15.3 (total is 15 points with each part 5 points)
a. Blocks are Investigators and Treatments are Mixtures.

b. Randomly assign the four Mixtures to the each of the Investigators.

c. The randomized complete block design guarantees that each investigator measures each of the four mixtures, whereas in a completely randomized design, it is possible that some of the investigators may not measure some of the mixtures. This may cause a bias towards some of the mixtures if a particular investigator tends to always give high readings no matter which mixture is measured.

15.4 (total is 25 points with each part 5 points)
a. \( x_{ij} = \alpha_i + \beta_j + e_{ij}; \ i = 1, 2, 3, 4; \ j = 1, 2, 3, 4, 5; \)
   - \( \alpha_i \) is measurement of jth investigator on ith mixture
   - \( \beta_j \) is the ith mixture effect
   - \( \beta_j \) is the jth investigator effect

b. \( \bar{x} = \frac{\sum x}{n} = 2463.75 \)
   - \( \bar{x}_1 = \frac{\sum x_1}{n} = 2351.0 - 2463.75 = -112.75 \)
   - \( \bar{x}_2 = \frac{\sum x_2}{n} = 2653.2 - 2463.75 = 189.45 \)
   - \( \bar{x}_3 = \frac{\sum x_3}{n} = 2444.2 - 2463.75 = -19.55 \)
   - \( \bar{x}_4 = \frac{\sum x_4}{n} = 2406.6 - 2463.75 = -57.15 \)
   - \( \bar{x}_5 = \frac{\sum x_5}{n} = 2462.5 - 2463.75 = -1.25 \)
   - \( \bar{x}_6 = \frac{\sum x_6}{n} = 2468.25 - 2463.75 = 4.5 \)
   - \( \bar{x}_7 = \frac{\sum x_7}{n} = 2469.25 - 2463.75 = 5.5 \)
   - \( \bar{x}_8 = \frac{\sum x_8}{n} = 2456.0 - 2463.75 = -7.75 \)
   - \( \bar{x}_9 = \frac{\sum x_9}{n} = 2462.75 - 2463.75 = -1 \)

c. \( F = 1264.73 \) with \( p \)-value < 0.0001 =>
   Reject \( H_0: \beta_1 = \beta_2 = \beta_3 = \beta_4 \) and conclude there is significant evidence of a difference in the means for the four mixtures.

d. Mixture 2 with the highest mean response would appear to be possibly the best mixture. A multiple comparison procedure could be used to confirm that the other three mixtures have significantly lower means.

e. \( \text{RE(RCB,CR)} = \frac{(b-1)\text{MSE} + b(b-1)\text{MSE}}{(b-1)\text{MSE}} = \frac{(5-1)113.12 + 5(4-1)68.86}{(5)(4) - 1(68.86)} = 1.14 \)
   It would take 1.14 times as many observations (approximately 6) per treatment in a completely randomized design to achieve the same level of precision in estimating the treatment means as was accomplished in the randomized complete block design.

15.46 (total is 10 points with each part 5 points)
a. There is significant evidence (\( p \)-value = 0.0200) of a difference between the five types of music relative to mean productivity.

b. The No Music treatment will be taken to be the Control treatment. Using Tukey’s HSD we can find that Music types A, C, and D have mean productivity higher than No Music.