

**Coherence Principle:** In order to incorporate the coherence principle, the visual was made to be simple, without extraneous information. The simple and clear step-by-step visuals, combined with concise and relevant text, makes it easy for learners to follow the process without needing a lengthy explanation. The design avoids unnecessary details and distractions, focusing only on the essential information needed to complete the magic ring.

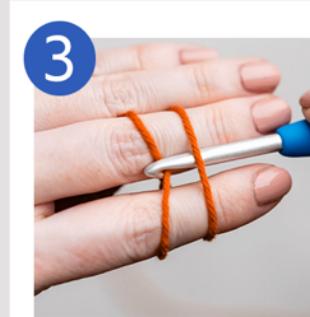
# How to Crochet a Magic Ring



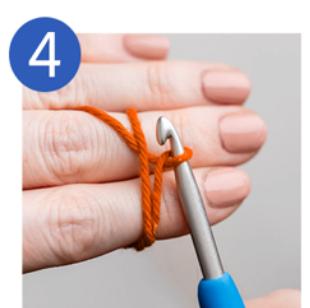
Lay yarn tail in hand



Loop yarn around fingers,  
forming an X



Insert hook  
under the first strand



Grab the second strand  
and pull through



Yarn over with  
working yarn

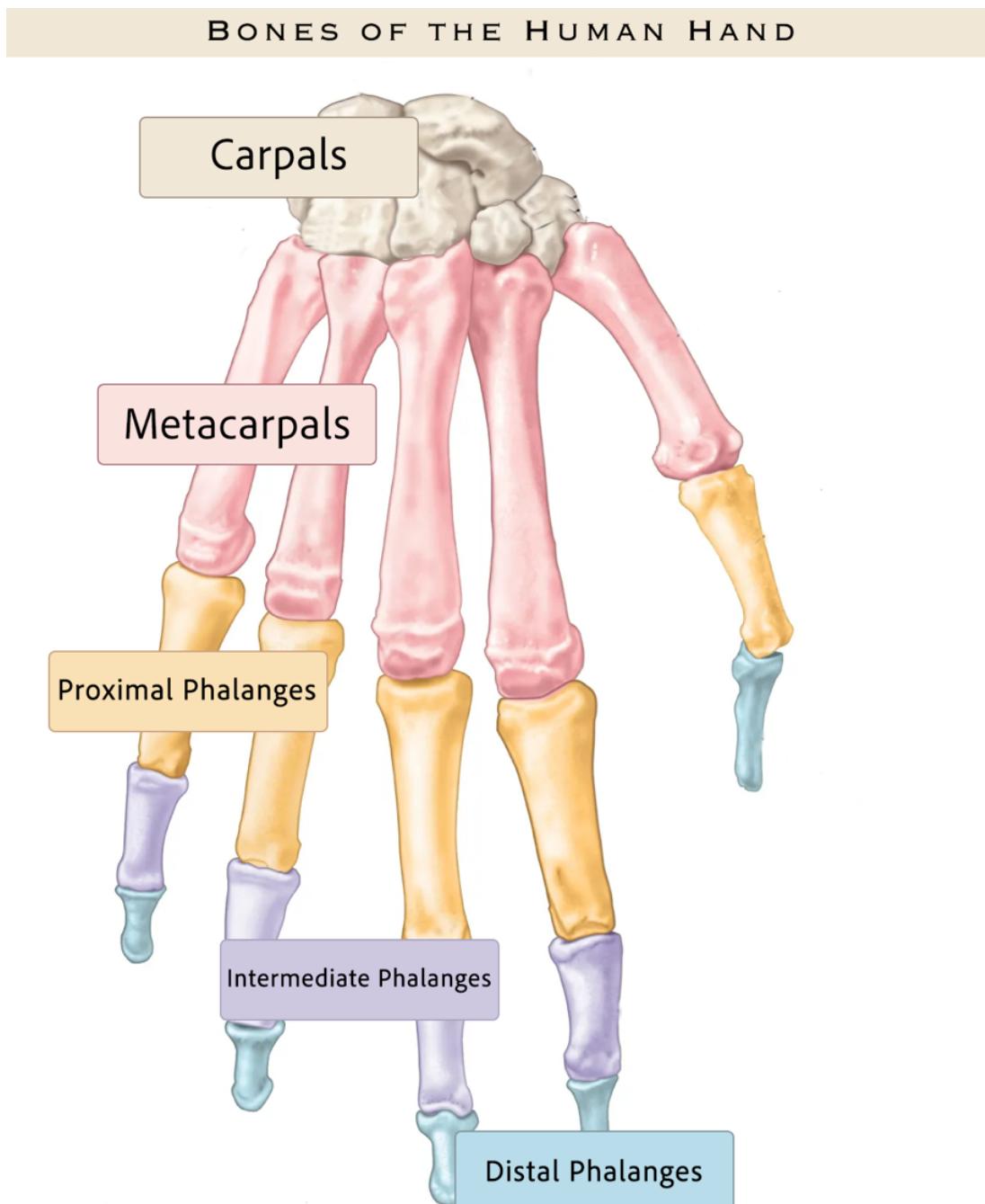


Pull through to create  
a chain stitch



Completed magic ring

**Spatial Contiguity Principle:** I designed the diagram following the Spatial Contiguity Principle by placing each label directly next to the corresponding bone section rather than listing them separately in a legend. This ensures that learners can immediately associate names with visual representations without extra cognitive effort. Additionally, I used color coding to distinguish between different groups of bones, reinforcing the structure without overwhelming the viewer. The background behind each label improves readability while keeping the design clean and uncluttered.



Another example of the **Spatial Contiguity Principle** is the following infographic. I designed it so each example is placed directly next to its corresponding image within the permutation or combination section, rather than separating them into a distant list. This allows learners to immediately connect the concept with its visual representation, reducing unnecessary cognitive load. Additionally, grouping related items within bordered sections reinforces the distinction between the two concepts while maintaining a clean and organized layout.

