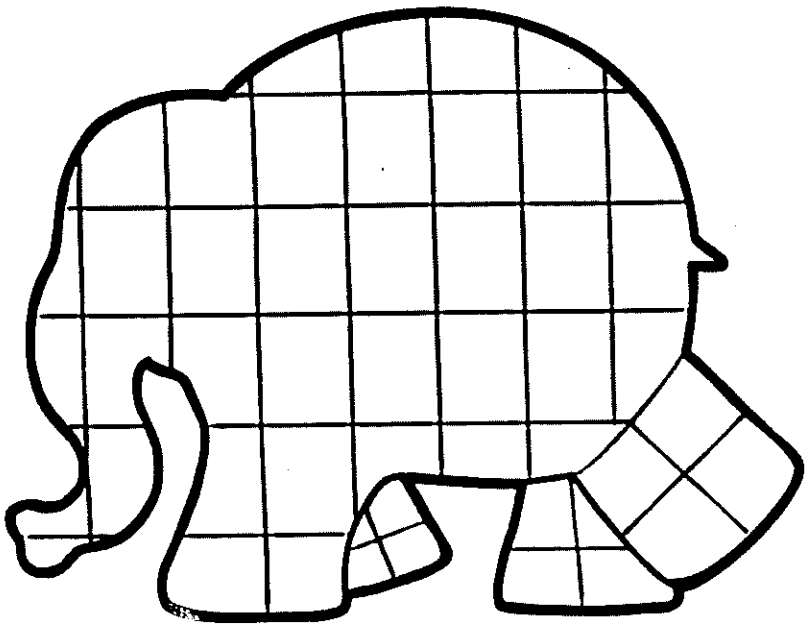
Exploring Discrete Mathematics in the Classroom

Kiddie Lit!
K-4

A Workshop for Teachers About Connecting Children's Literature with Topics in Discrete Mathematics



Developed by Participants in the Rutgers Leadership Program in Discrete Mathematics: Mary Knuck, Ann Lawrence, and Annie McClendon

Edited by
Valerie DeBellis
Ann Lawrence
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Connecting Children's Literature with Discrete Math
Grades K-4

Abstract

Teachers in grades K-4 can use children's literature as a vehicle to motivate their students and enrich both the reading and mathematics curricula. Numerous stories offer vivid, engaging contexts for explorations with discrete mathematics topics. Such cross-curricula connections are very powerful and maximize effective use of classroom time.

Workshop Overview

Summary

Participants will engage in several motivating activities involving children's literature as well as topics in discrete mathematics. The focus of each activity is on a topic from a different area of discrete mathematics: patterns in numbers; paths and graphs; graph coloring; and counting, listing, and probability.

Workshop Outline

I. Objectives

Participants will:

*work together to solve several problems that connect a discrete math topic with a story or excerpt from children's literature

* be exposed to several methods for teaching these mathematical concepts plus integrating curricula, and

* be provided with materials to implement the activities in their classrooms.

(Note: Use three of the following four activities for any given workshop.)

II.	Activity #1 --All Aboard	25 Minutes
III.	Activity #2 - -Two for the Road	25 Minutes
IV.	Activity #3 --The Patchwork Pachyderm	25 Minutes
V.	Activity #4 --Rub-a-dub-dub	25 Minutes
VI.	Workshop Summary	10 Minutes
VII.	Workshop Evaluation	05 Minutes
	Total Workshop Time:	90 Minutes

Workshop Environment

I. Room Arrangement

Ideally, participants should be seated at round tables in groups of six to eight persons. Each participant should have a reasonable view of the presenter and the screen. Round tables are best to use to facilitate discussion among group members.

II. Equipment

Overhead projector and screen
Calculators (Optional)

III. Workshop Materials List

A. Activity #1: All Aboard

Copy of Hey! Get Off Our Train by John Burningham
Manipulatives to represent five endangered species
Blank Transparencies
Transparency Markers

B. Activity #2: Two for the Road

Floor Graph
Blank Transparencies
Transparency Markers
Copy of Frog and Toad Are Friends by Arnold Lobel (optional)

C. Activity #3: The Patchwork Pachyderm

Colored Pencils or Markers
Copy of Elmer by David McGee (optional)

D. Activity #4: Rub-a-dub-dub

Manipulatives to represent seven characters
Blank Transparencies
Transparency Markers
Copy of The Tub People by Pam Conrad

Instructor's Notes

Activity #1 --All Aboard
(Allocated time = 25 minutes)

Introduce this activity by placing TSP #1 on the overhead and reading the following summary: Hey! Get Off Our Train is a counting book that acquaints readers with the topic of endangered species. In this book, a boy and his pajama-case dog climb aboard the toy train and embark on a glorious trip around the world. In their journey they meet representatives of endangered species who wish to join them. A counting-on pattern is easily discovered. Thus, this activity links a story with a counting pattern. Now, for this first part of the activity, simply read the book and model using manipulatives to develop the counting-on pattern.

A nice way to illustrate the characters is to make a transparency from the book, color and cut out the characters, and use them as manipulatives. Of course, counters or cubes of any kind can be used to represent the animals as well. As each new character boards the train, interrupt the story and count the passengers thus far. Point out that this kind of activity can be used with many counting books and could be extended to count-on by twos, threes, etc.

Say,"Another pattern that can be introduced with this book is the Fibonacci sequence. We will experiment with the animals boarding the train by either ones or twos. The challenge is to discover the total number of ways the five endangered animals can board the train. Remember: the animals may board one or two at the time and they always board in the same order: elephant, seal, crane, tiger, then polar bear. Work with a partner to complete your handout". Pass out HO#1. Circulate among the participants as they work. When nearly all have finished, let one or more pairs share their findings on a blank transparency. Then ask, "Now predict the total number of ways that ten animals can board the train by ones or twos." Using the Fibonacci sequence, they should be able to predict 55 ways. Record the solution on a blank transparency. Summarize the activity and answer any questions.

As you circulate, be sure to emphasize that the animals must board the train in the order specified. Also, some pairs may need help in getting started. Lead them to discover, for example, that the elephant, seal, and crane can enter in three ways: one(elephant), one(seal), then one(crane); two(elephant and seal), then one(crane); or one(elephant), then two(seal and crane) or numerically as 1-1-1, 2-1, or 1-2

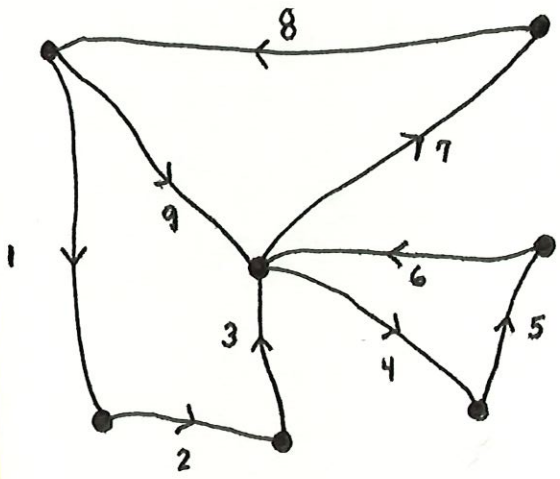
# of Animals	*Ways to Board*	*Total # of Ways*
1	1	1
2	1-1, 2	2
3	1-1-1, 2-1, 1-2	3
4	1-1-1-1, 1-2-1, 2-1-1, 1-1-2, 2-2	5
5	1-1-1-1-1, 2-1-1-1, 1-2-1-1, 1-1-2-1, 1-1-1-2, 1-2-2, 2-1-2, 2-2-1	8

***Option**: At the close of this first activity is a good time to emphasize the importance of communication, especially writing, in the mathematics classroom. Ask the participants to write what they think students might learn from this activity and let a volunteer share his/her thoughts. You can allow time for this kind of communication and/or assessment after any or all activities in this workshop.*

Activity #2 -- Two for the Road
(Allocated time = 25 minutes)

Place TSP#2 on the overhead as you say, "<u>Frog and Toad Are Friends</u> by Arnold Lobel is a collection of short stories revolving around the adventures of two likable amphibians. In this next activity, we will the selection, "A Lost Button", from this book to illustrate graphing concepts." Place TSP#3 on the overhead and say," In 'A Lost Button', Toad loses one of the buttons on his jacket during his long trek with Frog. Frog searches high and low for his best friend's button. Can he find the lost treasure? Retrace his steps and see." Distribute HO-#2and #3 . Challenge the participants to find a path for Frog and Toad that visits each site (vertex) only once and allows him to begin and end at home. Circulate and ask for volunteers to share their solution.

Review the terminology graph, vertex, and edge. Introduce vertex of odd degree and vertex of even degree. Elicit that this graph contains only two vertices of odd degree and that every successful path for this problem began at one of these vertices and ended at the other. Finally, define Euler path in terms of this activity; e.g., "What you have created here is known as an Euler path. Mathematicians define an Euler path as a path that includes every edge of the graph exactly once." Pose the question, "Can you have an Euler path with more than two vertices of odd degree?"



One possible path

No he can't start + end at home

Val - I think Frog + Toad needs more detail. See M3 in Lit 5-8

Now direct participants to find the shortest path/circuit for their walk. Share solutions. This would be the perfect place to introduce tree diagrams as a problem-solving strategy. Direct the participants to HO #4 and demonstrate how to construct a tree diagram. Use a blank transparency to model the procedure.

According to the level, knowledge, and experience of the participants(and their students), have participants walk on a floor graph of "Frog and Toad's Neighborhood" so that they can experience it in a bodily-kinesthetic manner. The vertices should be labeled with either words or pictures. As an edge is travelled, place a marker of some kind on that edge so that when the path is finished everyone can easily observe that each edge has been traveled exactly once.

This graph should be drawn on a shower curtain liner or tarp. Use large dots or small paper plates as vertices.

Summarize the activity and answer any questions from the participants. Suggest to the group that a possible extension could be a button sorting activity stemming from <u>The Button Box</u> by Margarette Reid.

Activity #3 --Patchwork Pachyderm
(Allocated time = 25 minutes)

Introduce this activity by placing TSP #4 on the overhead and reading the following summary: <u>Elmer</u> is a story about a patchwork elephant who is boldly colored. This discreet elephant really stands out in a crowd. He is very unhappy, because he is tired of being different. He believes all the other elephants are laughing at him. He finally realizes his peers

are laughing with him, not at him. Elmer discovers that his coloring is a very special gift that makes him unique. Explain that this book will be used with a graph coloring activity. After reading the story, review the map coloring rules. Remind participants that the basic question for mathematicians is: What is the smallest number of colors you can use to color a map? In math there are many different types of maps, but the main coloring rule for all maps is the following: when you color a map, no two areas that touch each other can be the same color. There is one exception to this rule: areas that touch at only one point can be the same color. Challenge the participants to color each Elmer in the fewest possible colors. Distribute HO#5-9. Several versions of coloring sheets are provided for use depending on the level of the participants' students. This activity can easily be completed in pairs. Have the participants share their solutions.

Use TSP#5-#9 to illustrate the different solutions. Elicit a discussion about what forces an extra color on Elmer. Be sure participants realize that if an area touches two other areas, three colors are necessary. Put TSP#9 on the overhead. Be sure the participants understand the solution for this sheet (HO#9). The solution is three colors. Note that the children may need several sheets to finish this task. This activity could also be used as an introduction to map coloring or as a component of a quilting unit.

Solutions for Other Handouts: HO#5-Two Colors, HO#6-Two Colors, HO#7-Three Colors, HO#8-Four Colors

Summarize the activity and answer questions from participants.

Activity #4 -- Rub-a-dub-dub
(Allocated time = 25 minutes)

Introduce this activity by placing TSP #10 on the overhead and reading the following summary: <u>The Tub People</u> by Pam Conrad is a story about six people and a dog in a tub. The father, the mother, the grandfather, the doctor, the policeman, the child, and the dog are neatly lined up on the edge of the bathtub each day. One evening the unspeakable happens, and the tub people must unite to save the day. Point out that teachers would, of course, read the entire story to the class. Pass out HO #10and #11 and explain to participants that they should work together to find all the ways to arrange three tub people in a row. Those who finish early should try to find all the ways to arrange four of them in a row. Volunteers will share their solutions.

Be sure scissors are on each table for participants who wish to cut out the tub people and use them as manipulatives in working together on this problem to find how many ways three tub people can be arranged in a row (<u>6</u>, as ABC, ACB, BCA, BAC, BAC, CAB, and CBA), then how many ways for four tub people (24, as ABCD, ABDC, ACDB, ACBD, ADBC, ADCB, BCDA, BCAD, BDAC, BDCA, BACD, BADC, CDAB, CDBA, CABD, CADB, CBAD, CBDA, DABC, DACB, DBCA, DBAC, DCAB, and

DCBA). You also need to cut the tub people from a transparency as well so that they can be used to arrangements. Circulate among the groups while they work to find those using different problem-solving strategies such as using a model(the cut-outs), making an organized list, and making a tree diagram. Be aware that some groups may have difficulty and need help in getting started. Using the cut-out tub people to physically create each possible arrangement and record as they go will nearly always produce accurate (if somewhat slow) results. Ask for volunteers to put their solutions on transparencies and share them with the group. Discuss any patterns participants discover. Then ask the participants to predict the number of possible arrangements for 5, 6, and 7 tub people, if appropriate. You may suggest an extension activity to find how many different ways you could divide three tub people into two boxes, then how many different ways to divide four tub people into two boxes, etc. This activity will, of course, introduce combinations.

In closing, emphasize to participants that mathematics teachers in grades K-4 can use children's literature as a vehicle to motivate their students and enrich the curriculum. Such cross-curriculum connections can be very effective. A partial listing of other books appropriate for such activities in grades K-8 is included in the bibliography(TKHM#12-#16) which you should distribute to participants.

Workshop Summary

Allow some time for participant qustions, then explain that this workshop has only "touched the tip of the iceberg!" Connecting children's literature with discrete math topics is a motivational and effective means of integrating curricula. This workshop provides a sampling of such activities.

