

# Engineering Design Challenge – Divisional Competition 2019

Thank you to the ConocoPhillips team  
for creating the  
2019 Engineering Design Challenge.



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# Engineering Design Challenge – Divisional Competition 2019

Find your team.



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- Find your team number (on the wall).
- If all 6 team members are present, pick up your team number sign and sit together.
- Everyone else stay by your team number and wait for instructions.



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## Today's Challenge:

Design a channel to transport bbs (representing fluids) across the landscape placed at your work station.

Your design will be judged by how many bbs you are able to transport

- within 30 seconds
- with no spills
- for the least amount of money.



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## Channel Design



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Channels transport fluids (water, oil, and gas) across varied, rugged landscapes.



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In the 1970s, ConocoPhillips teams designed and built a channel to carry oil from Alaska to the Pacific Shore.

<https://www.youtube.com/watch?v=WmO6loYsm4Q>



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A more recent project is the on the Alaskan North Slope, designed and built in collaboration with the local community.

<https://www.youtube.com/watch?v=00oZmYKhyD8>



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# The Landscape

Each team will have a landscape board to work on.

You must construct the mountain from the parts provided, and accurately place it on the circle near the middle of your landscape. The mountain and the landscape board may not be altered or moved.

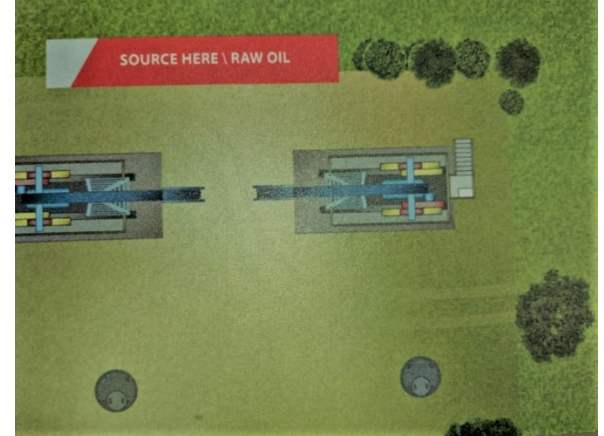


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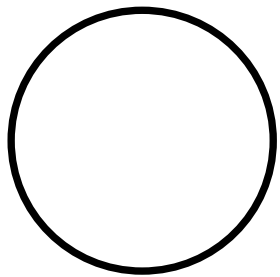
# Requirements

- BBs must move from the entry area to the collection area on the landscape board, through the team-designed channel.
- Your channel must stay within the board perimeter.

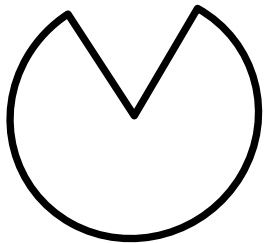


# Requirements

- All sections of the channel must be ‘covered’, and not have any open sections.



Covered Channel



Open Channel



# Requirements

- Only materials that are provided may be used for construction.
- Materials that are intact and not altered may be returned at judging for points (cost savings).
- The 10 bbs included with the materials are for testing while building and must be returned to the judges. There will be a penalty for any lost bbs.
- Judges will provide 60 mL of bbs in a plastic cup for judging and scoring the channel.

# Requirements

- The bbs must move because of gravity (flow from higher to lower levels) and will need to move from the entry zone to the collection zone within 30 seconds.
- You will have 60 minutes to design, build, and test your covered channel that will be used to transport the bbs across the landscape.

# Requirements

- The bbs must enter your channel in the loading area, without any spills.
- Team members and judges may not touch the channel when pouring bbs into the channel.
- The bbs must travel through the channel and be collected in the collection area without any spills.
- The ‘collection Ziploc bag’ must be used to collect the bbs in the collection area at testing and judging.



# Requirements

Your team will be asked to make a presentation discussing the design and economic choices you made and how those decisions impacted your channel.

