

# Volleyball Challenge Problem

*Seventh and Eighth Grade Math*



**Developed by:**

The teachers, students, and mentors in the  
Gaming Research Integration for Learning Laboratory® (GRILL®) Summer 2015

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## 1. VOLLEYBALL PROBLEM

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### 1.1. INTRODUCTION

For years, volleyball has been the focal point of the fall semester at several high schools. Muncie Burriss and Mishawaka High School in Indiana are perennially among the best in the nation. Their success has not come by accident. Great leadership and excellent coaching have helped to put these two schools on the map for their success. Coach Smith of Mishawaka High School attributes his team's success to their work ethic.

Each morning the athletes come in to lift weights. Once a week, athletes and coaches at each school study films to observe techniques and to watch traits of their competitors. In addition to lifting weights and watching films, the teams practice six days a week.

Not only do the athletes work hard, they also have strong attitudes about keeping alive their winning streaks. Upon being interviewed, athletes at each school point to the fact that they feel an obligation to keep the winning tradition alive. "We feel like we owe it to the girls that preceded us," states Mariana Sailors of Muncie Burriss. "They were so successful and we just don't want to disappoint them."

Another thing that athletes and coaches agree has helped each team continue in their winning ways is a summer volleyball camp. This camp is held each summer from the second to the fourth week of June in Huntington, Indiana. Huntington College hosts the camp, and professional players are brought in from the summer circuit when time permits. At the end of the camp, a volleyball tournament is held. High school girls from across the Midwest, ages 16-18, are paired with one another for teams. The organizers of the camp are coaches from the Big Ten and the Mid-American Conference (MAC). They make an attempt to divide girls from the same school so that no advantage exists for one team.

In the past few years some teams have drastically defeated the other teams. Mariana Sailors recalls coming to the camp last year and losing one match 15-3, 15-2, 15-6. "It was a humbling experience," states Sailors. "I came to the camp for two reasons. First, I wanted to improve as a player. Second, I wanted to compete against other teams and individuals." With the current system in place, it is not uncommon to get destroyed by the competition.

Because of the lack of competition in the tournament, interest in the camp is decreasing. The camp does offer players the chance to learn and improve their volleyball skills, but the tournament isn't as fun as it could be. Even the players that win regularly in the tournament are getting bored. They too would rather face stiff competition than win their games easily.

## 1.2. PROBLEM

The organizers of the volleyball summer camp want to have more competition in the camp's tournament. Thus, they need a way to fairly divide the campers into teams. They have compiled information about some of the players from tryouts and from the coaches. This information should be used to put together three teams of equal abilities to play volleyball.

The camp organizers need you to split the players into three equal teams. In addition to forming these three teams, they need you to write a letter to them describing how you created your three equal teams. They will use your process for the next camp when they need to split a LARGE number of players into equal teams. Thus, you need to make sure that your process for creating teams will also work for a very large number of players.

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### 1.2.1. READINESS QUESTIONS

Table 1: Use this table to solve the Volleyball problem.

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**Volleyball Spikes! In volleyball, spikes are often classified as follows:**

**Kill: The other team was unable to return the ball.**

**Out of Bounds: The hitter spiked the ball out of bounds so the other team gets the serve.**

**Returned: The other team returned the spike.**

**Dink-unreturned: The hitter faked the spike and only tipped the ball over the net. The other team did not return the dink.**

**Dink-returned: The hitter faked the spike and only tipped the ball over the net. The other team returned the dink.**

**In the Net: The hitter failed to hit the ball over the net.**

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Table 2: Use this table to solve the Volleyball problem.

Name	Height of Player	Vertical Leap in Inches	40 Meter Dash in Seconds	Serve Results (number of serves successfully completed out of 10)	Spike Results (Out of 5 attempts)
Gertrude	6'1"	20	6.21	8	DR / DU / K / ITN / R
Beth	5'2"	25	5.98	7	K / R / OB / DR / K
Jill	5'10"	24	6.44	8	OB / R / R / K / ITN
Amy	5'10"	27	6.01	9	K / K / DU / K / R
Ana	5'6"	25	6.95	10	OB / ITN / R / R / DR
Kate	5'8"	17	7.12	6	K / DU / K / R / K
Rhonda	5'3"	21	6.34	5	OB / K / ITN / ITN / DR
Christina	5'5"	23	7.34	8	ITN / K / K / K / DU
Andrea	5'5"	24	6.32	9	ITN / OB / ITN / OB / R
Nikki	5'7"	19	8.18	10	DU / K / K / OB / R
Kim	5'9"	23	6.75	7	DR / K / R / OB / K
Robin	5'8"	15	5.87	8	K / K / K / DU / ITN
Ermalinda	5'4"	21	6.72	8	K / R / OB / ITN / DR
Lori	5'7"	19	6.88	9	OB / ITN / ITN / K / R
Tina	5'1"	24	6.27	6	DU / DR / DR / K / OB
Angie	5'10"	23	6.54	8	OB / K / OB / OB / DR
Ruth	5'3"	26	7.01	9	DU / ITN / K / K / K
Rebecca	5'9"	18	6.78	10	ITN / OB / K / DR / K