Distribute the take-home packet of materials (TKHM) and encourage participants to review and use them for carrying out the workshop activities in their K-4 classrooms. In addition, they should be encouraged to develop other activities through which they can accomplish an integrated curriculum.

Workshop Evaluation

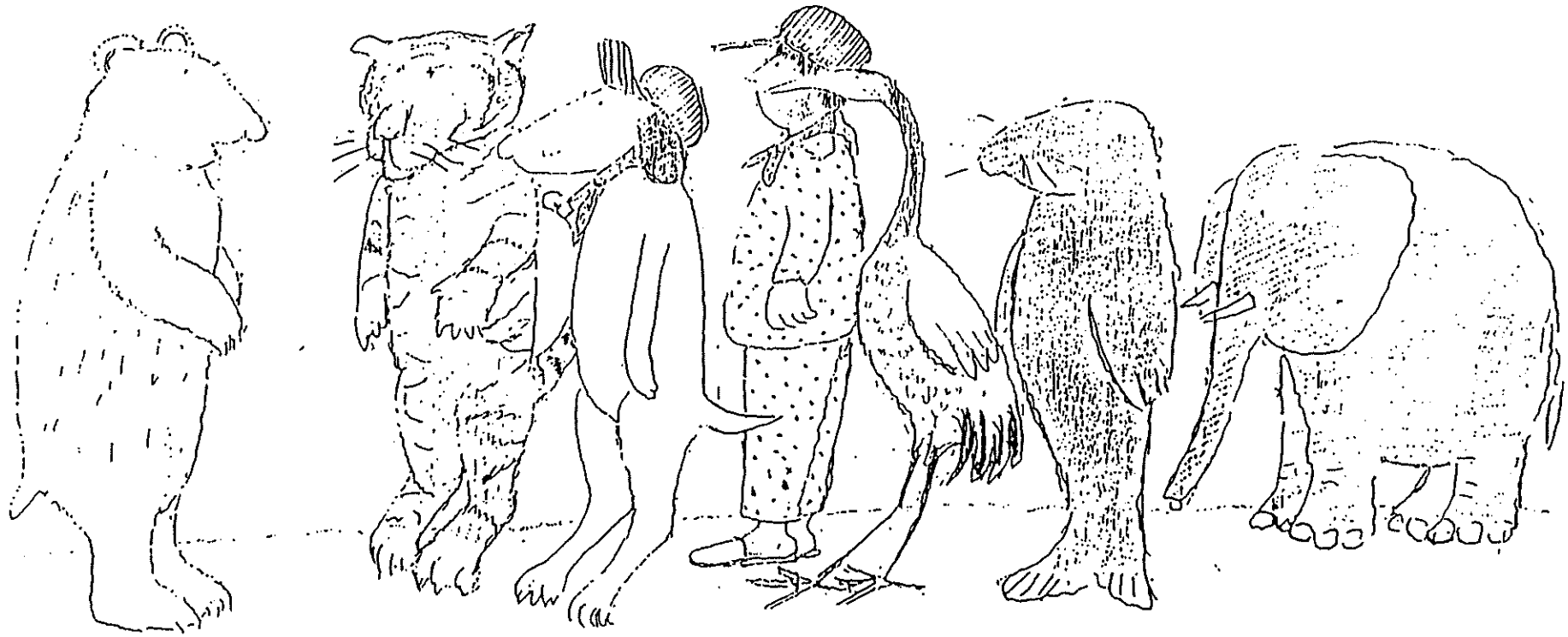
Pass out the evaluation forms. Encourage participants to offer constructive suggestions for future presentations of this workshop. Collect forms from participants as they leave the room. Be sure to provide five minutes for this! Immediately following your workshop (or at the latest that evening when you get home) please review the evaluation forms and complete the workshop leader evaluation summary form.

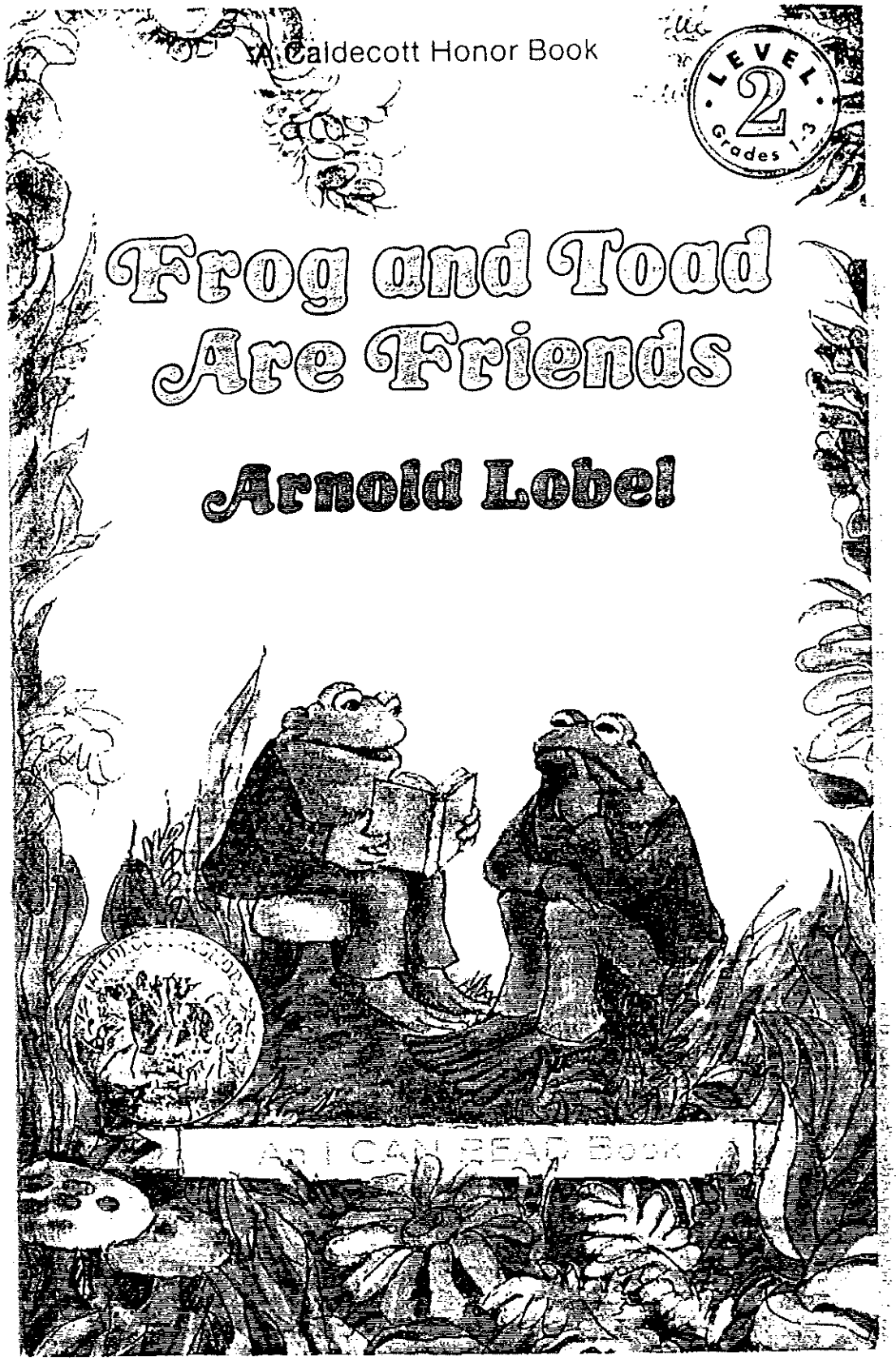
Within three days of your workshop, please mail all evaluation forms and the workshop leader evaluation summary form to our office at the following address:

K-8 Workshop-Workshop Evaluation Information
P.O. Box 10867
New Brunswick, NJ 08906

