MESA DAY CONTEST RULES 2025-2026
(DRAFT)

BIO BREAKTHROUGH

LEVEL: High School (HS)

DIVISION(S): Grades 9/10 and 11/12

COMPOSITION OF TEAM: 2-3 students per team

NUMBER OF TEAMS: Preliminary – Determined by your local MESA center
Regional – # of teams per division at the discretion of each region (Northern, Central, LA/Central Coast, and Southern)

SPONSORS: University of California San Francisco MESA College Prep
University of Southern California MESA College Prep

OVERVIEW: Changes, if any, from "DRAFT" rules are highlighted in "yellow." Did you know that by using CRISPR technologies, scientists are able to edit and create new DNA. CRISPR has been used to study and treat a wide variety of diseases. In this four-part competition, students will research, design, and present innovative ways to explore the potential of using CRISPR technology to solve real-world problems.

Watch: CRISPR Explained

RESOURCES: Bio Breakthrough 2025-26 Online Training Modules

SCIENCE JOURNAL: A science journal is a required component of this competition. The purpose of the Science Journal is not only to help guide students through some of the information surrounding the competition, but to also align with the process that scientists follow while completing research. MESA projects are not designed to be completed in a single class period or day, but to be the result of thoughtful research, planning, analysis and evaluation. Keeping a science journal throughout the process will help to keep a designer on track, using a logical progression of planning, in order to develop their project efficiently.

For the Science Journal, **electronic submissions will be required**. Teams should use an electronic portal/application such as Google Docs to keep and maintain a science journal. Access and permission to the science journal is then given to MESA Day staff and judges OR science journal is submitted electronically (e.g., PDF file) for review. **Please check with your local MESA center for the deadline and submission platform to submit your team's science journal for local events.**

See "HSBioBreakthrough_Science_Journal Template Google Doc 2025-26" at https://mesa.ucop.edu/.

- Purpose of Science Journal:
  - Record notes / research for quiz bowl
  - Verify guide RNA is correct (sequence)

MATERIALS: **For the Cas9 CRISPR Model:**

- All materials are legal with the exception of food, hazardous materials, or unsafe energy. The use of recycled and repurposed materials is highly encouraged.
- No kits allowed.

The Host Center will provide the following:

- Printouts of Quiz Bowl instructions given at proper time intervals
- Tables to set up physical models

GENERAL RULES FOR QUIZ BOWL + TRANSCRIPTION:

1) Students will be in their predetermined teams of 2-3 scientists. Teams will be given table space away from other teams. Each team should be assigned a number (or choose team names).
2) The Quiz Bowl and Transcription Competition rules will be announced by the judges. Both activities will occur simultaneously. Teams may choose which activity they want to complete first.
3) Teams will write their team number / name of team members, school site, MESA Center, and grade level on the given *Quiz Bowl Questions Handout*, as well as the *Transcription Competition Puzzle Handout.*
4) The quiz bowl consists of 10 questions. All questions will be given to each team and/or projected onto a screen. The transcription portion consists of 3 transcription puzzles. Once prompted, **students will have 60 minutes** to work within their team to record their answers. When students are ready, the start of the competition will be announced. Students may talk within their own teams, but not with other teams. After 60 minutes, judges will collect each team's handouts. The competition will consist of one timed round. Students must show each part of the process to be awarded points.
5) If a team completes both tasks in fewer than 60 minutes, they must raise their hand quietly and judges will come to collect their handouts. Once handouts have been collected, teams may not revise responses. Additionally, submission times will be recorded and used in the event of a tie-breaker to create an efficiency score.
6) Books, notes, or other resource materials may not be used on the day of the competition.
7) Cell phones, laptops, ipads, smart watches, or any other electronic devices are strictly prohibited.
8) Digital media (e.g., photos, video recordings, etc.) will not be accepted for judging purposes. **All judging decisions are final.**

GENERAL RULES FOR SCIENCE JOURNAL:

1) Teams will be required to submit a science journal with the following requirements:
   a) The students' full name, grade level, school name and MESA center must be clearly labeled/identified in the Science Journal. A 10% penalty in the score will be assessed for failing to properly label.