**DR = Dink-Returned / DU = Dink-Unreturned / ITN = In the Net / K = Kill / OB = Out of Bounds**

Complete the following problems after the completion of reading the problem and looking over the above tables.

1. What problem is the camp having?
2. What type of a spike would be classified as a Dink-Unreturned with the proposed tryout system?
3. What type of a spike would be classified as a Kill with the proposed tryout system?
4. Who is the tallest player among the players listed in the table?
5. Which player can jump the highest? Is this the same person as the player that can reach the highest point? Why or why not

**1.2.2. DIVIDE THE CAMPERS INTO TEAMS**

The camp organizers need you to divide the players into three equal teams. In addition to forming these three teams, they need you to write a letter to them describing how you created your three equal teams. They will use your process for the next camp when they need to split a LARGE number of players into equal teams. Thus, you need to make sure that your process for creating teams will also work for a very large number of players.

Table 3: Use this table to solve the Volleyball problem.

Player	Remarks
Gertrude	Gertrude is slow getting to the ball.
Beth	She is very agile on her feet.
Jill	Jill’s height could prove to be an asset for any team.
Amy	She is an awesome leaper, but she needs to know when to use it.
Ana	She comes from teams that have not been successful.
Kate	Kate has great quickness to get to the ball after serves.
Rhonda	Rhonda plays best when the team is playing well.
Christina	Her family life has negatively impacted her ability to play well. She is exceptionally strong for her age.

<b>Andrea</b>	
<b>Nikki</b>	She does many things well, in particular she serves well.
<b>Kim</b>	Kim is a great blocker.
<b>Robin</b>	Robin is the hardest worker we've ever had at the high school.
<b>Ermalinda</b>	Ermalinda is a girl that others want to be with because whatever she's in, she seems to always find a way to win.
<b>Lori</b>	Lori does not always get her serve over the net.
<b>Tina</b>	She is one of the most intense players we have ever seen.
<b>Angie</b>	Her father coaches at a local school.
<b>Ruth</b>	Ruth's sister is a very good volleyball player at the University of Alabama.
<b>Rebecca</b>	Rebecca is very coachable.

### 1.3. PROJECT WRITE-UP

- Math Concepts Used
  - What mathematical concepts and skills did you use to solve the problem?
- Group Interactions
  - How did you interact within the group or share insights with each other?
- Data Organization and Problem Perspective
  - How did you organize the problem data?
  - How did you interpret the task?
  - What perspective did you take?
- Tools
  - What tools did you use?
  - How did you use these tools?
- Miscellaneous Comments
  - About the group functionality or the problem.
- Cycles of Assessment and Justification
  - How did you question your problem-solving processes and your results?
  - How did you justify your assumptions and results?
  - What cycles did you go through?

## 1.4. RUBRIC

Section	Points	Notes	Comments
<i>Statement of the problem</i>	/10	Clear statement of the problem and sufficient background to put it into the appropriate context	
<i>Assumptions</i>	/10	Clear identification of simplifying assumptions made for each question with justification and discussion of how much they matter; i.e. if you changed the assumptions, would the model change significantly? How?	
<b>Addressing the client's needs: Usefulness of the tool for the purposes of the client</b>			
<i>Mathematical Model</i>	/25	Mathematically correct	
<i>Organization</i>	/10	Ease of finding each section with appropriate order	
<i>Explanation</i>	/25	Clear explanation about what was done by the group	
<i>Generalizability</i>	/15	Model useful enough with needed explanations so that client could use the tool as is or modify it for use in similar situations. How did you determine if the model is generalizable?	
<i>Presentation</i>	/5	Units when appropriate, sufficiently proofread, correct grammar and spelling, neat. Points will be deducted when needed.	

<b>Total</b>	<b>/100</b>		