These will be the ‘back of the envelope’ calculations you make as you design the channel.



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# Scoring

Total Score = Design Score  
+ Presentation Score  
+ Performance Score



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# Scoring

Points will be awarded based on design, presentation and performance. These are outlined on the SCORING SHEET.

Pay close attention to all point values on SCORING SHEET.

Fill out team number, channel name and team member information.



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# Scoring: Design

Pay attention to Design point values:

Design	Point Allocation	
Channel has a name marked on landscape	Yes (+10)	No (0)
Team number is marked on landscape	Yes (+10)	No (0)
Mountain is assembled, placed in accurate location and not altered	Yes (+10)	No (-50)
Entire channel is covered	Yes (0)	No (-30)
Fluid enters channel within entry zone	Yes (0)	No (-100)
Fluid leaves channel within collection circle	Yes (0)	No (-100)
Channel stays within board perimeter	Yes (0)	No (-100)
Channel has support structures in water	Yes (-100)	No (0)
Channel crosses protected lands	Yes (-30)	No (0)
Channel has support structures in protected lands	Yes (-75)	No (0)

# Scoring: Presentation

Pay attention to Presentation point values:

PRESENTATION					
Strategy to maximize points earned	2	4	6	8	10
Explain engineering challenges and design choices	2	4	6	8	10
Team works well together	2	4	6	8	10
Design	2	4	6	8	10
Paperwork is complete	2	4	6	8	10

# Scoring: Performance

Pay attention to Performance point values:

<b>PERFORMANCE</b>		
Operations engineer touches channel while pouring bbs during judging	Yes (-50)	No (0)
Environmental engineer uses small baggie to collect all bbs that are moving through the channel at testing.	Yes (+10)	No (-50)

40 – 60 ml of fluid collected (200 points)	20 – 40 ml of fluid collected (100 points)	0 – 20 ml of fluid collected (50 points)
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No fluid spilled (50 points)	Some fluid spilled during judging at entry zone, collection circle or along the channel (-50 points)
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# Scoring Summary

## Get points by:

- Returning unused materials
- Amount of fluid transported
- Complete documentation
- Creative design and teamwork

## Lose points by:

- Poor use of materials
- Spilling fluid (bbs)
- Not paying attention to costs on landscape
- Incomplete documentation
- Not working together



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# Scoring: Analysis

## A back of the envelope calculation is:

- a rough calculation, typically jotted down on a scrap of paper. It is more than a guess but less than an accurate calculation.
- a critical engineering design tool that requires input from the entire engineering team to be successful.
- used in ANY design with more than one course of action, no matter the size.
- used to balance scope-time-cost.