b) TRANSCRIPTION AND TRANSLATION: Describe the processes of transcription and translation:
   i) What is Transcription?
   ii) What is Translation?
   iii) What are the steps of transcription?
c) Basic CRISPR Knowledge: In two or three sentences, describe the following
   i) What is a CRISPR Cas9?
   ii) How does CRISPR edit genes?
d) **Transcription & Translation Puzzle:**
   i) Students must complete a guided transcription and translation puzzle including:
      (1) Identification of a DNA sequence edited by CRISPR
      (2) Transcription of the edited sequence into mRNA
      (3) Translation of mRNA into an amino acid sequence
      (4) Functional explanation of the resulting protein
         (a) Please refer to the Science Journal Template for puzzle
e) Define the following scientific terms:
   i) Gene editing
   ii) Guide RNA (gRNA)
   iii) Cas9 Protein

2) The science journal must be the original work of the students.

GENERAL RULES FOR MODEL:

1) The students' full name, grade level, school name, and MESA center must be clearly labeled on the model.
2) In order to be eligible to place in the Bio Breakthrough competition, teams **must** submit and present a physical Cas9 model. Teams without a physical model will not be eligible for placement regardless of performance in other sections.
3) Teams will explore how the use of CRISPR technology can help create a solution for a social issue impacting a particular community.
4) Teams must create a Cas9 model that demonstrates their knowledge of CRISPR.
   a) The design concept should address the following: using the principles of CRISPR, create a Cas9 model that will target a disease that impacts a community of your choice.
5) Only non-perishable items may be used for the Cas9 model. All materials are legal with the exception of food and hazardous materials.
6) The Cas9 model must have a **MINIMUM** width/length of 4 cm by 15 cm and a **MAXIMUM** width/length of 35 cm by 35 cm with a **HEIGHT** minimum of 9 cm and maximum height of 35cm. **Models that do not meet these size requirements will not receive points.**
7) The Cas9 model must have the following parts CLEARLY labeled and displayed on the model:
   a) **Cas9 Protein:** The enzyme that acts as molecular scissors.
   b) **Guide RNA (gRNA):** The RNA sequence that guides Cas9 to the specific DNA location.
   c) **Target DNA:** The DNA sequence to be edited.
   d) **PAM Sequence:** The short DNA sequence required for Cas9 binding.
   e) **Repair Template:** The DNA strand used for homology-directed repair.
8) Teams are not allowed to use kits for the Cas9 model.
9) The Cas9 model must be the original work of the students

GENERAL RULES FOR PRESENTATION:

1) Teams will explore how the use of CRISPR technology can help create a solution for a social issue impacting a particular community.
2) Teams must create a pre-recorded video presentation that demonstrates their knowledge of both CRISPR and the world. Presentations should emphasize how gene editing technologies like CRISPR may benefit or impact under-resourced communities.
3) Teams must submit presentations in advance of the competition day. **Please check with your local MESA center for the deadline and submission platform to submit your team's presentation for local events.**
4) Teams' video presentations should not exceed 5 minutes. The video should include information on the community impacted by the disease, the genetic mutation in question, and the impact of their proposed solution for the selected under-resourced community.
5) Models **MUST** be present and shown in the video in order for the team to be eligible to place. Teams that do not include a physical Cas9 model in the presentation will not be eligible for awards.
    a) Teams are encouraged to incorporate additional research into their video presentations, particularly regarding the potential impacts of medicine on marginalized communities. This may include potential negative consequences of CRISPR/gene editing.
    b) Videos longer than 10 minutes will be **stopped at the 10-minute mark**, and any content beyond that point will not be reviewed or scored by judges.
6) Teams should explain what part of the DNA needs to be fixed and how their Cas9 model will cut that section to help solve the problem
7) Teams should ensure that their presentation is engaging, clear, and well-organized.

