It has one or more moveable parts, a good analogy that imparts basic information.	It has two or more moveable parts, a clear analogy that imparts additional information.
10 Test Questions that Test the CA Standards and Textbook Objectives	Has less than 10 questions that do not cover the standards and objectives and has accuracy or format problems.	Has a set of 10 questions, but they do not cover either the standards or the objectives and has format or accuracy problems.	Has a set of 10 questions that mostly cover the standards and objectives but has accuracy and/or format problems.	Has a class set of 10 mostly accurate questions that cover the standards and objectives but has format problems.	Has a class set of 10 accurate, in depth questions that cover the standards and objectives well.
Overall Quality of Exhibit 1. accurate 2. engaging 3. pertinent vocabulary 4. clear ideas 5. design layout & color Big idea is clearly communicated	The exhibit lacks all of the following: clear ideas, accuracy, & vocabulary but is engaging. It has many errors, and craftsmanship is poor.	The exhibit lacks two of the following: clear ideas, accuracy, & vocabulary, but is engaging. It has many errors. Craftsmanship is poor.	The exhibit lacks either clear ideas, vocabulary, or accuracy, and is not very engaging. It has several errors. Craftsmanship is adequate/ acceptable	The exhibit has ideas that are not quite clear or not entirely accurate. It is engaging, includes vocabulary and has few errors. Craftsmanship is good.	The exhibit has very clear ideas, is accurate, and is very engaging. It has additional vocabulary & few or no errors. Craftsmanship is excellent.
Overall Presentation 1. introduction 2. information 3. conclusion 4. model demonstration 5. commands attention /good eye contact	Little or no information is given; no introduction; no conclusion; model does not hold up for the demonstration; does not command attention or have good eye contact.	One of the 5 are done well and at least 2 are done moderately well.	Two or 3 are done well and 2 are done moderately well.	Four are done well and the 5 th is done moderately well.	All 5 are done well.

Possible Score 60

Score: _____ x 2 = _____ **Total Score**



NAME _____

DESIGN CHALLENGE REFLECTION

1. What factors were important to consider when designing your model?

2. What aspect of your system did your model demonstrate?

3. How well did your model demonstrate that aspect?

4. How would you change or improve your model?

5. What would you change or improve in your display?

- | | | | |
|--|-----|-----------|----|
| 6. As a group, did we all share? | Yes | Sometimes | No |
| 7. Did we take turns? | Yes | Sometimes | No |
| 8. Did everyone contribute to the model? | Yes | Sometimes | No |
| 9. Did everyone contribute to the display? | Yes | Sometimes | No |
| 10. Did we listen to each other? | Yes | Sometimes | No |
| 11. Did we help each other? | Yes | Sometimes | No |