## Does Order Matter?

### PERMUTATION (ORDER MATTERS)



Assigning 1<sup>st</sup>, 2<sup>nd</sup>, and 3<sup>rd</sup> in a race

Arranging books on a shelf



Assigning seats to dinner party guests

### COMBINATION (ORDER DOESN'T MATTER)

Choosing 3 pizza toppings from a menu



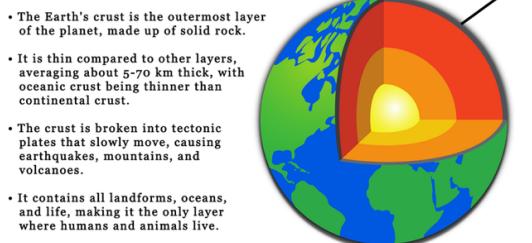
Selecting team members for a project



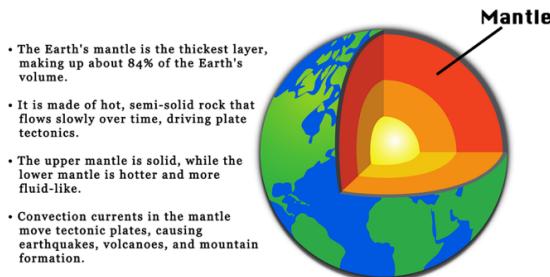
Choosing 4 video games to borrow from a friend

**Temporal Contiguity Principle:** These slides follow the Temporal Contiguity Principle by presenting corresponding words and visuals together rather than separately. Each slide: (a) labels the specific Earth layer being discussed while showing its location in a cutaway diagram, (b) provides bulleted text descriptions alongside the labeled diagram so students can process verbal and visual information at the same time, and (c) avoids separating explanation and visuals in time, which helps learners integrate the information more effectively in working memory. By aligning images and text in real-time, this design helps reduce cognitive overload and enhances learner comprehension and retention.

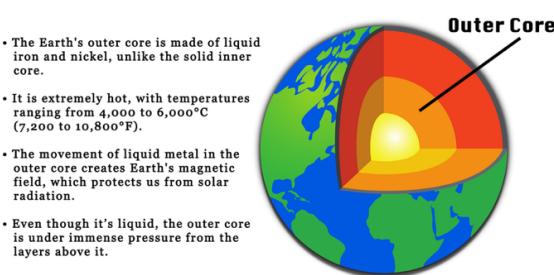
#### Earth's Layers: Crust



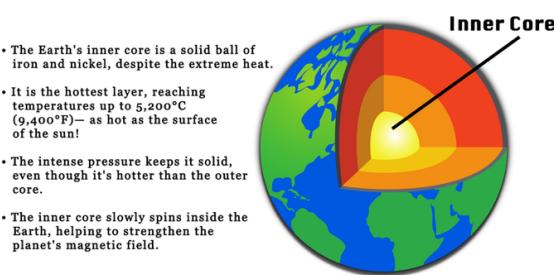
#### Earth's Layers: Mantle



#### Earth's Layers: Outer Core



#### Earth's Layers: Inner Core



**Pre-training Principle:** I designed the material according to the Pre-training Principle from the Cognitive Theory of Multimedia Learning, which states that people learn better from multimedia lessons when they already know the names and characteristics of key concepts. The first slide focuses solely on building that key knowledge by presenting the terms visually and verbally. This separates component learning from causal learning, reducing essential processing during the main instructional slide.