QUIZ BOWL + TRANSCRIPTION JUDGING:

1) Judges will have the roles of proctors, time keepers, and material distributors.
    a) Quiz Bowl and Transcription Competitions can be proctored by one person if necessary.
2) Judges will announce start and end times, track submission times, and record scores.
3) During the quiz bowl and Transcription portion, judges will provide each team with all 10 quiz bowl questions and/or project them on a screen, as well as the 3 transcription puzzles simultaneously. Judges will collect completed handouts when teams indicate that they are finished, or when the 60 minute timer runs out.
4) Submission times will be recorded and used in the event of a tie.

SCORING:

1) Science Journal = Up to 25 points
2) CRISPR Cas9 Model = up to 25 points
3) Bio Breakthrough Presentation = Up to 40 points
4) Quiz Bowl + Transcription = up to 85 points
    a) Quiz Bowl = up to 40 points (4 points for each correct answer)
    b) Transcription = up to 45 points (15 points for each correct answer)
5) The team with the most cumulative points after all rounds are completed wins.
6) Tie-Breaker: in the event of a tie, the highest Quiz Bowl + Transcription Efficiency score (# correct points / submission time) will be the winner.

AWARDS:

- Awards will be given per division: Grades 9/10 and Grades 11/12.
- Medals will be awarded for 1st, 2nd, and 3rd place.

- Ribbons will be awarded for Creative Model Design.
- Only teams that place in Overall Score will advance to Regional MESA Day; please check with your MESA center to determine the number of teams that advance to Regional MESA Day.

ATTACHMENTS/APPENDIX:

- Bio Breakthrough Resource Library
    - includes the Science Journal template, codon chart, transcription and translation practice activities, judge guide, and updated scoring rubric to support student preparation and judge calibration
- Next Generation Science Standard
- Cas9 Labeling Example
- Score Sheet for Bio Breakthrough

Next Generation Science Standard

The specific Next Generation Science Standard link this competition covers is below:

- HS-LS1-1 From Molecules to Organisms: Structures and Processes
    - Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins, which carry out the essential functions of life through systems of specialized cells. [Assessment Boundary: Assessment does not include identification of specific cell or tissue types, whole body systems, specific protein structures and functions, or the biochemistry of protein synthesis.]

Science Concept Resource (Key topics to cover:)

- DNA bases, and which pair together
- RNA bases, and which pair together
- DNA to RNA: “transcription”, and base complementarity
- Start codons
- Stop codons
- RNA to proteins: “translation”
- Amino acids (building blocks of proteins) - names and abbreviations
- Nucleases, specifically the Cas9 nuclease involved in CRISPR
- Cas9 PAM sequence
- Chemical & functional differences between DNA RNA
- Uracil vs. Thymine - Usage differences: single strand (ss) vs. double strand (ds)

Additional related information:

