

### Model Science – The Heart

**LEVEL:** High School – Grades 9<sup>th</sup> – 12<sup>th</sup>

**TYPE OF CONTEST:** Individual / Team

**COMPOSITION OF TEAMS:** 1 – 2 students per team

**NUMBER OF TEAMS:** 3 teams per Center

**SPONSOR:** Nicole Patterson, UC Irvine MSP

**OVERVIEW:** Students will construct an original model of a bisected human heart which will *simulate blood flow through the four chambers of the heart*. Students will be prepared to answer questions drawn from an assigned list using reading material provided in the MESA Day curriculum. Participation logistics, limits, and competition facilities may vary by host site. Advisors and students are responsible for verifying this information with their center director.

**MATERIALS:** The following materials will be provided by the students:

- Nonperishable materials with which to build the original model
- Nonperishable materials to represent the “blood” for testing

#### **RULES:**

1. The model must be the original work of the student(s). Judges may ask questions to verify authenticity of the model.
2. Only materials that are not perishable may be used in the model’s construction. Nonperishable items are those that will not rot, spoil, or decay without refrigeration. Use of any other items will result in disqualification. Commercial models may NOT be used. **Violation of this rule and only this rule will result in disqualification.** Students are encouraged to fully incorporate a variety of allowable materials in the model.
3. The model should be clearly labeled with student name(s), school and MESA center. If the model is not clearly labeled with student name(s), school and MESA center, a **9** point penalty will be deducted from the total score.
4. The model should be no larger than 3 feet high by 3 feet wide by 2 feet deep.
5. The model should realistically depict all required structures and demonstrate blood flow through all four chambers of the heart.

6. The representation of the blood is at the student's discretion, but it must be a nonperishable item.
7. Students must provide all materials needed to demonstrate their model. Host center will not provide electrical power, liquids, or any material to use in the demonstration of the model.
8. A materials table should be provided with the model. The materials table may be attached to the model or provided separately. If provided separately, it must be clearly labeled with student name(s), school and MESA center.
9. The competitors will attempt to answer three randomly selected questions from the attached list, plus unpublished tiebreaker questions if needed.

**JUDGING:**

1. Four points will be awarded for the following: **(maximum 4 points)**
  - a. The model, including the stand and all of its components is no larger than 3 feet high by 3 feet wide by 2 feet deep.
2. Three points will be awarded for a COMPLETE display table listing all materials utilized for all structures on the model. **(maximum 3 points)**

**Sample Materials Table**

| Structure         | Material    |
|-------------------|-------------|
| 1. Aorta          | Red Tubing  |
| 2. Left Ventricle | Red Balloon |

3. Points will be awarded for each of the 14 required structures presented on the model as listed below. **(maximum 42 points)**
  - a. Required structure present: 0 – ½ point awarded
  - b. Required structure correctly labeled: 0 – ½ point awarded
  - c. Realistic depiction of required structure: 0 - 2 points awarded

| Structure               | Present<br>(0 - .5 point) | Correctly Labeled<br>(0 - .5 point) | Realistic Depiction<br>(0 – 2 points) |
|-------------------------|---------------------------|-------------------------------------|---------------------------------------|
| Aorta                   |                           |                                     |                                       |
| Left Ventricle          |                           |                                     |                                       |
| Right Ventricle         |                           |                                     |                                       |
| Left Atrium             |                           |                                     |                                       |
| Right Atrium            |                           |                                     |                                       |
| Mitral Valve            |                           |                                     |                                       |
| Tricuspid Valve         |                           |                                     |                                       |
| Superior Vena Cava      |                           |                                     |                                       |
| Inferior Vena Cava      |                           |                                     |                                       |
| Right Coronary Artery   |                           |                                     |                                       |
| Left Coronary Artery    |                           |                                     |                                       |
| Aortic Valve            |                           |                                     |                                       |
| Pulmonary Valve         |                           |                                     |                                       |
| Interventricular Septum |                           |                                     |                                       |

