



Official Handbook

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I. Background

How to build a Chain Reaction Contraption

You are challenged to build your own Chain Reaction Contraption. A Chain Reaction Contraption accomplishes a simple task in a unique way. It is your mission to construct a contraption that uses multiple steps to complete an assigned task, which varies from year to year.

The majority of the steps should apply general laws of physics, relying on kinetic and potential energy, gravity, centripetal or centrifugal forces, etc. to complete the task. Teams are encouraged to use as many mechanical principles in their design as possible.

Your contraption may take some time to put together. Many contraptions undergo a couple months of strategy and planning; others are put together in a few days. Each team plans its contraption's construction in its own way. Some teams try to plan their whole design before starting to build it; others just start building and see what evolves. Maybe the best way is to use a little of each approach.

The materials you use are the most important components of the contraption. See what you have around the house; raid your old toy chest, pick up odds and ends from broken appliances. A good contraption connects everyday devices and objects and uses them in unconventional ways. Anything goes when you are building a Chain Reaction Contraption. Follow the adage "Nothing is impossible if you try." Your imagination is your only limit.

Your contraption should also have a theme. Come up with your own weird and wacky or fun theme when you design your contraption. Try to use objects and steps that conform to your theme. Keep in mind that your theme should be apparent in how you design the steps and in how you make them work together to accomplish the task. Costumes, cheers, jokes, music, acting, etc. that align with the theme of the contraption are encouraged.

Each team may wish to seek the assistance of a mentor along with the help of a teacher. This mentor should be a technical professional, preferably with an engineering or science background. The mentor's role is to provide technical advice, guidance and support whenever it may be needed. The mentor is not to make decisions regarding the contraption or direct the team's work. The assistance of a mentor is strongly recommended, but no penalty applies for the absence of a mentor.

II. 2023-24 Contest Information

This Year's Challenge:

Score!

Important Dates:

December 29, 2023	Registration Deadline
January 5, 2024	Conceptual Design Proposal Deadline
January 12, 2024	Media Release Form Deadline
January 19, 2024	Progress Report #1 Deadline
February 2, 2024	Progress Report #2 (Photo) Deadline
February 9, 2024	Progress Report #3 (Video) Deadline
February 16, 2024	Final Submittals Deadline
February 23, 2024	Contest Day @ Westinghouse Cranberry Woods HQ

Notes:

1. All deliverables are preferred to be submitted via email (chainreactioncontest@westinghouse.com). Any alternate submission processes (e.g. web page submittal) developed for the contest will be communicated to the teams as they are available.

III. Contest Outline

1. Deliverables

a. Conceptual Design Proposal

The conceptual design proposal contains an illustrative drawing or drawings of your ideas for your contraption. The contraption (as complete on contest day) does not have to match the drawing(s) that you create. The proposal should contain high level information on how the contraption will accomplish the task but does not need detail on each individual step.

b. Media Release Forms

A media release form must be submitted for all participants in the contest. This includes any students, teachers or mentors involved. The media release form must be provided for each individual that participates regardless of whether that individual appears in a video submission or participates in any live video or audio session.

c. Progress Reports

Three progress reports are required. Each report shall include a description of changes since the previous report. Each report should include information on steps that gave the team trouble, ideas that did not work, and improvements to the reliability of the contraption. Any innovative scientific or engineering applications should also be highlighted. The 2nd report shall include a picture or two of the contraption's evolution. The 3rd report shall include a video.

The video shall be made in one continuous and unedited recording of the team completing the verbal presentation and the contraption operation (including both runs, the reset, and any restart as needed). The video shall be made as if the team was being judged in person (see Section III-2) and shall not include additional times to describe or show the contraption outside of the verbal presentation and contraption operations. The measurement of the contraption shall be incorporated into the verbal presentation.

d. Final Submittals

A list of contraption steps, % of recycled/scavenged materials, and two pictures of the contraption (one of just the contraption and one with the entire team and the contraption) are required to be submitted as well. This information shall match the contraption as it appears in the video progress report.

e. Submitting Forms

All forms (see Appendix A) should be emailed to chainreactioncontest@westinghouse.com. Forms may be faxed or mailed if email is unavailable. Forms received on or before the due date (see Section II) will receive full credit. Forms that are received after the due date, but before the next deliverable due date will receive partial credit. Forms received after the next deliverable due date will receive no credit. The school name shall be included on every page or picture submitted. Any form that is incomplete, or does not accompany the deliverable, will not receive credit.

NOTE: Final Submittals will not receive any credit if received late.