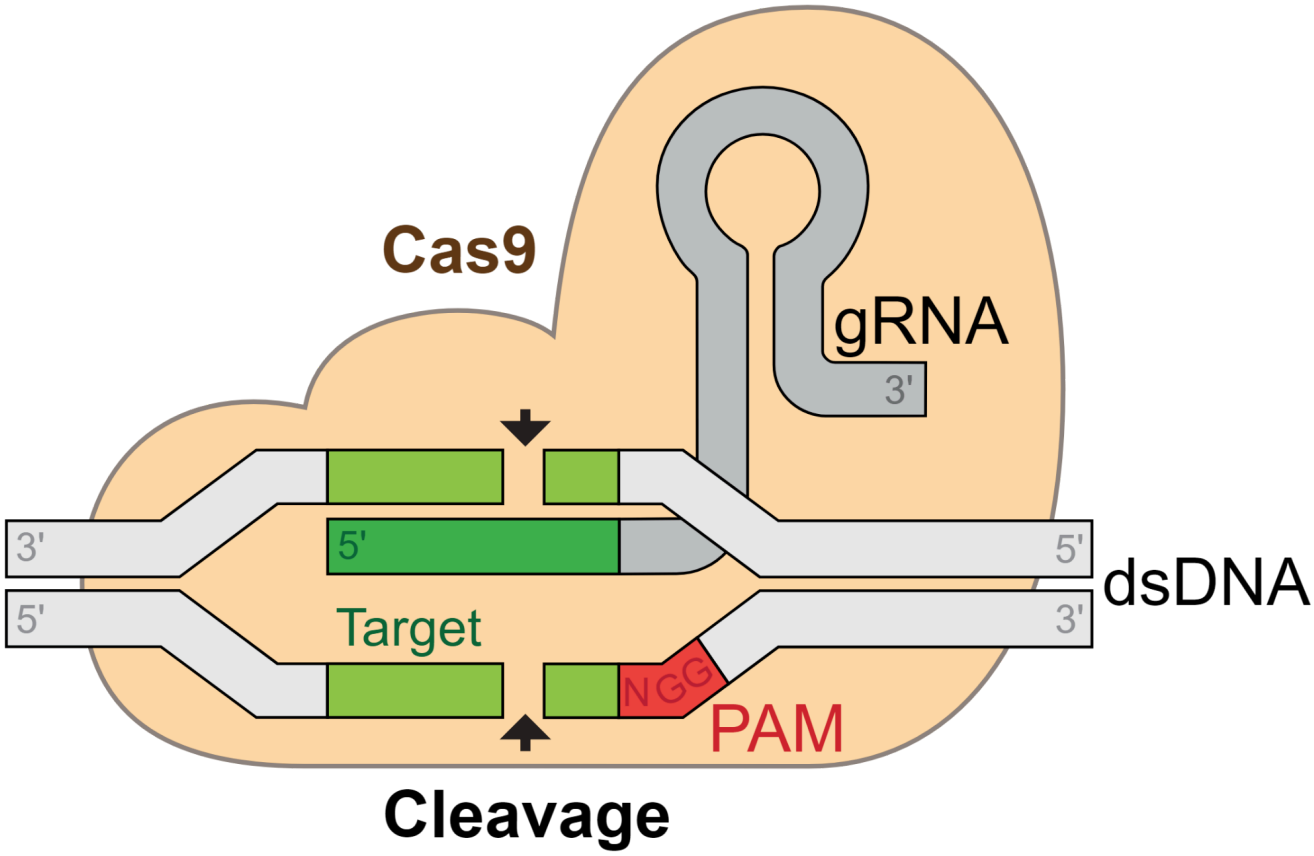
- RNA polymerase
- 5’ to 3’ replication
- Types of DNA mutations: point, frame-shift, missense, silent, etc
- Recombinant DNA
- Plasmids
- Cloning vectors
- Restriction enzymes

Vocabulary

- Genetic code
- Nucleotide
- Nucleoside
- Adenine
- Guanine
- Cytosine
- Thymine
- Uracil

Cas9 Labeling Example: Image of a CRISPR Cas9

This picture functions as a reference for labeling Cas9 models.



Bio Breakthrough Checklist

This checklist is provided **ONLY** as a reference for teams to "pre-inspect" their Bio Breakthrough Science Journal, Model, Presentation, and Quizbow readiness to ensure they meet the rules specifications. Teams may check-off each of the following items after comparing their competition-ready Bio Breakthrough materials with the rules. **This checklist will NOT be used by judges.**

General

- ☐ 2025-2026 rules are used.

Science Journal

- ☐ All sections are complete
- ☐ Journal includes solved example and completed practice puzzle
- ☐ Properly labeled with full names, grade level, school, and MESA Center

Cas9 Model

- ☐ Physical model meets size requirements (4 cm x 15 cm x 9 cm min; 35 cm x35 cm x 35 cm max) - See General Rules for Model # 5.
- ☐ Clearly labeled with:
    - Cas9 Protein
    - gRNA
    - PAM Sequence
    - Target DNA
    - Repair Template
- ☐ Properly labeled with full names, grade level, school, and MESA Center

Video Presentation

- ☐ Submitted on time
- ☐ Under 5 minutes
- ☐ Includes physical model and a visual aid
- ☐ Explains the mutation, community impact, and CRISPR solution