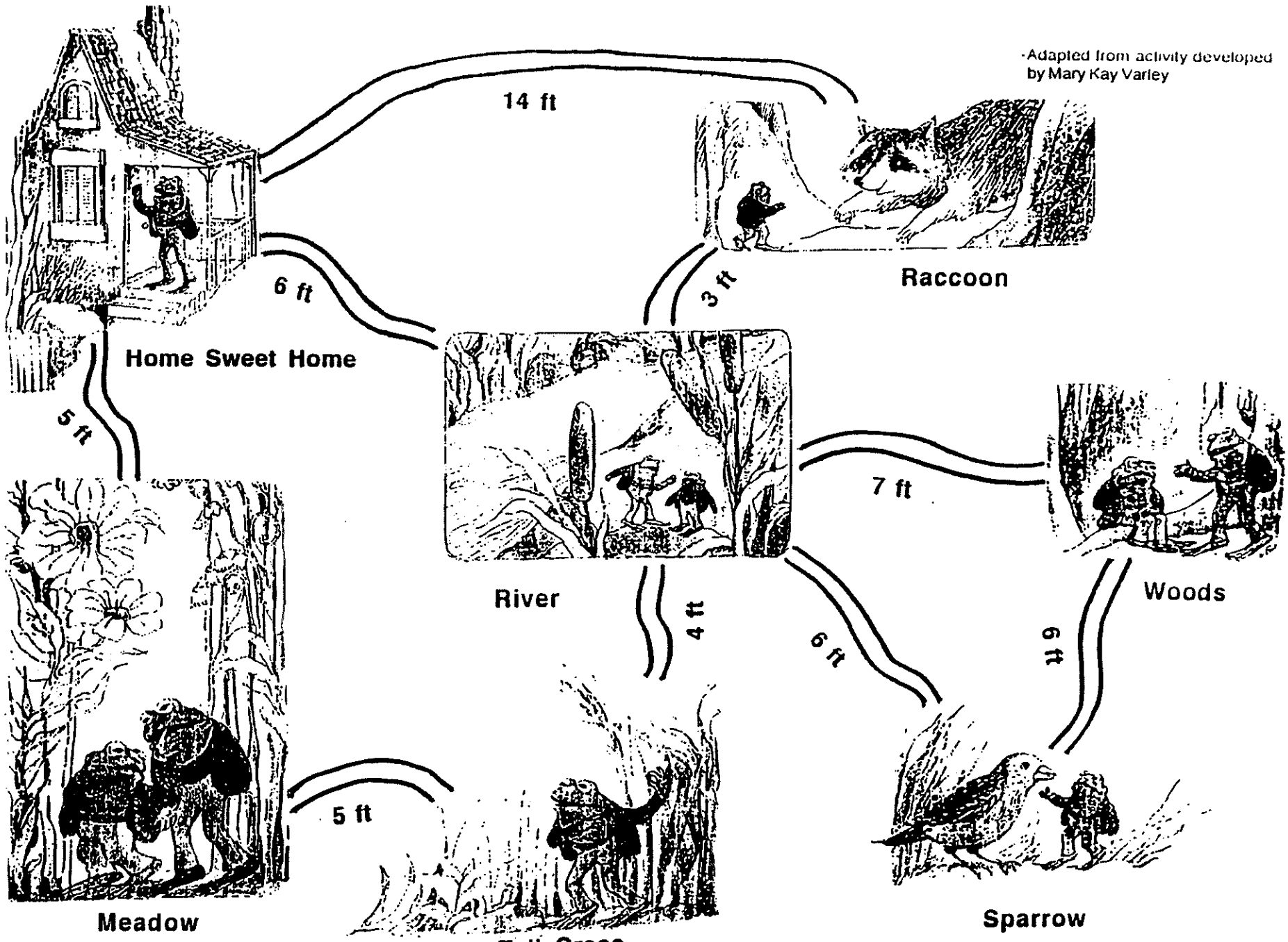
Hey! Get Off Our Train

John Burningham



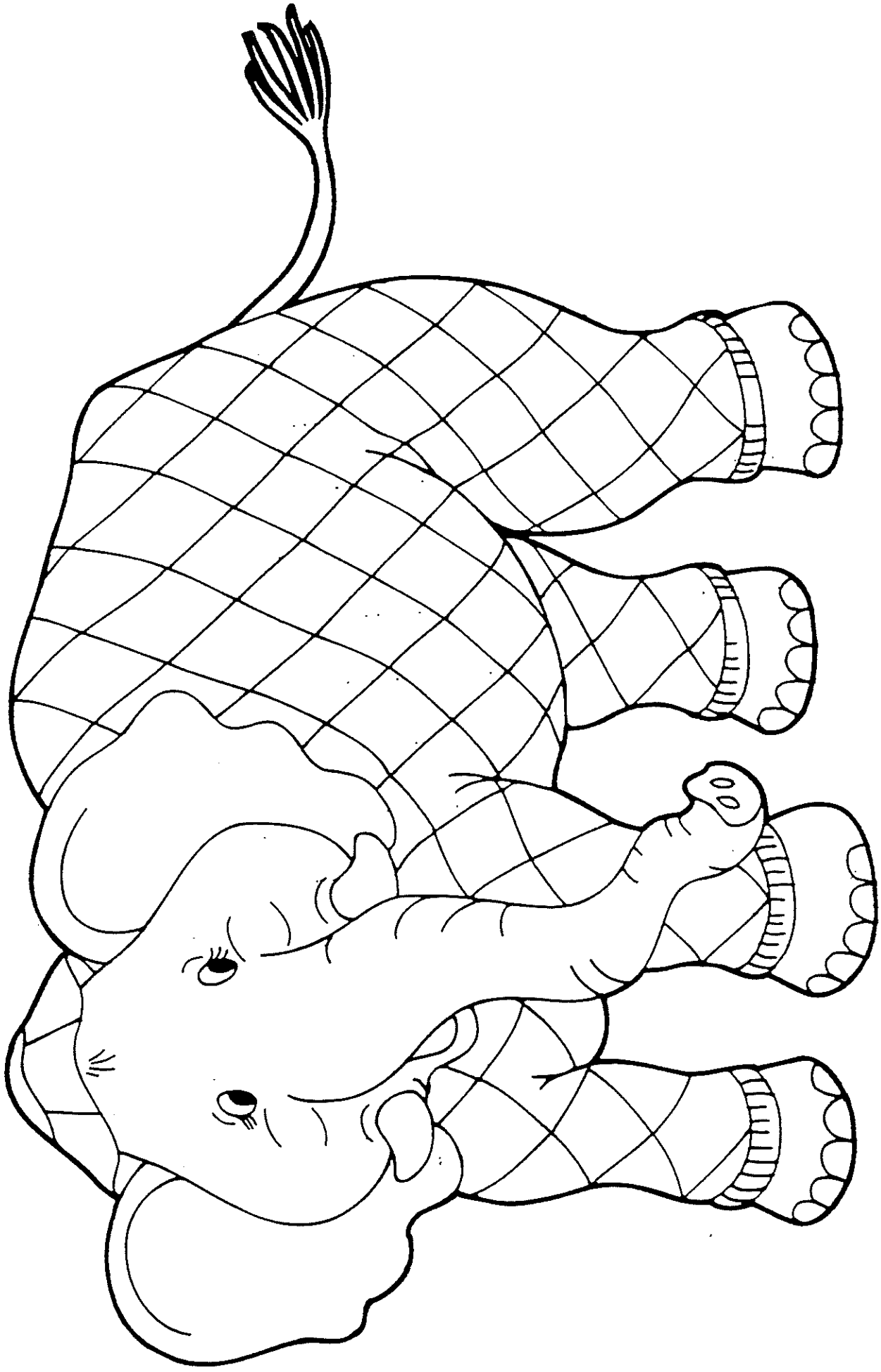

A Caldecott Honor Book
LEVEL 2 Grades 1-3
Frog and Toad Are Friends
Arnold Lobel

FROG AND TOAD'S NEIGHBORHOOD

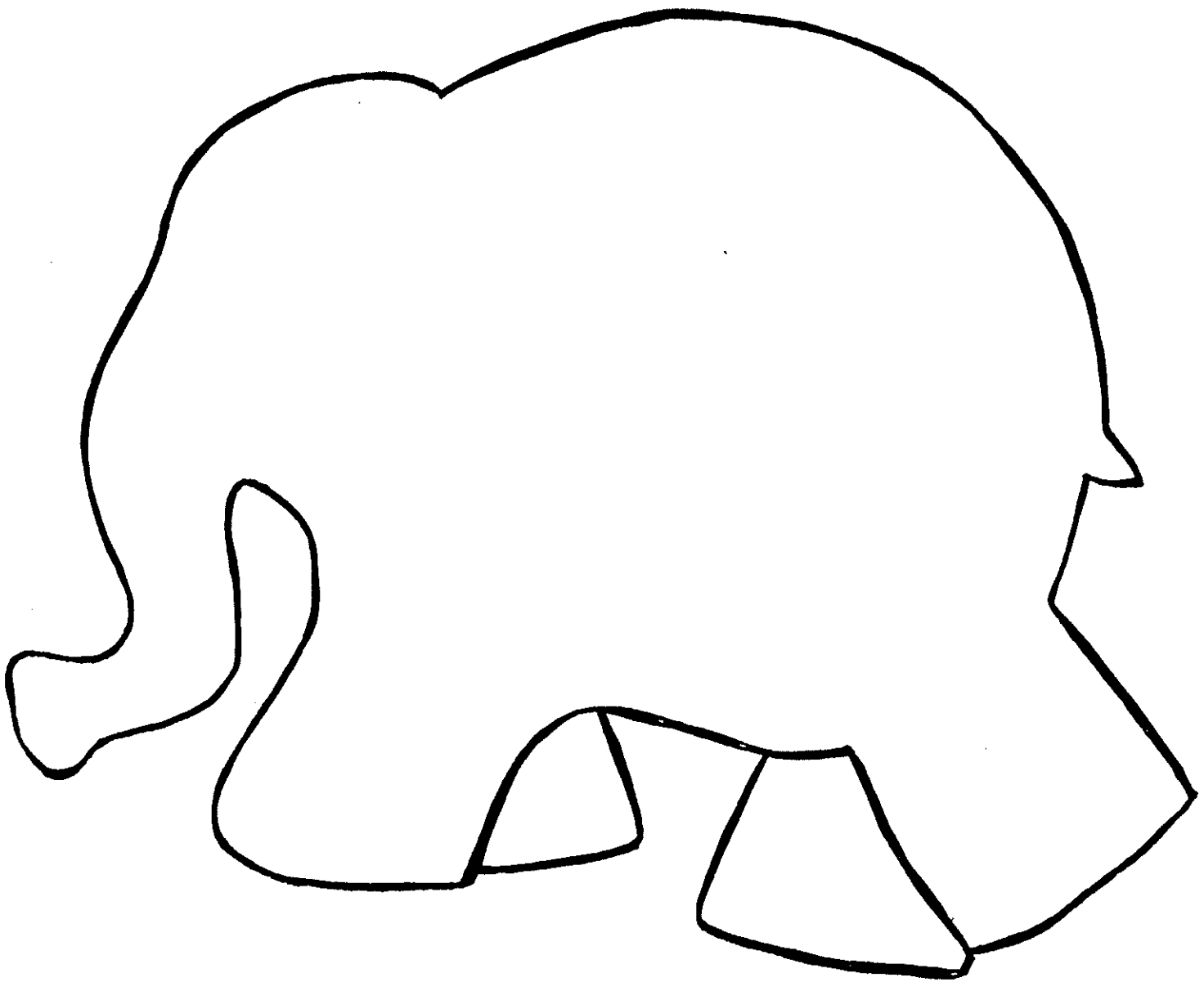


Adapted from activity developed by Mary Kay Varley

ELMER by David McKee



Color Elmer with the fewest colors. When you color, areas that share a border (edge) must be different colors. Think before you color.



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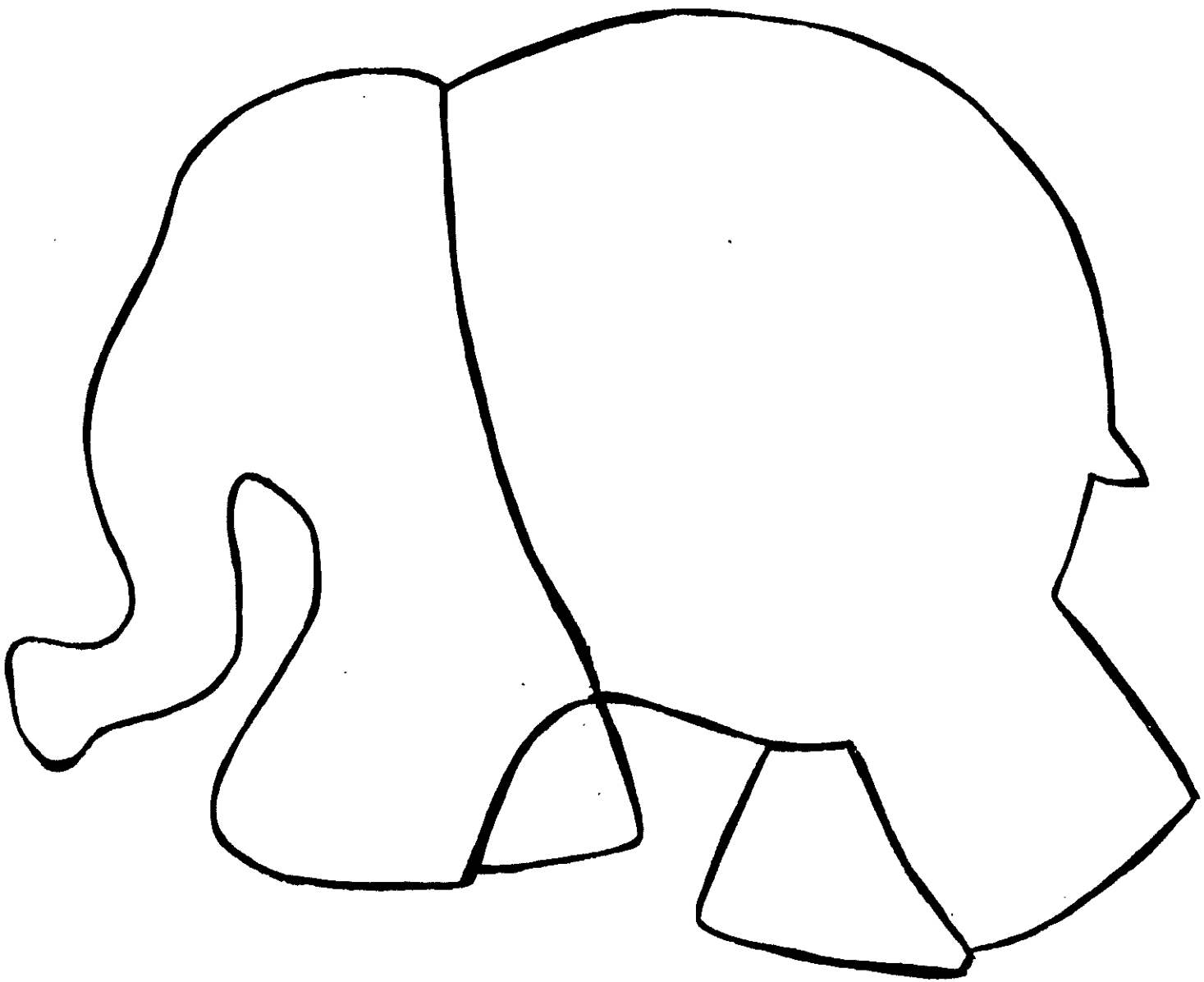

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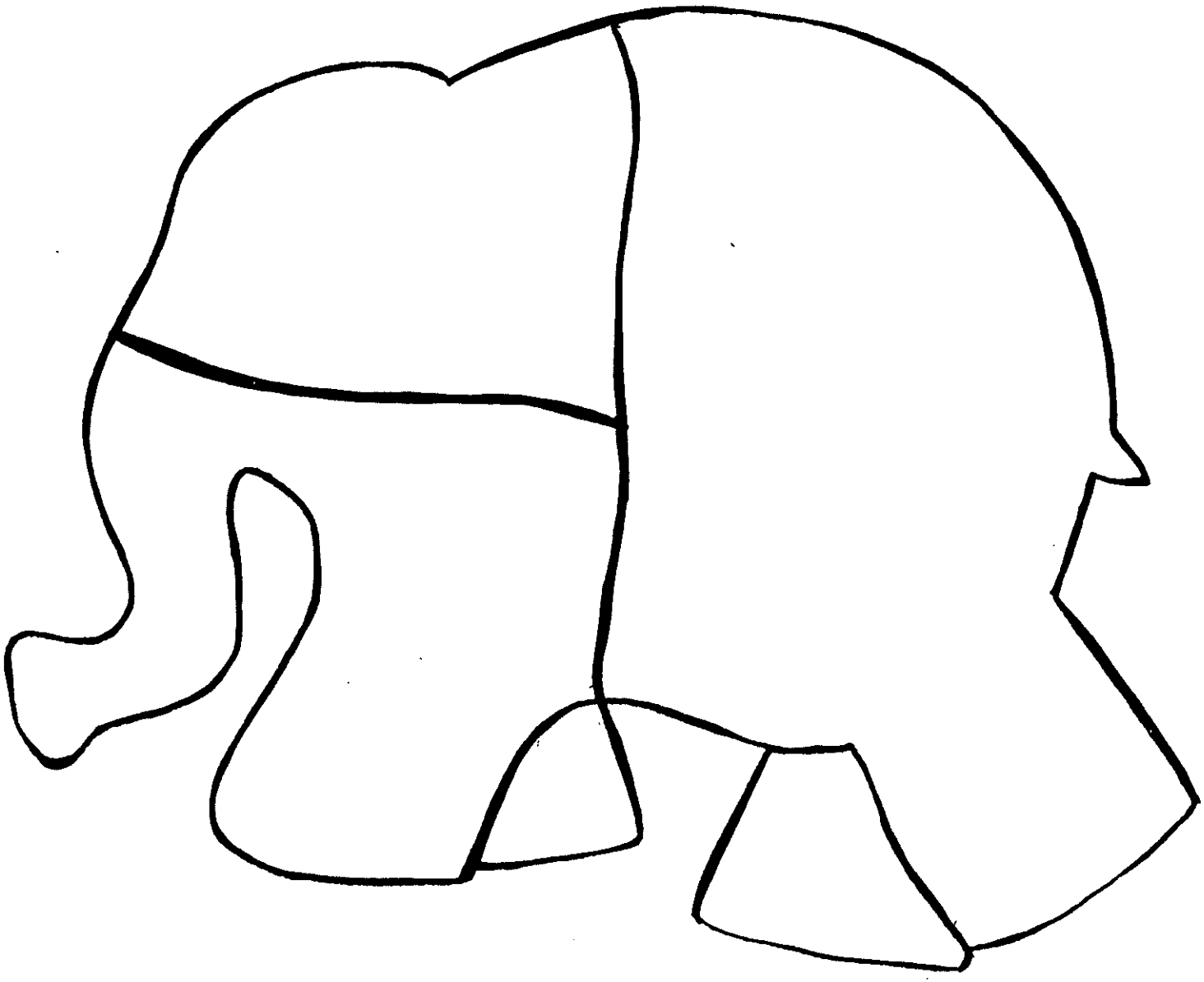

