

Model Science – The Human Heart

LEVEL:	Grades 9 - 12
TYPE OF CONTEST:	Individual/Team
COMPOSITION OF TEAM:	1-2 Students per team
NUMBER OF TEAMS:	Preliminary – Determined by your local MESA Center Regional – 3 of teams per MESA Center
SPONSOR:	Nicole Patterson, Associate Director, 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 student team members:

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

GENERAL RULES:

- 1) The model must be the original work of the student(s). Commercial models may NOT be used. Judges may ask questions to verify the authenticity of the model. **Violation of this rule will result in disqualification.**
- 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. Students are encouraged to fully incorporate a variety of allowable materials in the model. **Violation of this rule will result in disqualification.**
- 3) The model and accompanying materials table should be clearly labeled with student name(s), grade, school and MESA center. If the model and accompanying materials table is not clearly labeled with student name(s), grade, school and MESA center, a **9.5** 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 simulation of blood flow must be initiated by a team member. Once the simulation has begun the team may no longer have contact with the model itself and the simulation should

continue uninterrupted. The team may however control the blood flow through an adjacent mechanism separate from the model e.g. syringe, pump. Contact with the model itself before the simulation has ended will result in an immediate stoppage and void any remaining points. Maximum time to complete the simulation is 2 minutes.

- 7) The representation of the blood is at the student’s discretion, but it must be a nonperishable item.
- 8) 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.
- 9) 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), grade, school and MESA center.
- 10) The competitors will attempt to answer five randomly selected questions from the attached list, plus unpublished tiebreaker questions if needed.

JUDGING:

- 1) Three points will be awarded for the following: (maximum 3 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) Five points will be awarded for a COMPLETE display table listing all materials utilized for all structures on the model. (maximum 5 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 28 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 - 1 point awarded

Structure	Present (0 - .5 point)	Correctly Labeled (0 - .5 point)	Realistic Depiction (0 – 1 point)
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 3 additional structures other than the required structures. (maximum 6 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 - 1 point awarded
- 5) Points will be awarded based on the depiction of the blood flow pathway within the heart model. Five points will be awarded upon the completion of each of the flow criteria listed below. (maximum 30 points)

Blood Pathway	Points Awarded
Inferior and/or Superior Vena Cava → Right Atrium	5 points
Right Atrium → Right Ventricle	5 points
Right Ventricle → Lungs	5 points
Lungs → Left Atrium	5 points
Left Atrium → Left Ventricle	5 points
Left Ventricle → Aorta	5 points

- 6) Points will be awarded for creativity. Do the 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 2 minutes to demonstrate blood flow through the heart. Once the judge gives the start order the team will initiate the simulation of blood flow and may have no further contact with the model itself until the simulation has ended or 2 minutes have passed. The team may however control the blood flow through an adjacent mechanism separate from the model e.g. syringe, pump.
- 9) Students will answer five questions from an assigned list based on the content provided in the MESA Day curriculum. (maximum 15 points) Question/answer portion judged as follows:
 - a. Students will randomly select 5 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.
 - d. There will be a set of 5 previously unpublished tiebreaker questions available on the day of the competition. Each tiebreaker question is worth up to 3 points each.

AWARDS:

- Medals will be awarded for 1st, 2nd, and 3rd place.

ATTACHMENTS/APPENDIX:

- Specification Checklist
- Questions for Model Science – The Human Heart
- Score Sheet for Model Science – The Human Heart

Model Science – The Human Heart Specification Checklist

**Note: As the name above implies, this list is intended simply as a guide for meeting the required competition specs. It should not be treated as an official judging document.*

- Only nonperishable items used in the construction of the model.
- The model is clearly labeled with student name(s), grade, 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. The simulation is initiated by a team member and continues undisturbed to completion.
- A materials table is included with the model.

Model Science – The Human Heart 2016-2017
QUESTIONS FOR MODEL SCIENCE – THE HEART
2016 – 2017
High School (Grades 9th – 12th)

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 (Grades 9th – 12th)
2016 - 2017

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

Name & Grade: _____ Name & Grade: _____

School: _____ MESA Center: _____

Part I: Model Criteria/Materials Table

Size (3 points) _____
 Materials Table (0-5 points) _____

Subtotal for Part I (max 8 points) _____

Part II: Model Structures

Required Structures (28 points):

Structure	Present (0 - .5 point)	Correctly Labeled (0 - .5 point)	Realistic Depiction (0 – 1 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			

Additional Structures (6 points):

Structure	Present (0 - .5 point)	Correctly Labeled (0 - .5 point)	Realistic Depiction (0 – 1 points)

Subtotal for Part II (max 34 points) _____

Part III: Blood Flow Simulation

Blood Pathway	Points Awarded
Inferior and/or Superior Vena Cava → Right Atrium	5 points
Right Atrium → Right Ventricle	5 points
Right Ventricle → Lungs	5 points
Lungs → Left Atrium	5 points
Left Atrium → Left Ventricle	5 points
Left Ventricle → Aorta	5 points

Subtotal for Part III (max 30 points) _____

Part IV: Overall Creativity of Model

0 - 2 points each:

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 (max 8 points) _____

Part V: Human Heart Questions

0 - 3 points each:

Question 1: _____ Question 2: _____ Question 3: _____
 Question 4: _____ Question 5: _____

Subtotal for Part V (max 15 points) _____

Labeling Penalty - _____

Deduct 9.5 points if model and materials table is not clearly labeled with student name(s), grade, school and MESA center.

GRAND TOTAL _____

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

Maximum score is **95**

Tie Breaker Questions (ONLY IF NEEDED)

0 - 3 points each:

Question 1: _____ Question 2: _____ Question 3: _____
 Question 4: _____ Question 5: _____

Total including tie breakers _____

Judges: _____