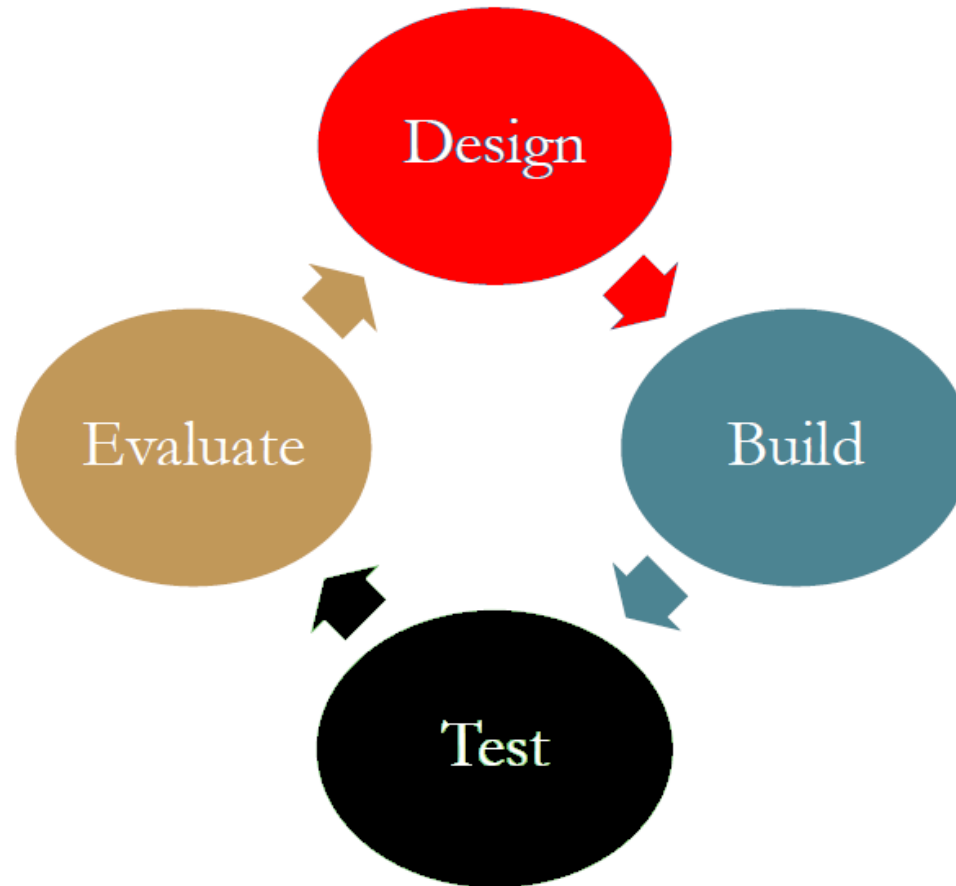
# Scoring: Analysis

Back of the envelope calculations are invaluable when striking a balance between cost, quality and time.



Your team must figure out which trade-offs are ideal.

# Engineering Design Process



# Project Plan

You will have **60 minutes** to design, build and test your project.

Suggested Schedule:

- Discuss and design: 10 minutes
- Build: 30 minutes
- Test and refine: 20 minutes



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# Project Plan

- Test your design as you build to make sure the channel is stable and the fluid travels through easily. The combined weight of the bbs needs to be considered in building your supports.
- Divide and conquer, allow team members to work on different parts of the design.
- Be creative. There are many different ways to build a winning channel.
- Follow the Engineering Design Process as you work on this challenge.



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# Teams and Supplies

- Each team is given the same set of instructions and supplies.
- Be sure to check your supplies immediately since any missing supplies must be replaced in the **first five minutes of the challenge.**
- Read all instructions carefully before beginning the challenge.



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# Team Roles

Each team member has a role:

- Project Engineer
- Civil Engineer
- Construction Engineer
- Environmental Engineer
- Economist
- Operations Engineer



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# Judging Process

- Operations Engineer will release the bbs into the channel. You may not touch any part of the channel during fluid release.
- Environmental Engineer will collect the bbs.
- You will have 30 seconds to move the bbs through the channel for judging and scoring.



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# Judging Process

## BB control

How to do you maintain control over 63,000 bbs?

- Keep the white plastic sheet under your game board.
- During judging, have a team member at each corner of the board holding up both sides of the white plastic sheet.
- Once bbs are released, team members may not move the sheet so that the game board is moved.
- Once your testing is complete, tilt the game board so all bbs in the channel fall out of it and onto the sheet.
- Pull up the corners of the sheet so the bbs group together at the lowest point of the sheet.
- Do not try to pour the bbs out. Use your plastic cup to scoop them out.
- The sheeting may not be altered not used in any other part of your channel.



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- Read the instructions carefully, follow them precisely.
- Read what the rules state and base your decisions on the rules.
- If the rules do not state that you cannot do something, then you may do it, as long as it is safe and not destructive.



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- You are responsible for cleaning up your work area.
- After your channel has been judged, break it down and straighten the materials and area based on instructions.



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Wait until your channel has been judged  
and your area is clean before moving to  
the next activity.

Good Luck!



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