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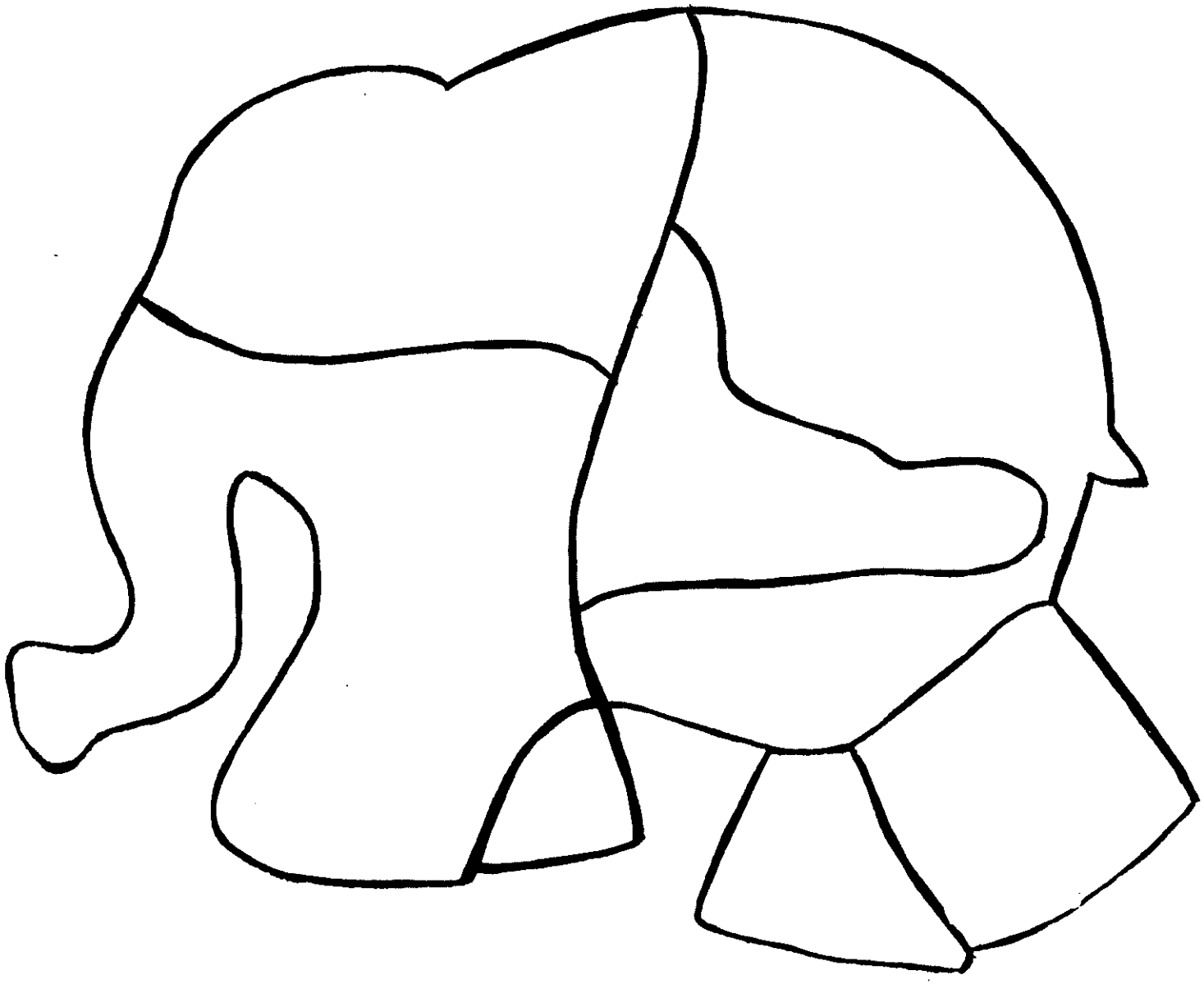

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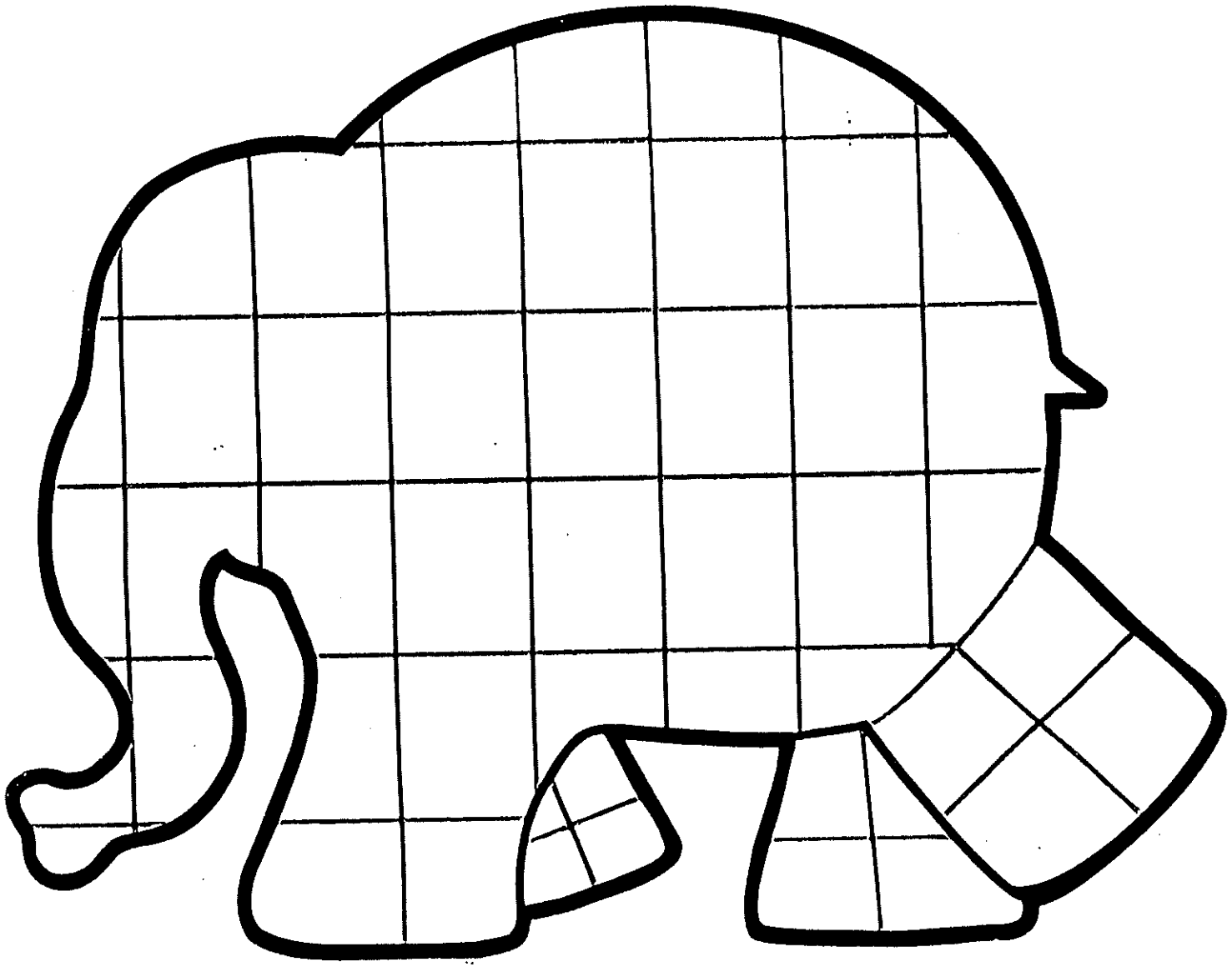
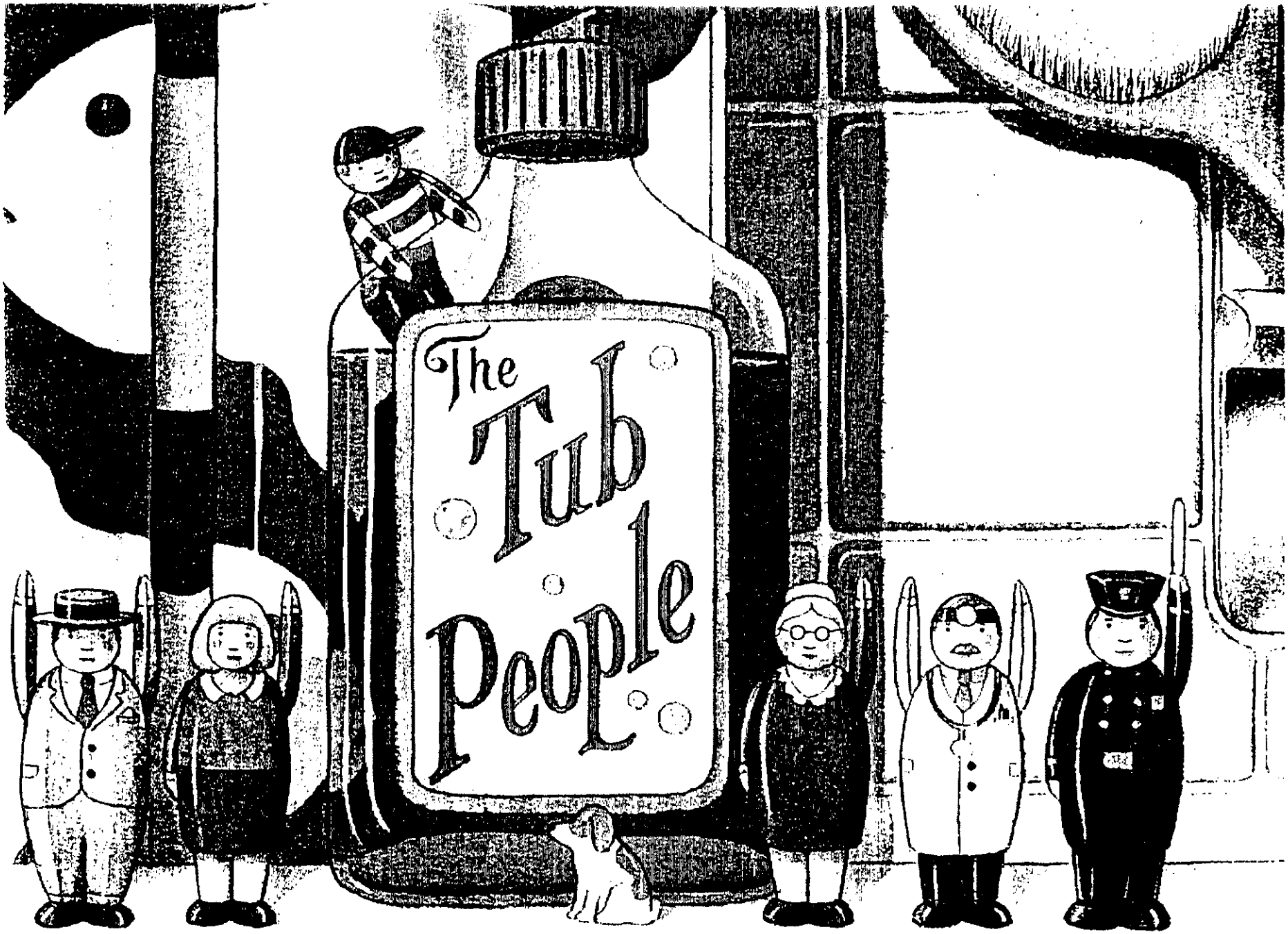
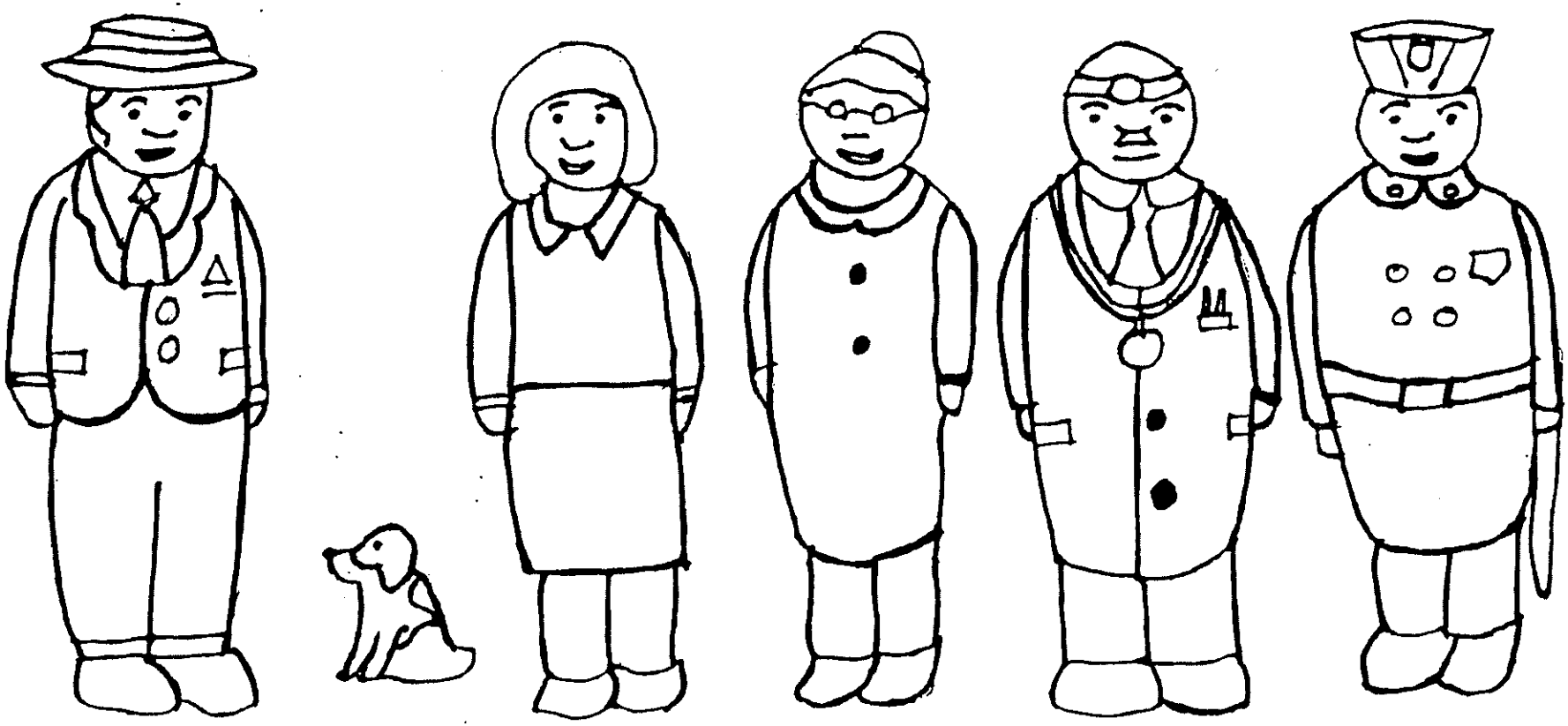