## How to Make a Paper Quilling Flower

Before you begin: Learn the tools & shapes

**Quilling Tool**



Rolls paper strips into coils

**Paper Strips**



The basic material for all quilling shapes

**Tight Coil**



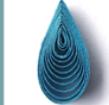
Tightly rolled and glued closed

**Loose Coil**



Released coil that forms open shapes

**Teardrop**



A common petal shape

**Precision Glue**



For tiny, clean glue dots

You'll use these shapes and tools to create your flower on the next slide!

## How to Make a Paper Quilling Flower

Step-by-step instructions to make a simple flower

- 1 
- 2 
- 3 
- 4 
- 5 

Use the quilling tool to roll one tight coil and glue the end

Use the quilling tool to roll six coils and let them loosen before gluing the ends

Pinch the six loose coils to turn them into a teardrop shape

Glue petals in a circle with the tight coil at the center

Press and shape flower while glue still wet. Ta-da! You just made a quill flower!

Want to try more? Change the number of petals or colors for a different look!

Another example of the **Pre-Training Principle** is the following infographic. The first section establishes what each component is before showing how they interact. It begins with clear definitions of key terms related to calculating regression coefficients. In this way, the learners are first introduced to the necessary components. The step-by-step approach builds progressively from simple concepts to more complex calculations. Visual aids and concrete examples are provided that connect abstract formulas to their real-world meaning. Because of the design's focus on building in pre-training, learners are able to focus on understanding the process rather than trying to decode unfamiliar terminology at the same time.

### Calculating Linear Regression Coefficients

Step-by-step guide to finding the slope and intercept for the best-fit line

#### Key Terms & Components

Before we begin calculating, let's understand the main components of linear regression:

**y Dependent Variable**  
 The outcome we're trying to predict. It's plotted on the vertical axis.

**x Independent Variable**  
 The predictor variable used to make predictions. It's plotted on the horizontal axis.

**$\beta_0$  Y-Intercept**  
 The value of y when  $x = 0$ . It's where the regression line crosses the y-axis.

**$\beta_1$  Slope**  
 Measures how much y changes when x increases by one unit. Represents the steepness of the line.

**What we're building:** A straight line that best fits our data points.  
**The equation:**  $y = \beta_0 + \beta_1 x$

We need to find the values of  $\beta_0$  (y-intercept) and  $\beta_1$  (slope) that minimize the total squared distance between our line and all data points.

**Visualization Tip:** Notice how the slope  $\beta_1$  represents the change in y when x increases by 1 unit, and the intercept  $\beta_0$  is where the line crosses the y-axis.



#### Calculation Process

- 1 Understand the Linear Model**  
 Linear regression expresses the relationship between x and y as a straight line:  

$$y = \beta_0 + \beta_1 x + \epsilon$$

Where:  
 -  $\beta_0$  is the y-intercept (where the line crosses the y-axis)  
 -  $\beta_1$  is the slope (how steep the line is)  
 -  $\epsilon$  is the error term (distance between actual points and our line)
- 2 Calculate the Mean of x and y**  
 First, find the average of all your x values and all your y values:  

$$\bar{x} = (1/n) \times \sum x_i$$

$$\bar{y} = (1/n) \times \sum y_i$$

Where n is the number of data points.

**Example:** If  $x = [2, 4, 6, 8, 10]$ , then  $\bar{x} = (2+4+6+8+10)/5 = 6$
- 3 Calculate the Slope ( $\beta_1$ )**  
 The slope coefficient  $\beta_1$  represents how much y changes when x increases by 1 unit:  

$$\beta_1 = \frac{\sum [(x_i - \bar{x})(y_i - \bar{y})]}{\sum (x_i - \bar{x})^2}$$

This formula can be broken down into parts:

  1. For each point, find the distance from x to the mean of x:  $(x_i - \bar{x})$
  2. For each point, find the distance from y to the mean of y:  $(y_i - \bar{y})$
  3. Multiply these distances together for each point
  4. Sum all these products
  5. Divide by the sum of squared x distances
- 4 Calculate the Intercept ( $\beta_0$ )**  
 The y-intercept  $\beta_0$  represents the value of y when  $x = 0$ :  

$$\beta_0 = \bar{y} - \beta_1 \times \bar{x}$$

Once you know the slope ( $\beta_1$ ) and the means of x and y, finding the intercept is straightforward:

  1. Multiply the slope by the mean of x
  2. Subtract this product from the mean of y

**Example:** If  $\bar{y} = 15$ ,  $\beta_1 = 2$ , and  $\bar{x} = 6$ , then  $\beta_0 = 15 - (2 \times 6) = 3$
- 5 Matrix Form (for Multiple Variables)**  
 For multiple linear regression (with more than one x variable), we use matrix notation:  

$$\beta = (X^T X)^{-1} X^T y$$

Where:

  - X is the design matrix with each column representing a variable (first column is all 1s for the intercept)
  - y is the vector of y values
  - $X^T$  is the transpose of X
  - $(X^T X)^{-1}$  is the inverse of  $X^T X$

This matrix approach is a generalization of the formulas in steps 3 and 4.
- 6 Verify Your Model**  
 After calculating coefficients, evaluate how well your model fits the data:
  - **R<sup>2</sup>:** Measures the proportion of variance explained (ranges from 0 to 1)
  - **Residual analysis:** Check if the differences between predicted and actual y values show patterns
  - **Assumptions:** Verify linearity, independence, homoscedasticity (equal variance), and normality

**Practice Tip:** Use a small dataset to calculate coefficients by hand, then verify using statistical software.

**What's really happening:** The calculation process finds the line that minimizes the sum of squared errors (SSE) between the predicted and actual y values. This method is called "Ordinary Least Squares" (OLS) and provides the most statistically optimal estimates for the coefficients under certain assumptions.

**Segmenting Principle:** I designed this material based on the Segmenting Principle from the Cognitive Theory of Multimedia Learning. This principle states that people learn better when instructional content is broken into learner-controlled segments rather than presented all at once. Each of the four steps is visually separated and clearly labeled, allowing learners to focus on one key idea at a time. There are also “Next” buttons to allow for learner-paced instruction. This format reduces cognitive overload and supports deeper understanding of each concept before the learner moves on to the next step.

## Adding Fractions with Like Denominators

### ① Introduction to Fractions

A fraction represents a part of a whole. It has two numbers: the top number (numerator) shows how many parts you have, and the bottom number (denominator) shows how many equal parts the whole is divided into.

$$\frac{3}{4}$$

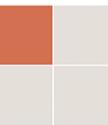


Next

### ② Like Denominators

Fractions must have the same denominator to be added easily.

$$\frac{1}{4}$$



$$\frac{2}{4}$$



Next

### ③ Adding the Numerators

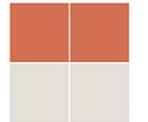
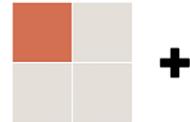
Keep the denominator the same. Just add the numerators.

$$\frac{1}{4} + \frac{2}{4} = \frac{3}{4}$$



Next

### ④ Visual Model



Finish

Next

**Signaling Principle:** I designed the diagram material to highlight the signaling principle of multimedia instruction. Important variables ( $a$ ,  $b$ ,  $c$ ) are color-coded and font-distinguished), guiding learners to key information and quickly showing where they come into play during a subsequent step. Visual separation of the steps (with their own color-coding) help learners mentally organize the process. This also allows leaners to concentrate on one concept at a time (segmenting principle). The bold, colored, solution statement reinforces the final result. Overall, the design was optimized to highlight key elements while maintaining an easy-to-read format.

## Solving Quadratic Equations Using the Quadratic Formula

**Solve:  $ax^2 + bx + c = 0$**

### Step 1: Identify the values

For the equation  $2x^2 - 5x - 3 = 0$ ,

$$a = 2 \quad b = -5 \quad c = -3$$

### Step 2: Apply the quadratic formula

$$x = (-b \pm \sqrt{b^2 - 4ac}) / (2a)$$

$$x = (-(-5) \pm \sqrt{(-5)^2 - 4 \cdot 2 \cdot (-3)}) / (2 \cdot 2)$$

### Step 3: Simplify and calculate

$$x = (5 \pm \sqrt{25 - (-24)}) / 4$$

$$x = (5 \pm \sqrt{49}) / 4$$

$$x = (5 \pm 7) / 4$$

### Solution:

Therefore,  $x = 3$  or  $x = -0.5$