Quiz Bowl + Transcription

- ☐ 2–3 teammates ready for the 60-minute timed round
- ☐ No outside materials used
- ☐ All answers and transcription steps written clearly
- ☐ Team names, grade level, school, and MESA Center written on handouts

SCORE SHEET FOR BIO BREAKTHROUGH

High School - Grade 9/10 and Grades 11/12

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

Student Names: _____. Grade: **9/10** or **11/12** (circle one)

SCHOOL:_____ HS CENTER:_____

SCIENCE JOURNAL					TOTAL
Transcription Definition ____/5	Translation Definition _____/5	Transcription Puzzle Solved ____/5	CRISPR Defined ____/5	Gene Editing Defined _____/5	____/25*

Cas9 MODEL RUBRIC						TOTAL
MODEL LABELING	Cas9 Protein ___/5	Guide RNA ___/5	Target DNA ___/5	PAM Sequence ___/5	Repair Template ___/5	___/25*

If the model does not meet size requirements, 0 points will be awarded for the model.

BIO BREAKTHROUGH PRESENTATION CRITERIA	Excellent (4 points)	Good (3 points)	Fair (2 points)	Needs Improvement (1 point)	Not Present (0 points)
Introduction and Framing					
Community Context: Clearly introduces the disease and its relevance to an underserved community.	4	3	2	1	0
CRISPR Purpose: Explains what the CRISPR-based solution aims to change or improve in that community.	4	3	2	1	0
Scientific Understanding					
Basic Understanding: Provides a general explanation of how CRISPR works, avoiding heavy technical jargon	4	3	2	1	0
Ethical Awareness: Acknowledges relevant ethical, social, or medical concerns around gene editing	4	3	2	1	0
Community Relevance and Impact					
Impact Explanation: Describes how the disease/problem specifically affects the chosen community.	4	3	2	1	0
Equity Lens: Shows how the solution could reduce health disparities or improve access to care/resources.	4	3	2	1	0
Model and Visual Communication					
Model Design: Represents key parts of the CRISPR concept with creativity and clarity	4	3	2	1	0
Model Explanation: Students clearly explain what the model shows and how it its functions	4	3	2	1	0
Presentation Skills					
Clarity and Engagement: Students speak clearly and confidently; the presentation is easy to follow and engaging	4	3	2	1	0
Collaboration: All group members contribute meaningfully to the presentation.	4	3	2	1	0
COLUMN TOTALS:					
PRESENTATION SCORE:					____ /40
TOTAL SCORE: *(BIO BREAKTHROUGH MINUS TIME DEDUCTION)*					_____

QUIZ BOWL QUESTION SET RUBRIC		
Question 1:	/ 4 pt	
Question 2:	/ 4 pts	
Question 3:	/ 4 pts	
Question 4:	/ 4 pts	
Question 5:	/ 4 pts	
Question 6:	/ 4 pts	
Question 7:	/ 4 pts	
Question 8:	/ 4 pts	
Question 9:	/ 4 pts	
Question 10:	/ 4 pts	
TRANSCRIPTION SET RUBRIC		
Transcription (15 points per puzzle):	**/ 45 pts**	
Recorded Time For Quiz Bowl + Transcription (/ 60 min)		
TOTAL Question Set + Transcription Transcription (max of 85 pts)		

OVERALL SCORE
SCIENCE JOURNAL TOTAL(X/25):___/**25**
SCIENCE JOURNAL LABELING DEDUCTION(-10%): YES/NO:
Science Journal SUBTOTAL: _____.
Cas9 MODEL SCORE (X/25):____/**25**
MODEL LABELING DEDUCTION(-10%): YES/NO:
Model SUBTOTAL: _____.
PRESENTATION TOTAL:_____/40
QUIZ BOWL QUESTION SET TOTAL(X/85 POINTS): _____/85
OVERALL SCORE = science journal + model + question set + presentation (X/175 POINTS): _____/**175**

Science Journal Submitted: ☐ Yes ☐ No **Cas9 Model Submitted:** ☐ Yes ☐ No

Teams who do not submit a Science Journal or a Cas9 Model will NOT be eligible for any awards.