Prepared by Rutgers Leadership Program in Discrete Mathematics Wksp/Wksp TSP #10



BY PAM CONRAD ILLUSTRATIONS BY RICHARD EGIELSKI

THE TUB PEOPLE

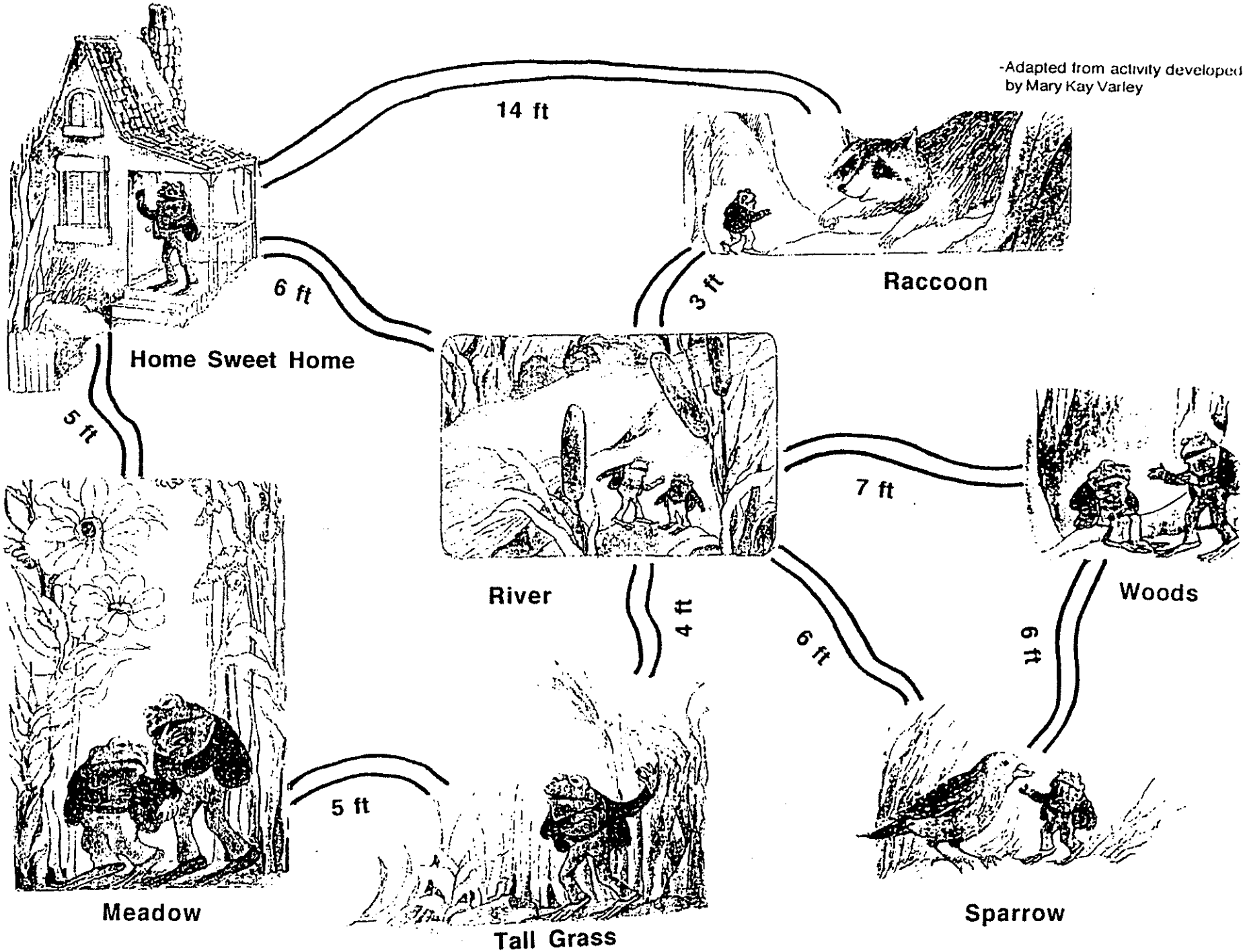


ALL ABOARD

Directions: The five endangered animals boarded the train in the following order: elephant, seal, crane, tiger, polar bear. They boarded in groups of either one or two at the time. How many different ways could the animals board the train? How many ways could the elephant (one animal) board the train? How many ways could the elephant and seal(two animals) board the train? Continue listing for groups of three, four, and five animals, always keeping the same order. Try to find a pattern and predict the number of ways ten animals could board the train.

Number of Animals	Ways to Board	Total # of Ways
1		
2		
3		
4		
5		
6		

FROG AND TOAD'S NEIGHBORHOOD



TOAD LOSES A BUTTON

1. Can Frog and Toad visit each place (vertex) only once on their walk and be able to return home? List or describe the paths they could take.

2. What is the shortest route Frog and Toad could take on their walk through their neighborhood? Describe the path and tell the distance.

3. What have you learned about paths and circuits? Try to include new vocabulary words you have learned.

-Adapted from activity developed by Mary Kay Varley

WHICH WAY DO I GO?

Constructing a tree diagram is one method of listing all the possible paths on a graph. Use the space below to create a tree diagram for finding the shortest path/circuit for Frog and Toad to follow.

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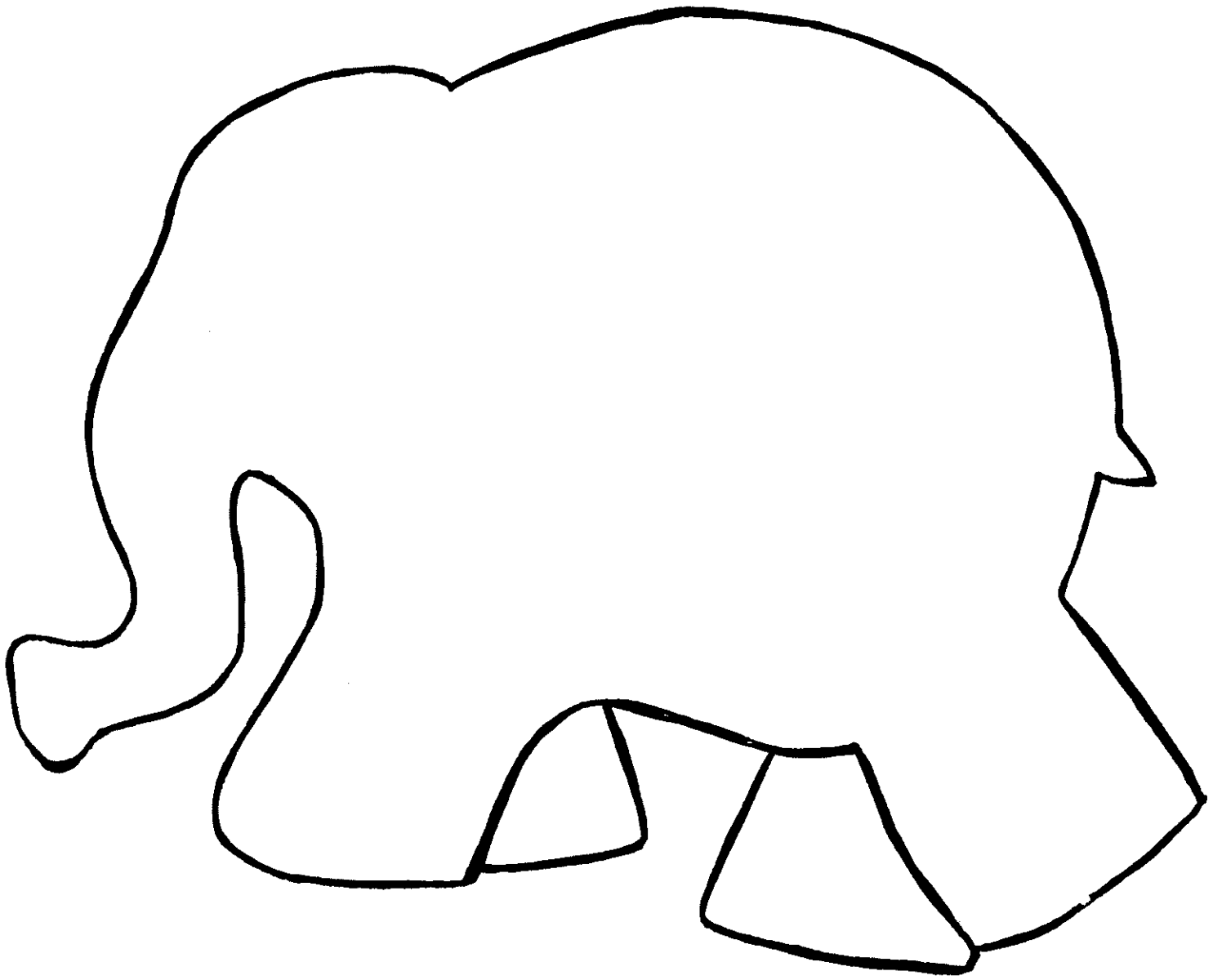

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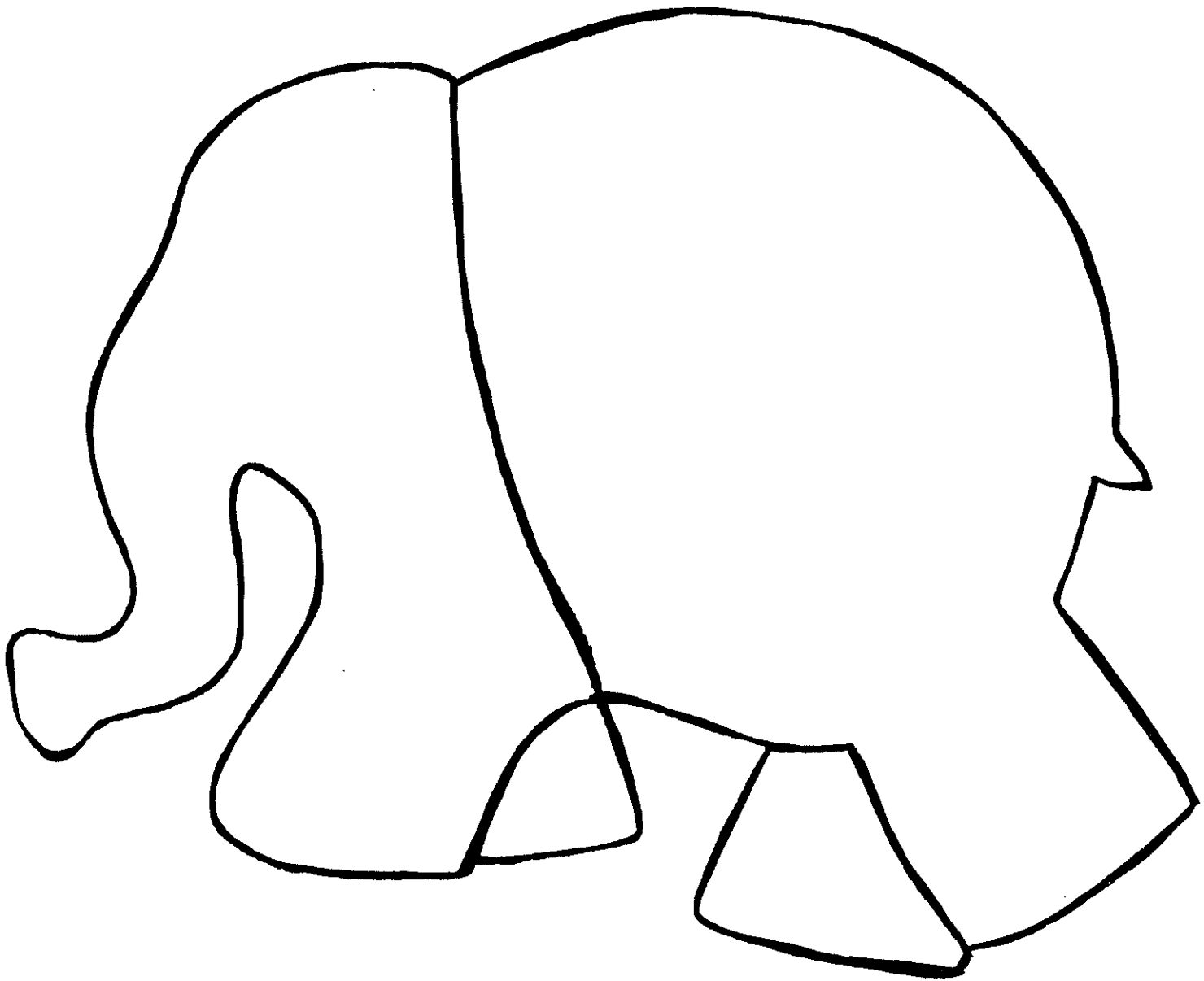