4. Points may be awarded for the presence of up to 4 additional structures other than the required structures. **(maximum 12 points)** Additional structures will be judged as follows:
  - a. Additional structure present: 0 – ½ point awarded
  - b. Additional structure correctly labeled: 0 – ½ point awarded
  - c. Realistic depiction of additional structure: 0 - 2 points awarded
  
5. Points will be awarded based on the depiction of the blood flow pathway within the heart model. One point will be awarded based on each of the flow criteria below. Blood must complete at least one full cycle in order to be awarded points. **(maximum 12 points)**

| Blood Pathway                                     | (2 points) |
|---|------------|
| Inferior and/or Superior Vena Cava → Right Atrium |            |
| Right Atrium → Right Ventricle                    |            |
| Right Ventricle → Lungs                           |            |
| Lungs → Left Atrium                               |            |
| Left Atrium → Left Ventricle                      |            |
| Left Ventricle → Aorta                            |            |

6. Points will be awarded for creativity. Do the model and various structures display characteristics of originality and creativity in terms of overall composition? Are the different structures variable with different colors, textures, and dimensions? Is the use of materials used to depict the different structures creative? **(maximum 8 points)**
  
7. Judges will determine team order by random drawing and will post the team order prior to the start of the competition.
  
8. Once a team is called they will be given a maximum of 3 minutes to demonstrate the functionality of their heart models.  
 Students will then answer three questions from an assigned list based on information provided in the MESA Day curriculum. **(maximum 9 points)**  
 Question/answer portion judged as follows:
  - a. Students will randomly select 3 questions.
  - b. Students will have a maximum of 30 seconds to answer each question.
  - c. Each correct answer will be awarded up to 3 points. Partial points may be awarded for partial answers.
  - d. There will be a set of 5 previously unpublished tiebreaker questions available on the day of the competition. Each tiebreaker question will be worth up to 3 points each.

**AWARDS:**

Awards will be given for 1<sup>st</sup>, 2<sup>nd</sup>, and 3<sup>rd</sup> place.

**MODEL SCIENCE – The Heart  
Specification Checklist for Students  
NOT FOR USE BY COMPETITION JUDGES**

- Only nonperishable items used in the construction of the model.
- The model is clearly labeled with student name(s), school and MESA center.
- The model of the heart is no larger than 3 feet x 3 feet x 2 feet deep.
- The model is clearly labeled w/ required structures.
- The model depicts blood flow through the four chambers of the heart.
- A materials table is included with the model.

ATTACHMENTS:    Questions for Model Science – The Heart  
                          Score Sheet for Model Science – The Heart

## QUESTIONS FOR MODEL SCIENCE – THE HEART

2015 – 2016

High School – All Grades

**Students MUST be prepared to answer each question with a complete sentence or sentences.**

1. What is the size of the human heart?
2. Describe the fetal heart's developmental stages.
3. Describe the pericardium and its function.
4. What is the function of the aorta and what are the sections of the aorta?
5. Describe the pulmonary arteries and its function.
6. Name 4 risk factors for heart disease.
7. Describe the left ventricle and its function.
8. Describe the right ventricle and its function.
9. Where is the tricuspid valve located? What is its function?
10. What is the function of the superior and inferior vena cava?
11. Describe the right atrium and its function.
12. What is the purpose of the cardiovascular system?
13. What is arteriosclerosis?
14. Describe what happens in a myocardial infarction.
15. What three types of exercise are needed for a healthy heart? Describe each.
16. Name 4 differences between angina and heart attack.
17. Describe a heart-healthy diet.
18. What three major waves of electrical signals appear on the ECG/EKG? Describe each wave.
19. What regulates the rhythm of the heartbeat?
20. Describe ventricular systole.