2. Judging

a. Verbal Presentation

Each team of students will have a maximum of 5 minutes to introduce themselves and explain their Chain Reaction Contraption prior to running the contraption. Students should incorporate responses to several of the Sample Judges' Questions, which are included in Score Sheet 1, into their verbal presentation. Scoring for the verbal presentation will be in accordance with Score Sheet 1 in Appendix B.

b. Contraption Operation

The students shall run the contraption and indicate to the judges when the contraption is complete. If a human intervention or restart is required, the students shall indicate as such. Once the contraption operation is complete, the students shall reset the contraption. Students shall indicate when the reset is complete, and the contraption is ready to run again. The students shall run the contraption a second time, again indicating when the contraption is complete. Scoring for the contraption operation will be in accordance with Score Sheet 2 in Appendix B.

The Chain Reaction Contraption judges will be responsible for scoring the verbal presentations and contraption operation. Oversight will be provided by the Chain Reaction Contraption Judging Committee. The Judging Committee may consult with judging teams to resolve disputes and to clarify rules and specifications of the Chain Reaction Contraption Handbook. The decisions of the Judging Committee are final.

c. Rounds

The contest will consist of a preliminary and a final round. All teams will compete in the preliminary round. All teams will be randomly split into groups of schools for preliminary round judging. Each group will be judged by a separate judging team. All scores as described in Section III-3 below will be included in the preliminary round judging to determine the team's score.

8 teams will be included in the final round. The top-scoring team from each preliminary round group will advance to the final round and any remaining slots will be filled by the highest remaining total scores from the preliminary round. The final round will include an interactive session between the students and the judges. The format and expectations for this session will be communicated to the teams. Pre-contest and preliminary round scores will not be part of the final round scores.

d. Awards

Prizes, including a trophy for the school, will be awarded to the top three teams, based on final round scores. All teams competing on contest day are eligible for numerous Special Awards. Special Awards judging (e.g., Best Use of Gravity, Best Presentation) and Operations judging will be done by separate teams of judges.

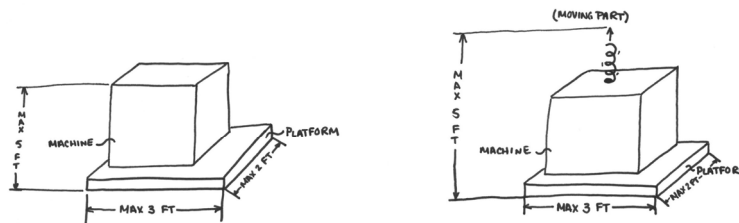
3. Scoring

Point Summary		
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3.	Progress Reports	
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	Progress Report 2 (Photo)	4
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4.	Final Submittals	4
5.	Verbal Presentation	20
6.	Contraption Operation	120
Total Points Possible		170

Penalty Deductions	
Human intervention during contraption operation	3 points
Requiring human intervention delays to meet minimum run time	5 points
Restarting a contraption	5 points
Unintentional loose or flying object outside the set boundaries of the contraption	2 points
Intentional loose or flying object outside the set boundaries of the contraption	Disqualification
Unsafe contraption	Disqualification
Exceeding the dimensional limits	10 points
Coaching by a team's teacher, mentor, parent, etc. during verbal presentation, contraption operation or interactive session	10 points
Unsportsmanlike conduct by team members or guests	20 points
Damaging another team's contraption	Disqualification

IV. Rules

- Judging will be based on the rules, specifications and scoring as defined in this handbook.
- The judges will inspect the contraption, deem it safe, and assess any rules infractions. All decisions made by the Judging Committee are final.
- The finished contraption shall, at maximum, have dimensions of 2 feet by 3 feet by 5 feet. This means that the entire contraption, including while operating, shall fit and remain completely within an imaginary box whose dimensions are 2 feet by 3 feet by 5 feet. The platform will be included in the contraption's dimensions. No decorations or additions outside the boundaries of the contraption are allowed during any part of the contest. The visual depictions below are examples on how to measure only and may not reflect the actual size requirements of this year's contest.