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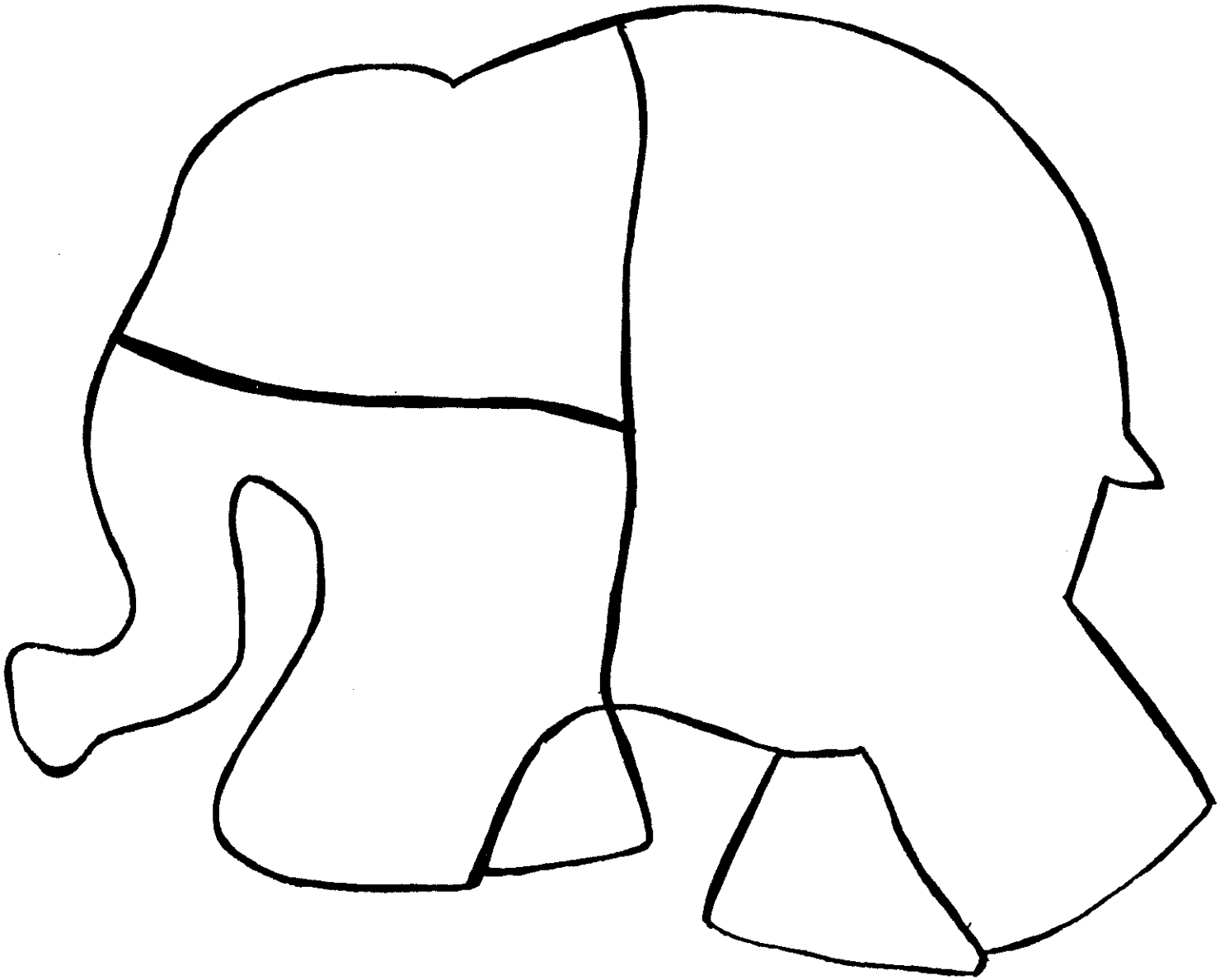

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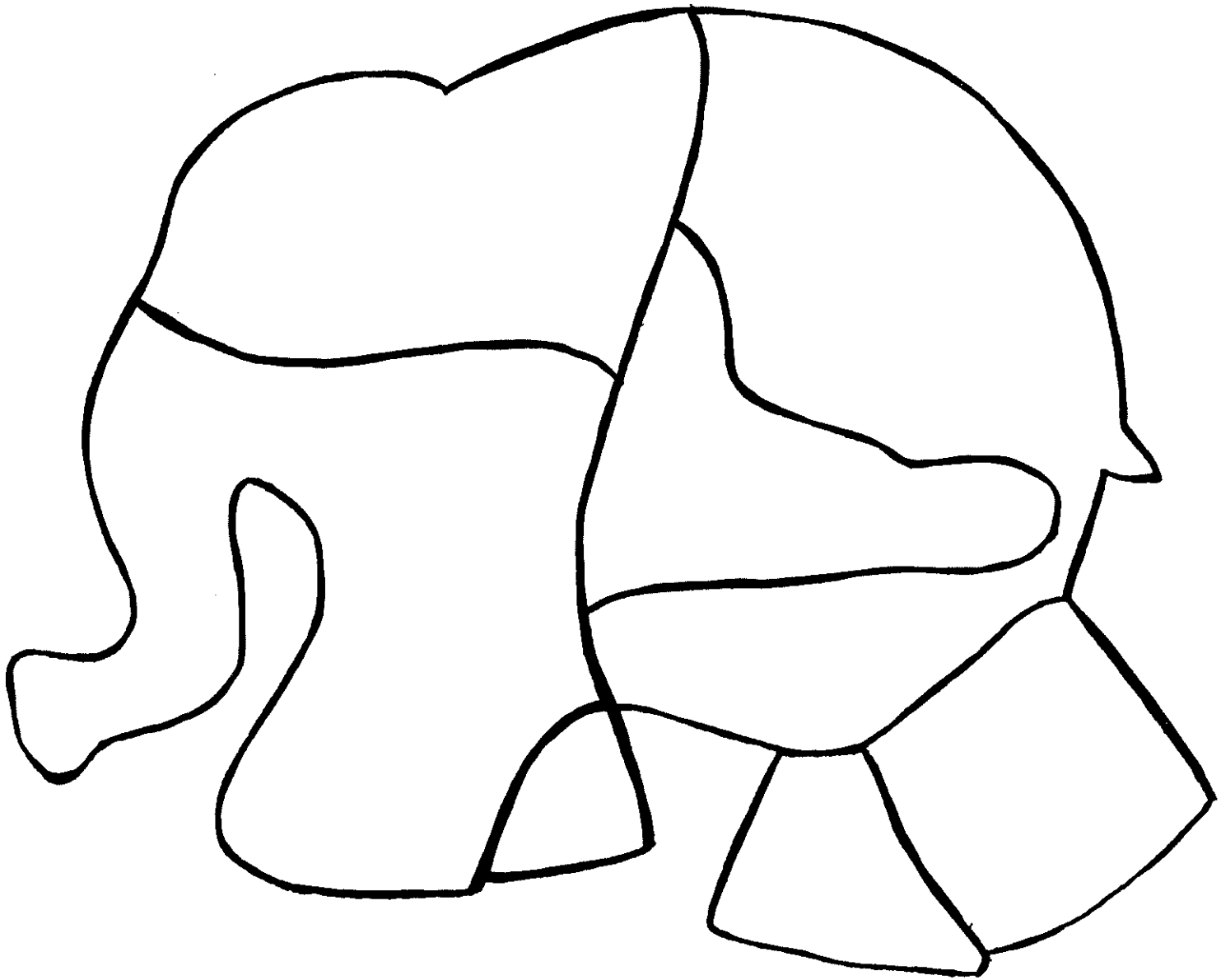

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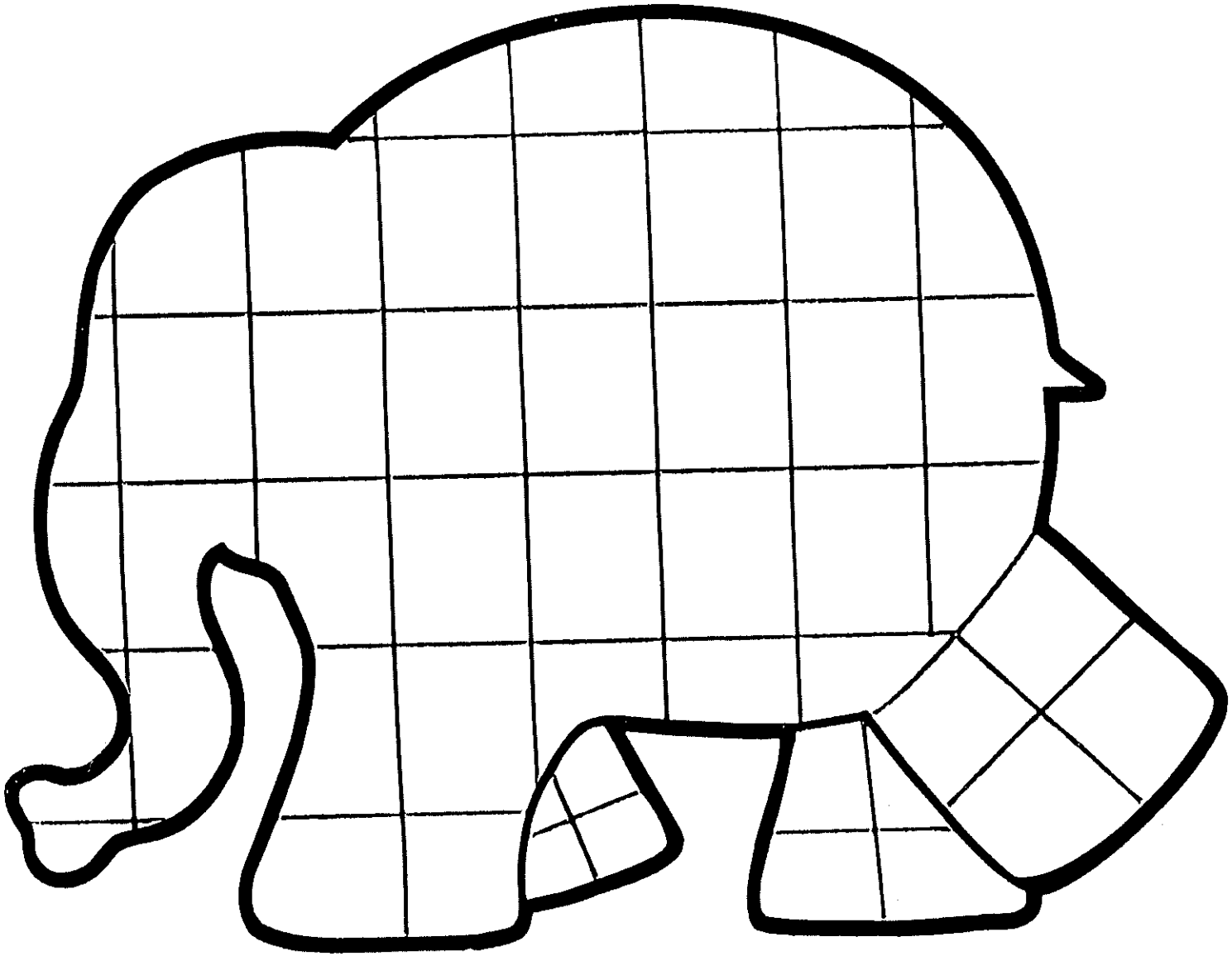


RUB-A-DUB-DUB

1. How many ways can you arrange three tub people in one row? Draw a diagram, list, or describe your answer.

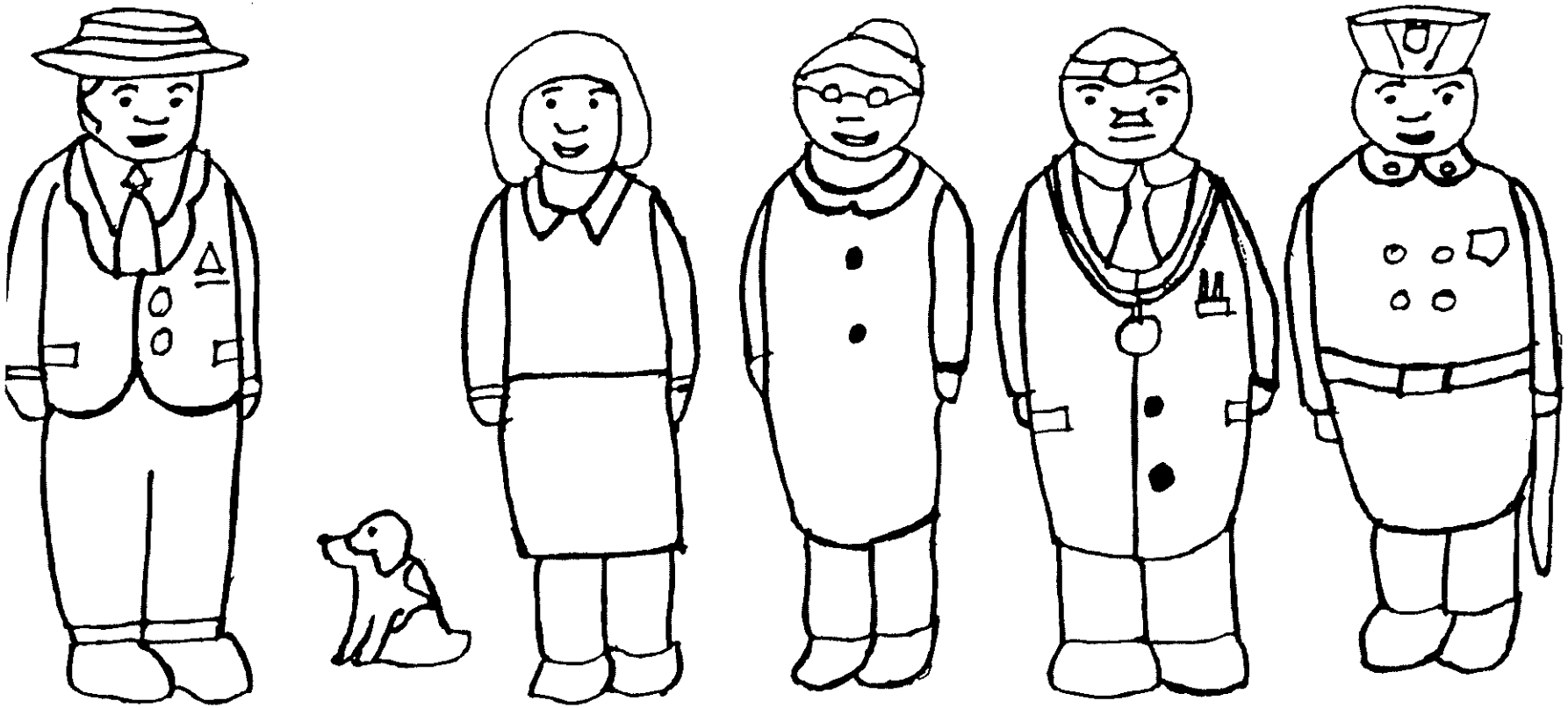
2. Now add a fourth person. How many arrangements can you make? Show your work.