**SCORE SHEET FOR MODEL SCIENCE – THE HEART**  
**High School – All Grades**  
**2015 - 2016**

*Copies of this score sheet will be provided by the MESA Day Host Center.*

Student Name(s): \_\_\_\_\_

Center & School: \_\_\_\_\_

Judges: \_\_\_\_\_

**Part I: Model Criteria/Materials Table (7 points max)**

Size (4 points) \_\_\_\_\_

Materials Table (0-3 points) \_\_\_\_\_

**Subtotal for Part I** \_\_\_\_\_

**Part II: Model Structures (54 points max)**

Required Structures:

| <b>Structure</b>        | <b>Present<br/>(0 - .5 point)</b> | <b>Correctly Labeled<br/>(0 - .5 point)</b> | <b>Realistic Depiction<br/>(0 – 2 points)</b> |
|-------------------------|-----------------------------------|---|---|
| Aorta                   |                                   |   |   |
| Left Ventricle          |                                   |   |   |
| Right Ventricle         |                                   |   |   |
| Left Atrium             |                                   |   |   |
| Right Atrium            |                                   |   |   |
| Mitral Valve            |                                   |   |   |
| Tricuspid Valve         |                                   |   |   |
| Superior Vena Cava      |                                   |   |   |
| Inferior Vena Cava      |                                   |   |   |
| Right Coronary Artery   |                                   |   |   |
| Left Coronary Artery    |                                   |   |   |
| Aortic Valve            |                                   |   |   |
| Pulmonary Valve         |                                   |   |   |
| Interventricular Septum |                                   |   |   |

Additional Structures:

| <b>Structure</b> | <b>Present<br/>(0 - .5 point)</b> | <b>Correctly Labeled<br/>(0 - .5 point)</b> | <b>Realistic Depiction<br/>(0 – 2 points)</b> |
|------------------|-----------------------------------|---|---|
|                  |                                   |   |   |
|                  |                                   |   |   |
|                  |                                   |   |   |
|                  |                                   |   |   |

**Subtotal for Part II** \_\_\_\_\_

**Part III: Blood Flow (12 points max)**

| Blood Pathway                                     | (2 points each) |
|---|-----------------|
| Inferior and/or Superior Vena Cava → Right Atrium |                 |
| Right Atrium → Right Ventricle                    |                 |
| Right Ventricle → Lungs                           |                 |
| Lungs → Left Atrium                               |                 |
| Left Atrium → Left Ventricle                      |                 |
| Left Ventricle → Aorta                            |                 |

**Subtotal for Part III** \_\_\_\_\_

**Part IV: Overall Creativity of Model (8 points max)**

*0 - 2 point for each of the following:*

1. Creativity in the use of materials to depict colors \_\_\_\_\_
2. Creativity in the use of materials to depict textures \_\_\_\_\_
3. Creativity in the use of materials to depict dimensions \_\_\_\_\_
4. Creativity in the use of materials to depict variability of the different structures \_\_\_\_\_

**Subtotal for Part IV** \_\_\_\_\_

**Part V: Model Science Questions (9 points max)**

*Up to 3 points for each answer:*

Question 1 \_\_\_\_\_

Question 2 \_\_\_\_\_

Question 3 \_\_\_\_\_

**Subtotal for Part V** \_\_\_\_\_

**Labeling Penalty** - \_\_\_\_\_

**Deduct 9 points if model is not clearly labeled with student name(s), school and MESA center.**

**GRAND TOTAL** \_\_\_\_\_

*(Add subtotals for Part I – Part V; deduct penalty if applicable)*

*Maximum score is 90*

**Tie Breaker Questions**

*Up to 3 points for each answer:*

Question 1 \_\_\_\_\_ Question 2 \_\_\_\_\_ Question 3 \_\_\_\_\_

Question 4 \_\_\_\_\_ Question 5 \_\_\_\_\_

**TOTAL INCLUDING TIE-BREAKER QUESTIONS** \_\_\_\_\_