- The contraption must complete the challenge in 20 steps or more. A step is defined as an action that results in another action working towards the final goal of the contraption. For example, the act of tipping over a block of wood with a rolling ball is a step. The actual tipping motion of the block is not a step unless it causes another action to occur. A series of the same actions repeated (such as dominoes knocking each other over or a ball hitting another ball) are one step.
- Each step shall be marked (numbered or lettered consecutively) on the contraption and a written summary of each step shall be provided as part of the contest day submittals.
- The team must be able to run its contraption completely through its steps once, reset it and run it completely through its steps again. A complete run of the contraption through its steps once should take at least 30 seconds and at most 2 minutes. The reset can take 4 minutes at most. The team shall identify the contraption's final step to the judges during the verbal presentation to avoid confusion during the contraption operation.
- Human intervention will not be allowed once the contraption is in motion unless the contraption is stalled and requires assistance. At most, one human intervention will be assessed for each step of the contraption that requires a team member to intervene to complete the step in a given run.
- A restart is defined as a team member telling the judges that they will be discontinuing the contraption's operation, resetting the contraption and then rerunning it. The restart must be called by a team member before the contraption completes its final step and can only be called while the contraption is stalled. Once the final step has been completed, the contraption run is deemed final and no restart may be taken.
- If the team calls a restart, any interventions that occurred during the stalled run will not be penalized because the stalled run will be replaced by the restart run. Any interventions that occur after the restart will be penalized. Only 1 restart will be allowed per run during the contest.

- Any contraption that is determined by the judges to require the delays associated with the use of human interventions in order to meet the 30 second minimum time limit will be penalized.
- Any loose or flying objects must remain within the set boundaries of the contraption. If a loose or flying object intentionally exceeds the set boundaries of the contraption, the contraption will be disqualified for safety reasons.
- Live animals and plug-in electrical appliances are not permitted. Combustible fluids, explosives, open flames, or hazardous materials are not permitted.
- The contraption must not imply profane, indecent, or lewd expressions.
- Intentional destructive action against another contraption is cause for disqualification.
- Each school may register 1 additional team for the contest, for a maximum of 2 teams per school. An individual student may only participate on 1 contraption team. The number of these additional registered teams that can participate on contest day will be determined based on available space in the contest venue. If necessary, these available spaces will be determined by random selection of registered additional teams. Only 1 team per school can compete in the final round of the contest. In the case that both teams from a school meet the qualifications for the finals, the team with the highest preliminary round score will move on.
- Teams from conventional high schools, charter schools, technical schools and home schools may all participate. If necessary, the team may be made by combining students across multiple charter and/or home schools. Each participating home or charter school MUST provide proof of its certification.
- The contest will NOT be postponed due to inclement weather.
- Teachers, mentors, and spectators shall not coach or ask questions of the team in the presence of the judges. Anyone asking questions of the team or interacting with the team during the video or during an interactive session will incur penalties for the team.

Appendix A: Forms

Registration Form

Please print or type. Up to 2 teams per school may register for the contest. Complete a registration form for each team.

School Name _____
(Full name as it should appear in the program book)

Teacher's Name _____

Estimate number of students who will participate on this team _____

Does your school receive Title 1 funding (> 30% of low income families)? ____ Yes ____ No

School Address _____

School City _____ State _____ Zip _____

County _____

Best Phone Number to contact _____

Best Email to contact _____

Other email or phone number? _____

Student Team Leader(s) Name _____
(This student(s) will be added to our email CRCC distribution list)

Student Team Leader(s) Email _____

MENTOR IS OPTIONAL

Our team has a mentor. Please add to CRCC distribution list.

Mentor's Name _____

Company Name _____

Best Phone Number to contact _____

Best Email to contact _____

Conceptual Design Form

This form must accompany the team's design to receive credit. Put the school name on any pages accompanying this form to receive credit. Please print or type.

Contraption Name:			
School Name:			
# of Students Involved:			
Teacher's Name:		Email:	
School Address:			
School Phone:		School Fax:	
Student Team Leader(s)(TL):			
Student TL Email(s):			
Mentor (Optional)	Name:	Email:	
Short description of design concept: (i.e. theme, innovative scientific/engineering applications, key step ideas, expected challenges, risks, etc.)			

Media Release Form

I grant permission to Westinghouse Electric Company LLC (WEC) to use, reproduce and/or publish photographs, video footage, audio recordings, and/or reports submitted during my participation in the 2023-24 Chain Reaction Contraption Contest (CRCC) activities. This will include, but is not limited to: orientation, contest day, and National Engineers Week events.

The items above, and the information below, will solely be used for the following purposes: 1) the promotion of WEC and its programs (e.g., catalogs, magazine, websites, video, text panels, etc.), 2) to study the impact of the program on interest and careers in science and engineering (which may include contacting you in the future), and 3) to engage past participants in future contests. The use of these materials and information is strictly limited to WEC. The materials and information will not be sold, reproduced for sale in any form, or provided to any 3rd party.