3. What pattern do you see? _____

_____

4. On the back of this page write to tell how you solved these problems. What steps did you take?

THE TUB PEOPLE



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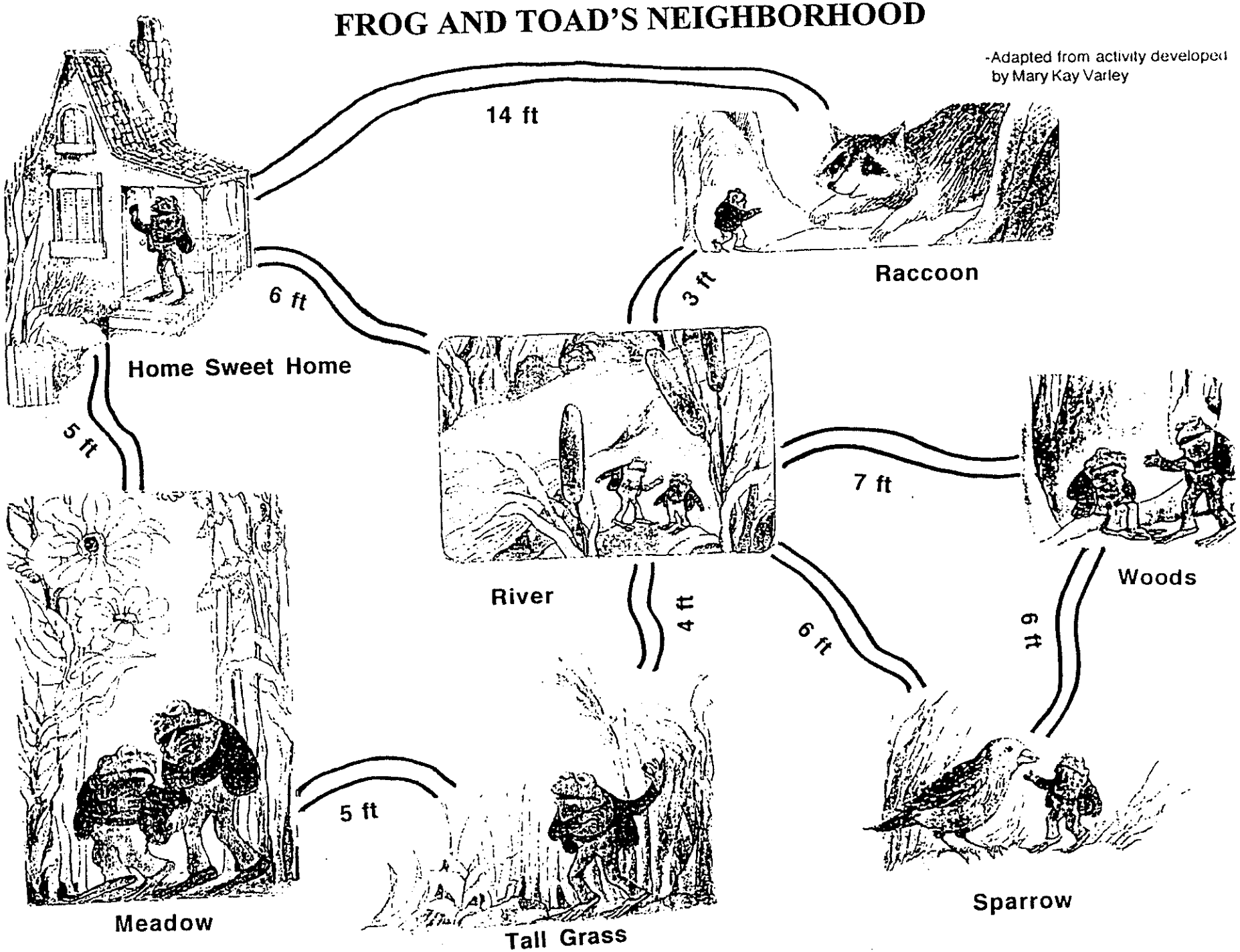

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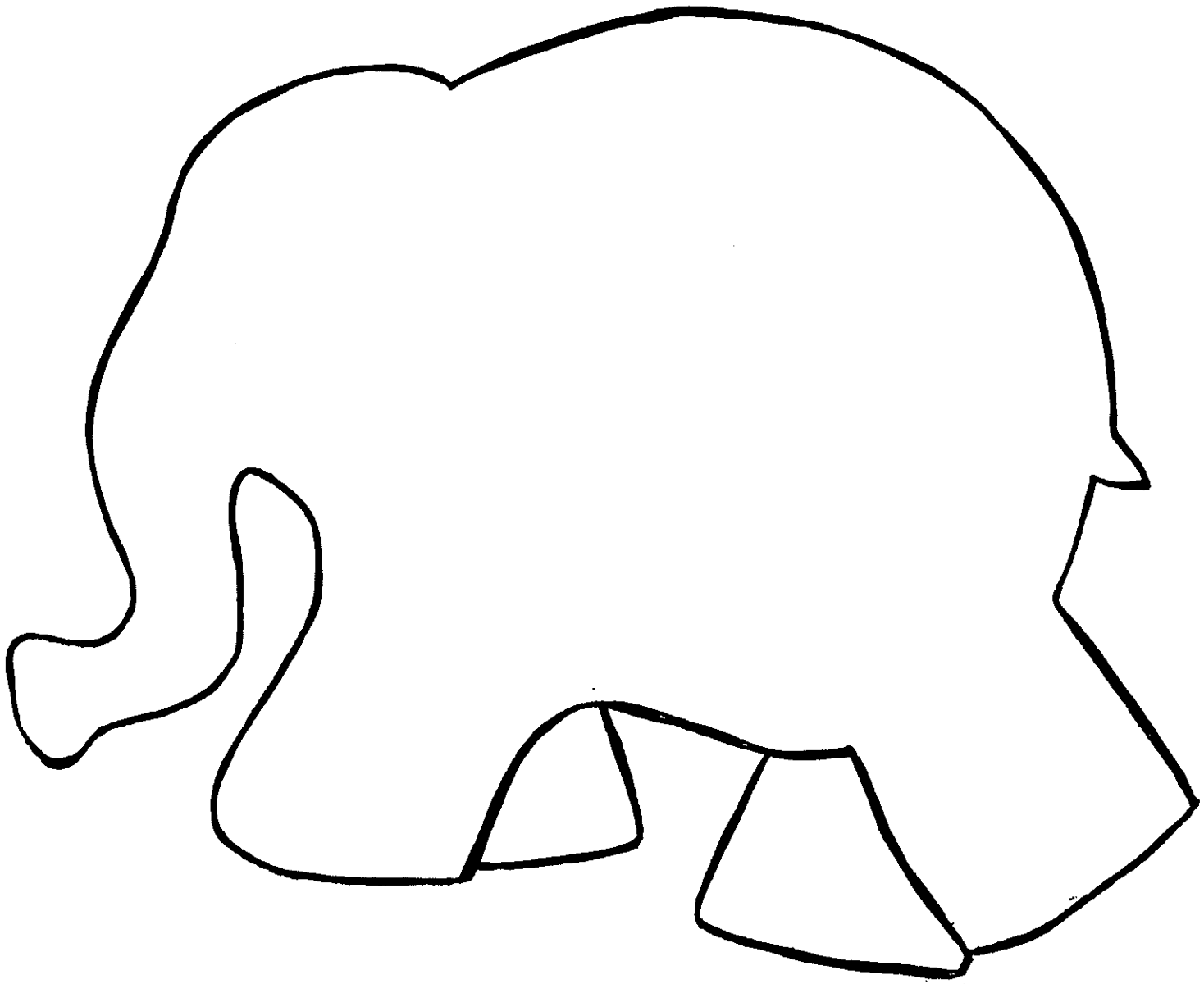

