**Lesson Guide: Bitmap to Vector Conversion**

**Target Audience:** Students who are comfortable with creating, editing, and managing basic vectors in the Vectric software.

**Time Allotment:** 75 minutes (45-50 minutes for instruction and demonstration, 25-30 minutes for hands-on practice).

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**Learning Objectives**

By the end of this lesson, students will be able to:

- **Differentiate** between **raster** (pixel-based) and **vector** (line-based) image types.

- **Identify** the characteristics of a good image for tracing (high-contrast, minimal color).

- **Import** a bitmap image into a Vectric project.

- Use the **"Trace Bitmap"** tool with both the **"Color"** and **"Black and White"** methods.

- **Adjust** the **Threshold slider** to achieve a clean and accurate trace.

- **Apply** the **"Fit Curves to Vectors"** tool to clean up and optimize the newly traced vectors.

- Use the **"Crop Bitmap"** tool to isolate a portion of an image using a vector as a "cookie cutter."

- Understand the importance of using royalty-free images to avoid copyright/ trademark issues.

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**Materials & Preparation**

- Instructor's computer with Vectric software connected to a projector.

- Student computers with Vectric software.

- A high-quality, high-contrast PNG image with distinct colors (like the green checkmark example) available for all students.

- A blank 12" x 12" job file open on all computers.

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**Lesson Procedure**

**Part 1: Theory and Preparation (10 minutes)**

1. **Introduction:** Briefly recap previous lessons. Introduce today's topic: turning a standard picture into something a CNC machine can cut.

2. **Raster vs. Vector:** Explain the two fundamental image types.

   - **Vector (AI, SVG, DXF):** Already made of lines and nodes. Needs cleanup, but not tracing.

   - **Raster (PNG, JPG, BMP):** Made of pixels. This is what we'll be working with. Must be traced.

3. **What Makes a Good Image?** Discuss the ideal characteristics for a traceable image:

   - High quality and resolution.

   - **High contrast** between the subject and background.

   - **Minimal colors.** Use the "shades of gray" analogy to explain how too many colors create messy vectors.

4. **Setup:** Have students import the provided PNG image into their blank project file. Point out that icons with a **bird** relate to bitmap functions.

**Part 2: The "Trace Bitmap" Tool (20 minutes)**

1. **Locating the Tool:** Guide students to select the imported image and click the **"Trace Bitmap"** icon (the bird with a squiggly line).

2. **Method 1: Tracing by Color**

   - Have students select the **Color** option.

   - Point out the color swatches that appear. Explain that for a full trace, they may need to select multiple shades.

   - Have them select the main green color and click **Preview**.

3. **Method 2: Tracing by Black and White (Recommended)**

   - Undo the previous trace. Select the **Black and White** option.

   - **The Threshold Slider:** This is the most critical setting. Explain that it determines which pixels are "on" vs. "off."

- **Activity:** Have students slide the threshold to 100% and point out how it captures unwanted noise. Then, guide them to slide it back down to find the "sweet spot" (e.g., 97%) that produces a clean outline.

4. **Tool Settings:** Briefly cover the other options:

   - **Corner Fit:** Check this to keep corners sharp.

   - **Noise Filter:** Set to 10 pixels to ignore small imperfections like dust.

   - **Group Vectors:** Leave this unchecked for now, as we will be cleaning the vectors next.

5. **Apply the Trace:** Once the preview looks good, click **Apply** and **Close**.

## Part 3: Post-Trace Vector Cleanup (15 minutes)

1. **Isolating the Vectors:** Guide students to the **Layers tab** and hide the **"Bitmap Layer"** to see the new vectors clearly.

2. **The Need for Cleanup:** Explain that traced vectors are often inefficient, with too many nodes.

3. **Activity: Using "Fit Curves"**

   - Select the newly traced vectors. Since they weren't grouped, they can be selected individually.

   - Open the **"Fit Curves to Selected Vectors"** tool.

   - Experiment with the different fitting types (**Circular Arcs, Bezier Curves, Straight Lines**) and click **Preview** for each to see how they reduce the node count while preserving the shape.

   - Have students choose the best option and apply it.

## Part 4: Advanced Bitmap Tools (15 minutes)

1. **The "Cookie Cutter" - Crop Bitmap Tool:**

   - Have students delete their traced vectors and unhide the bitmap layer to start fresh.

   - **Activity:**

     - Have them draw a closed vector (like a circle) around a specific part of the image (e.g., the checkmark).

- **CRITICAL STEP:** Emphasize the selection order: **Select the bitmap FIRST, then Shift-select the vector.**

- Click the **"Crop Bitmap"** tool. The image will be trimmed to the vector's shape.

- Explain that they can now trace this smaller, isolated image.

2. **Other Tools:** Briefly mention the **"Edit Picture"** tool for basic contrast/brightness adjustments and the **scaling handles** (slow double-click) for resizing.

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## Assessment & Final Reminders

- **Practice Challenge:** "Find a simple, high-contrast, royalty-free company logo or a simple silhouette icon online (e.g., a basic animal shape). Your task is to:

  1. Import and trace the image using the Black & White method.

  2. Perform a vector cleanup using the 'Fit Curves' tool to create an efficient toolpath.

  3. Use the 'Crop Bitmap' tool to isolate one specific feature of the logo."

- **CRITICAL WARNING:** Remind students about **copyright and trademarks**. Instruct them to only use royalty-free or stock images for any projects they plan to share or sell to avoid legal issues with companies like Disney, Harley-Davidson, etc.

- **Recap:** Review the core workflow: **Import -> Trace -> Clean.**

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## Key Vocabulary

- **Raster Image (Bitmap):** An image made of pixels (JPG, PNG).

- **Vector Image:** An image made of mathematical lines and curves (SVG, DXF).

- **Trace Bitmap:** The Vectric tool used to convert a raster image to vectors.

- **Threshold:** A setting that defines the cutoff between light and dark pixels during a black-and-white trace.

- **Fit Curves to Vectors:** A tool used to optimize vectors by reducing the number of nodes.

- **Crop Bitmap:** A tool that uses a vector shape to cut out a portion of a raster image.

- **Royalty-Free:** A type of license that allows for the use of an image without paying royalties for each use.

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