Activity:	2023-24 Chain Reaction Contraption Contest			
School Name:				
Team Member Information				
Name:			Age:	
Address:				
City/State/Zip:				
Phone:			Email:	
If 18 or older,	Signature:			
If under 18,	Parent/Guardian Name:			
	Parent/Guardian Signature:			
Demographic Information				
Note: All information in this section is optional and is used solely to understand the impact and reach of the CRCC. The responses will in no way have any impact on decisions related to judging.				
Gender:	Male	Female	Other	Prefer not to answer
Ethnicity:	Asian/Pacific Islander		Black or African	
	Hispanic or Latino		Native American/American Indian	
	White/Caucasian			
	Other: _____		Prefer not to answer	
How many years have you participated in this contest?			1	2
			3	4
Are you considering a career in STEM?	No	Possibly	Probably	Absolutely

Progress Report 1 Form

This form must accompany the report of your contraption to receive credit. Put your school name on any pages accompanying this form to receive credit. Please print or type.

Contraption Name:			
School Name:			
# of Students Involved:			
Teacher's Name:		Email:	
School Address:			
School Phone:		School Fax:	
Student Team Leader(s)(TL):			
Student TL Email(s):			
Mentor (Optional)	Name:	Email:	
Summary of activity: (i.e. changes in status, information on steps that gave the team trouble, ideas that did not work, improvements to the reliability, innovative scientific/engineering applications.			

Progress Report 2 (Photo) Form

This form must accompany the photos of your contraption to receive credit. Put your school name on any photos or pages accompanying this form to receive credit. Please print or type.

Contraption Name:			
School Name:			
# of Students Involved:			
Teacher's Name:		Email:	
School Address:			
School Phone:		School Fax:	
Student Team Leader(s)(TL):			
Student TL Email(s):			
Mentor (Optional)	Name:	Email:	
Summary of activity since last report: (i.e. changes in status, information on steps that gave the team trouble, ideas that did not work, improvements to the reliability, innovative scientific/engineering applications.			

Progress Report 3 (Video) Form

This form must accompany the video of your contraption to receive credit. Put your school name on pages accompanying this form to receive credit. Please print or type.

Contraption Name:			
School Name:			
# of Students Involved:			
Teacher's Name:		Email:	
School Address:			
School Phone:		School Fax:	
Student Team Leader(s)(TL):			
Student TL Email(s):			
Mentor (Optional)	Name:	Email:	
Summary of activity since last report: (i.e. changes in status, information on steps that gave the team trouble, ideas that did not work, improvements to the reliability, innovative scientific/engineering applications.			

Final Submittals Form

Contraption Name:	
School Name:	
<i>Final Contraption Steps</i>	
Step 1.	
Step 2.	
Step 3.	
Step 4.	
Step 5.	
Step 6.	
Step 7.	
Step 8.	
Step 9.	
Step 10.	
Step 11.	
Step 12.	
Step 13.	
Step 14.	
Step 15.	
Step 16.	
Step 17.	
Step 18.	
Step 19.	
Step 20.	
Step 21.	
Step 22.	
Step 23.	
Step 24.	
Step 25.	
To list more steps, please attach additional sheet(s).	
<i>Final Contraption Materials</i>	
% of materials in contraption that are recycled or scavenged:	
<i>Final Contraption Photograph</i>	
Include photographs of the contraption and the team with the contraption.	

Appendix B: Score Sheets

Score Sheet 1 – Verbal Presentation

Sample Judges' Questions

- 1) What math/science/engineering principles did you learn about and apply in building the contraption? Did you do any calculations to support your work?
- 2) How would you make your contraption more reliable and efficient?
- 3) Did all members contribute to the overall completion of the contraption?
- 4) What steps gave you the most trouble? How did you overcome the challenges?
- 5) Were there any ideas you tried that you could not get to work?

Presentation Score Sheet		
1.	Knowledge How well did the students describe the principles used in, and answer questions about, their contraption? (Judges enter a score anywhere between 0 and 5 points. Guidelines: Excellent is 5 points; Good is 3 points; Poor is 0 points.)	
2.	Cooperation How well did the students work as a team? (Judges enter a score anywhere between 0 and 5 points. Guidelines: Excellent is 5 points; Good is 3 points; Poor is 0 points.)	
3.	Overall Presentation How well did the students present their contraption to the judges? (Judges enter a score anywhere between 0 and 10 points. Guidelines: Excellent is 10 points; Very Good is 7 points; Good is 4 points; Poor is 0 points.)	
Total Presentation Score (0-20 points)		

Score Sheet 2 – Contraption Operation (Page 1 of 2)