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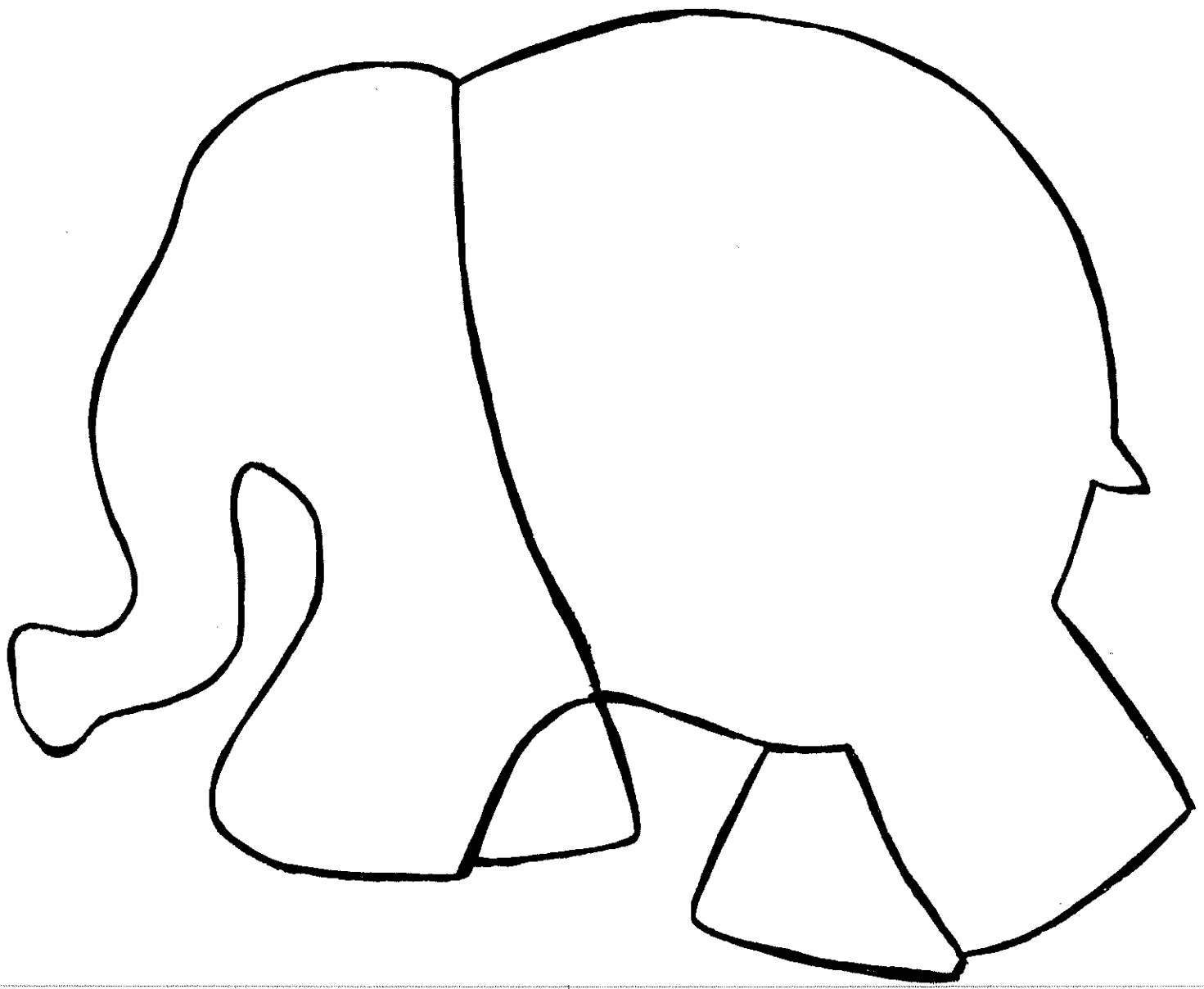
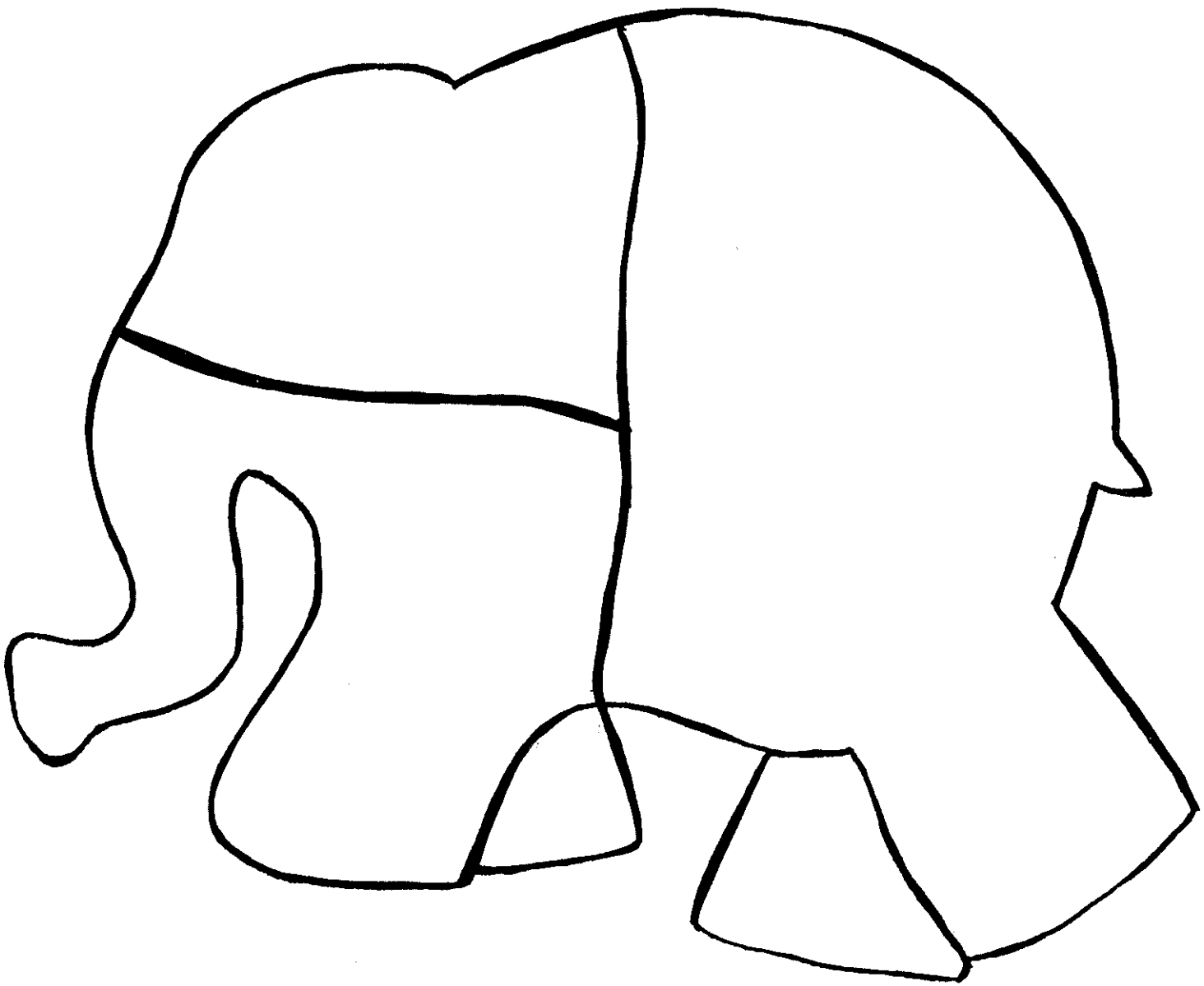
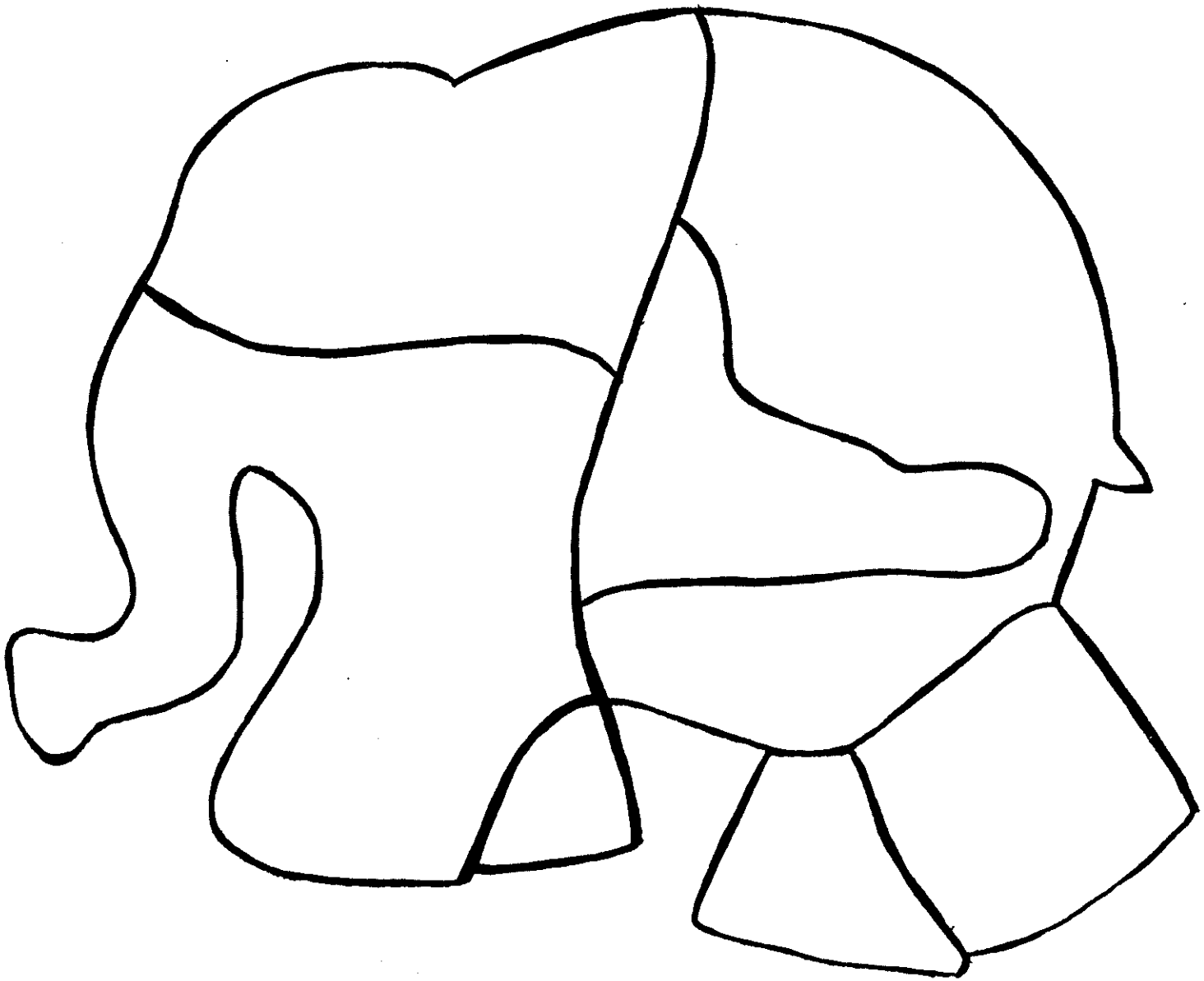


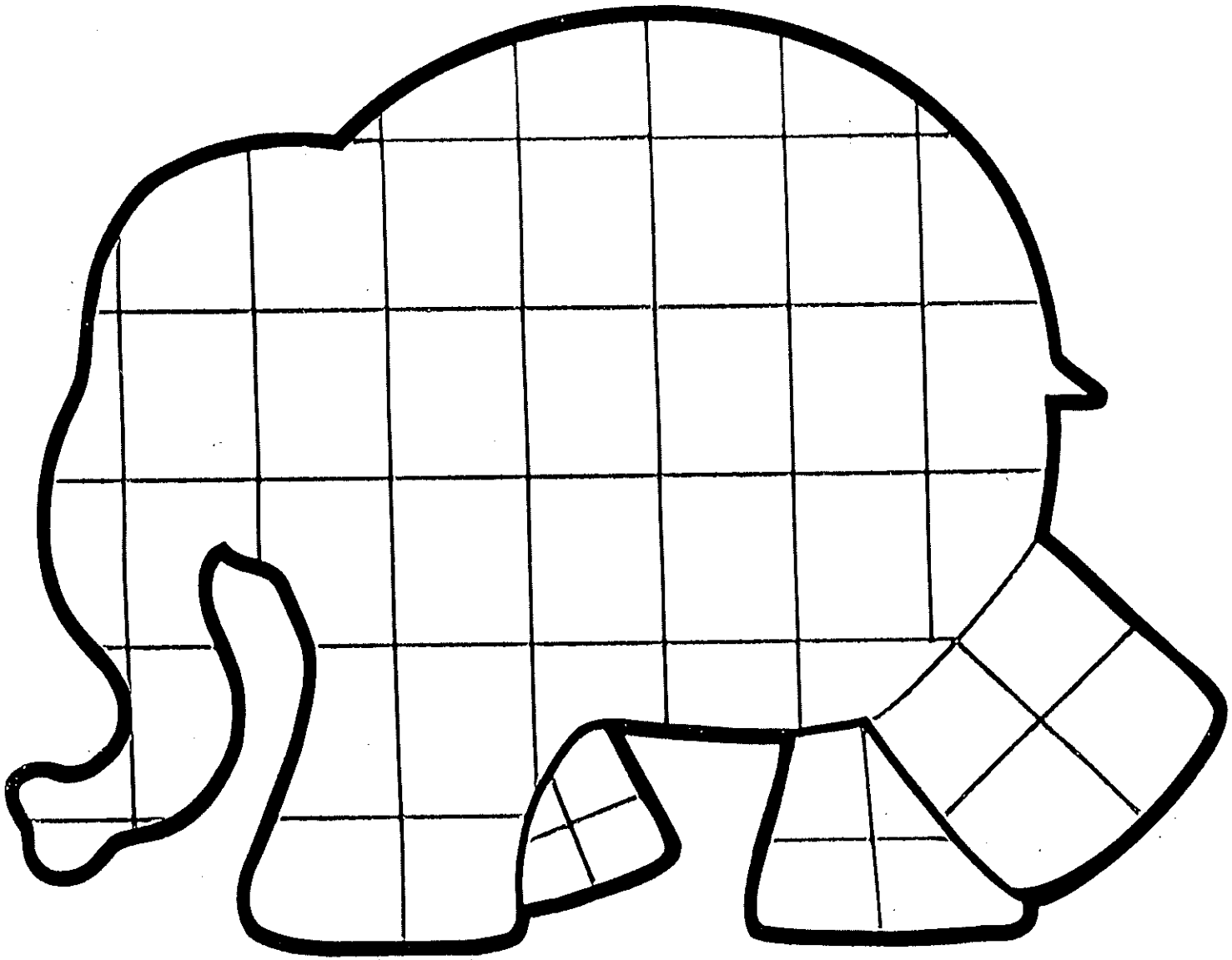
Color Elmer with the fewest colors. When you color, areas that share a border (edge) must be different colors. Think before you color.



Color Elmer with the fewest colors. When you color, areas that share a border (edge) must be different colors. Think before you color.



Color Elmer with the fewest colors. When you color, areas that share a border (edge) must be different colors. Areas that meet at a point (vertex) or that don't share an edge, may be the same color. Think before you color.



RUB-A-DUB-DUB

1. How many ways can you arrange three tub people in one row? Draw a diagram, list, or describe your answer.

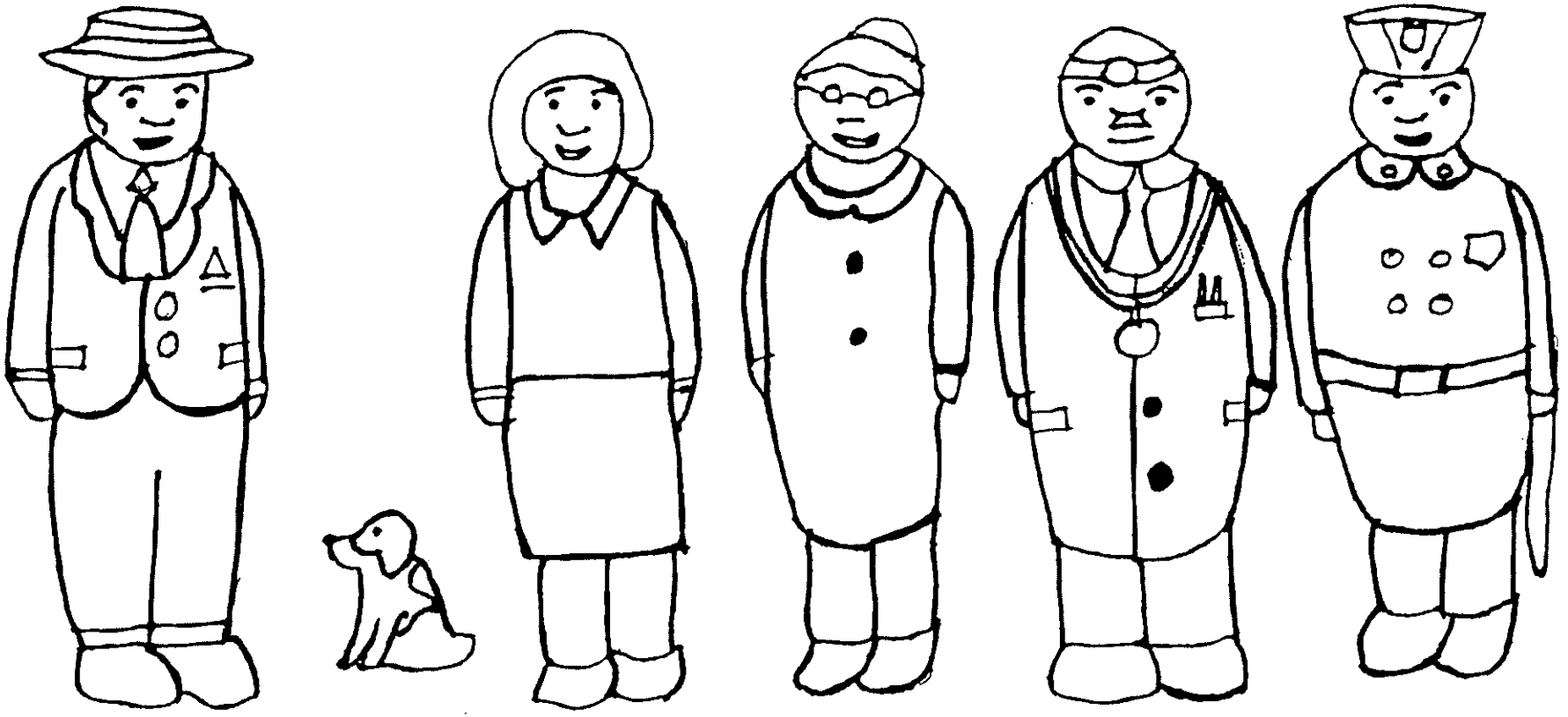
2. Now add a fourth person. How many arrangements can you make? Show your work.

3. What pattern do you see? _____

_____

4. On the back of this page write to tell how you solved these problems. What steps did you take?

THE TUB PEOPLE



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