Contraption steps:			
4.	How many steps does the contraption have? (Lead Judge enters number of steps. Each step equals 1 point up to a maximum of 20 points.)		
5.	Are the steps labeled on the contraption? (Lead Judge circles Y (yes) or N (no). Y = 5 points; N = 0 points.)	Y	N
First Run Time:			
6.	Minimum Run Time – Did the contraption operation complete in 30 seconds or more? (Lead Judge enters Y (yes) or N (no). Y = 5 points; N = 0 points.)	Y	N
7.	Maximum Run Time – Did the contraption operation complete in less than 2 minutes? (Lead Judge enters Y (yes) or N (no). Y = 5 points; N = 0 points.)	Y	N
12.	Did the reset complete in 4 minutes or less? (Lead Judge enters Y (yes) or N (no). Y = 5 points; N = 0 points.)	Y	N
Second Run Time:			
8.	Minimum Run Time – Did the contraption operation complete in 30 seconds or more? (Lead Judge enters Y (yes) or N (no). Y = 5 points; N = 0 points.)	Y	N
9.	Maximum Run Time – Did the contraption operation complete in less than 2 minutes? (Lead Judge enters Y (yes) or N (no). Y = 5 points; N = 0 points.)	Y	N
Deductions:		1st run	2nd run
10.	How many human interventions occurred? (Lead Judge enters number of interventions. 3-point deduction per intervention.)		
11.	How many restarts occurred? (Lead Judge enters number of restarts. 5-point deduction per restart.)		
13.	Did a loose or flying object unintentionally leave the set boundary of the contraption? (Lead Judge enters Y (yes) or N (no). Y = 2-point deduction; N = no deduction.)	Y	N
14.	Did the contraption require human intervention delays to meet the 30-second minimum run time? (Lead Judge enters Y (yes) or N (no). Y = 5-point deduction; N = no deduction.)	Y	N
15.	Did a teacher, mentor, parent, etc. provide coaching during the run or presentation? (Lead Judge enters Y (yes) or N (no). Y = 10-point deduction; N = no deduction.)	Y	N
Sub-Total 1 Contraption Operation (0-50 points)			

Score Sheet 2 – Contraption Operation (Page 2 of 2)

Diversity of steps		Question 16 is worth a maximum of 10 points.
16.	How well does the contraption incorporate diverse types of steps and energy sources to accomplish the task. (Judges enter a score anywhere between 0 and 10 points. Guidelines: 0 points for no diversity in steps or a single energy source; 5 points for some diversity, but repetitive steps; 10 points for very diverse steps and multiple energy sources.)	
Variety of building materials		Question 17 is worth a maximum of 10 points.
17.	How much of the contraption consists of used recycled/scavenged materials rather than new donated/purchased materials? (Judges enter a score anywhere between 0 and 10 points. Guidelines: 0 points if no items are used/recycled; 5 points if half the items are used/recycled; 10 points if all items are used/recycled.)	
Theme of contraption		Question 18 is worth a maximum of 5 points.
18.	How well is a centralized theme incorporated within the contraption? (Judges enter a score anywhere between 0 and 5 points. Guidelines: 0 points for no centralized theme; 5 points for a well-developed and well-executed centralized theme.)	
Efficiency of reset		Question 19 is worth a maximum of 5 points.
19.	How efficiently is the contraption reset and how well does the team work together to reset the contraption? (Judges enter a score anywhere between 0 and 5 points. Guidelines: 0 points is for an inefficient reset with no teamwork; 5 points is for a very efficient reset with coordinated teamwork.)	
Successful completion of task		Questions 20 and 21 are worth a maximum of 25 points.
20.	How well does the contraption complete the requirements of the task? (Judges enter a score between 0 and 15 points. Guidelines: 0 points if the task was completed poorly or unsuccessfully; 15 points if the task was completed extraordinarily well.)	
21.	How unique and creative is the approach to achieving the task? (Judges enter a score anywhere between 0 and 10 points. Guidelines: 0 points if approach to achieving the task is not unique or creative at all; 10 points if the approach to achieving the task is very unique and creative.)	
Application of engineering in design		Question 22 is worth a maximum of 15 points.
22.	How advanced is the engineering design of the contraption? (Judges enter a score anywhere between 0 and 15 points. Guidelines: 0 points if the contraption did not use engineering design principles; 15 points if sophisticated engineering design principles were used.)	
Sub-Total 2 Contraption Operation (0-70 points)		

Score Sheet 3 – Judges' Comments

What did this team do well?

In what areas could this team improve?

General Comments: