LESSON 1:

HOW ARE WE ALIKE? HOW ARE WE DIFFERENT?

SCIENCE

K - 5TH GRADE

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INTRODUCTION

The *Genomic Logic for Underlying Morphological Divergence (EPSCoR)* project aims to bring science-related learning experiences to schools. This lesson is the last of six, designed to facilitate learning the concepts of biodiversity (lesson 1), adaptation (lesson 2), evolution (lesson 3), plant and animal structures (lesson 4), heredity (lesson 5), and the care of butterflies (lesson 6). These lessons will serve as a tool for the trainer or professional in charge of teaching (teacher, professor, among others). For participants, they can be teachers (as part of their professional development) or students.[1]

In this first lesson, the instructors or teachers of the elementary level, and their students, will actively participate in some activities where they will understand the principles of biodiversity. Emphasis will also be placed on the similarities and differences between some given species, and to recognize structural similarities and differences between plants and animals.

This lesson includes:

- ✓ Scientific background of the concepts
- ✓ Glossary
- ✓ Alignment of the content to the standards, expectations, and specificities of the Department of Education of Puerto Rico (DEPR)
- ✓ Educational Process
- ✓ Detailed activities to carry out in the classroom.

[1] Unless otherwise stated, the neutral term will be used with nouns such as teacher/s, participant/s, professor/s, instructor/s, and/or student/s.

TEACHER'S GUIDE

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SUBJECT: Science **LEVEL:** Elementary (K-5)

CONCEPTS: biodiversity, species, adaptation, evolution, plant and animal structures, heredity

PRIOR KNOWLEDGE: similarities and differences, characteristics of living beings

SPECIFIC LEARNING OBJECTIVES

Conceptual objectives:

- To identify similarities and differences among given species.
- To interpret information related to the concepts of species and biodiversity.
- To recognize structural similarities and differences among plants and animals.
- To recognize characteristics that help a species to survive in a given environment.
- To define adaptation.
- To define evolution.
- To mention mechanisms that help a species to survive (for example: camouflage).
- To describe plant (host plants) and animal (butterflies) structures.
- To describe the phases of the life cycle of a plant and the life cycle of a butterfly.
- To describe the morphology of butterfly wings.
- To distinguish that progeny (offspring) comes from given progenitors (parents).
- To identify and mention the characteristics that are transmitted and kept from parents to offspring.
- To discuss and understand the order of events in butterflies' life cycle.
- To write, draw, and create a folded book (or accordion-type book) to capture the observations of the monarch butterfly.
- To mention how human intervention can contribute or affect the availability of a species.

Procedural objectives:

- To observe and identify organisms that share similar and different characteristics, and that belong to the same species.
- To use drawings and diagrams to explain structural similarities among species.
- To investigate how the butterfly arose (its evolutionary history).

Attitudinal objectives:

- To value and show appreciation for nature and life's diversity.
- To recognize the importance of taking care of biodiversity.
- To reflect upon the fragility of a species to grow and how we can look after it.
- To accept, respect, and recognize the works and ideas of others.

STANDARDS, EXPECTATIONS AND SPECIFICITIES:

Grado: 1-3ro

Indicadores según los estándares de contenido

Estándar: Estructura y niveles de organización de la materia

- Reconocer las similitudes estructurales y las diferencias entre los humanos, las plantas y los animales (puede usar dibujos, esculturas o representaciones teatrales).
- Hacer observaciones con el propósito de describir las estructuras que necesitan las plantas y los animales para sobrevivir y crecer.
- Desarrollar argumentos lógicos sobre el hecho de que las plantas y las crías se parecen mucho a sus progenitores, pero no son exactamente iguales a ellos.

Estándar: Conservación y cambio

- Interpretar información relacionada con el concepto de biodiversidad haciendo énfasis en el aprecio por la naturaleza y la diversidad de la vida.
- Reconocer que la materia (seres vivientes y no vivientes) cambian a través del tiempo.
- Describir los patrones de cambio en la materia.
- Reconocer que la reproducción es una forma de conservación de los seres vivientes.
- Deducir que los seres vivos cambian a través del tiempo.
- Identificar las características que se transmiten y se conservan de generación en generación

Estándar: Interacciones y energía

- Construir un argumento a partir de evidencia para explicar que en un ambiente particular, algunos tipos de organismos sobreviven mejor, otros viven con más dificultad y otros no logran sobrevivir.
- Explicar cómo las variaciones en características entre individuos de la misma especie ofrecen ventajas para sobrevivir, encontrar pareja y reproducirse.
- Describir el ciclo de vida de los organismos (nacimiento, crecimiento, reproducción y muerte).
- Analizar e interpretar datos para proporcionar evidencia de que las plantas y los animales tienen características heredadas de sus progenitores, las cuales varían dentro de los organismos que pertenecen a un mismo grupo.
- Explicar cómo las variaciones en características entre individuos de la misma especie ofrecen ventajas para sobrevivir, encontrar pareja y reproducirse.
- Comparar datos de distintas áreas y establece conexiones entre la biodiversidad y las condiciones ambientales.
- Observar plantas y animales para comparar la diversidad de la vida en una variedad de hábitats.

Grado 4-5to

Indicadores según los estándares de contenido

Estándar: Estructura y niveles de organización de la materia

- Mencionar y argumentar sobre las ventajas funcionales de las adaptaciones estructurales en los seres vivos.

Estándar: Conservación y cambio

- Definir, identificar y utilizar evidencia para elaborar argumentos sobre los mecanismos adaptativos en las plantas y animales que le permiten sobrevivir y reaccionar a cambios en el ambiente.
- Identificar formas para conservar la supervivencia de los organismos en su ambiente.
- Reconocer que la reproducción es necesaria para perpetuar la especie.
- Inferir en que la reproducción permite conservar o cambiar algunas características de las especies.
- Explicar los cambios relacionados con la forma, estructura y funciones vitales en los organismos.
- Reconocer que los organismos tienen ciclos de vida y cambian a través del tiempo.
- Reconocer que la forma, la estructura y las funciones vitales de los organismos pueden cambiar a través de sus etapas de desarrollo.

BACKGROUND

When we talk about **adaptation**, we refer to the characteristics that a species possesses that gives it the capability of survival in the environment it inhabits. A **species** is a group of organisms that share the same characteristics that can cross and produce a fertile descendance. However, individuals of one same species can show mild variations. These variations may be favorable or unfavorable. This lets the species survive in a particular environment. Depending on environmental factors, after many generations, a population can look very different. Adaptations can be **structural** or **physiological**. Butterflies are a particularly strong example of structural adaptations. These adaptations in butterflies include the way in which they use **mimicry**, **camouflage**, and even their capability to fly. Some examples of adaptations that butterflies possess are:

Camouflage = The principal structural adaptation of butterflies is in their wings and how they use them to hide. The wings of many species have evolved to imitate its surroundings, with the common green as a particularly good example. These butterflies have wings that have a color and shape that match exactly to the leaves in which they are found, which makes it more difficult for predators to find them.

Disguise and subterfuge = Many butterflies have developed “eye spots” on their wings. When their wings are open, these spots give the butterfly the appearance of a much larger creature, terrifying possible predators. In that same way, viceroy butterflies deliberately imitate the appearance of a monarch butterfly, which has evolved to be toxic upon consumption. As a result, predators avoid hunting both species. Another example that we can mention are the colors of *Heliconius*, who have red because animals associate it with a bitter taste.

Delight = Butterflies are cold-blooded creatures, which means that they need to heat their wings before taking off. That is where they are more vulnerable to predators, but it is a vital part in the progress of the butterfly. Butterflies may simply fold their wings if they overheat.

Sensibility to light = Every fourth generation of monarch butterflies migrates 2,000 miles (3,220 kilometers), traveling from as North as Canada to places to hibernate in Mexico. Monarch

butterflies use their antennae to detect the basic level of light around them. This lets them know the time of the day depending on the amount of light that they can see, which also lets them stay alert.

Examples of adaptation in living beings

Species	Adaptation	How can adaptation help it survive in the environment?
Crocodiles	Digestive apparatus	Adapted to ingest a large variety of preys
Fish	Travel	It is favored by the wavelike movements of its body
Horse	Growth in size	To face prairie predators
Wolves	Development of muscles for chewing	It makes it easier to chew their prey
Anteater	Tail	It works as a coat
Mollusks	Large muscular foot	It allows them to set themselves on the sand to travel
Primates	Fingers	To collect tree branches
Butterflies	Camouflage	It allows them to imitate its surroundings with makes it harder for predators to find them

GLOSSARY

1. **Similarity** – relation among people, animals or things that have common traits.
2. **Difference** – quality that lets something distinguish itself from another thing.
3. **Species** – group of organisms that can interbreed to produce fertile descendants.
4. **Biodiversity** – variety of organisms in our Planet.
5. **Adaptation** – trait form an animal that helps it survive in a specific environment.
6. **Structural adaptations** – adaptations that include changes in structure of some parts of the species' body.
7. **Mimicry** – structural adaptation that provides protection to an individual, letting it copy the appearance of other species.
8. **Camouflage** – structural adaptation that lets the individual blend into its surroundings. It involves the individual's change in color.
9. **Physiological adaptations** – changes in metabolic processes of an organism.
10. **Evolution** – change in inheritable traits of a population through time.

EDUCATIONAL PROCESS

BEGINNING

In this activity the knowledge that participants have about the terms *similarity* and *difference* is explored.

1. The teacher will use the game **"Simon says"** to establish that the students understand the meaning of the terms: *similarity* and *difference*.
2. For example: the teacher says to the students "Simon says: touch your nose," "Simon says: touch your legs," "Simon says: touch your ears," etc.
3. The teacher may repeat some instructions so that students touch various parts of their bodies.
4. Then, the teacher proceeds to tell the students the following instructions: "Simon says: touch your seat's nose."
5. Students are expected to answer that their seat does not have a nose.
6. The teacher reflects with the students:
   a. When I asked you to touch your nose, legs, and ears, all of you did it; but when I asked you to touch the nose of your seats, you told me that the seat does not have a nose.
7. Why do you have noses and seats do not?
   Expected answer: because we are different from seats.
8. The teacher instructs the students to mention some similarities that people share, besides all of them having a nose. In other words, mention other parts that all people have in common.
   Expected answers: All people have legs, eyes, a head, ears, etc. (unless they have suffered an accident).
9. The teacher resumes the activity by asking the students, "is it correct to say that similarities are characteristics that are shared or are the same among people, among animals, or among some objects?"
   Expected answer: Yes, they are the characteristics or things we have in common.
10. On the other hand, the teacher asks the students, "Could you say that differences are the characteristics or qualities that distinguish a person, animals, or objects from one another? In other words, they are the characteristics that make us different."
    Answer: Yes, differences distinguish a person, animal or object from others.

DEVELOPMENT

Lesson #1: How are we alike? How are we different? Worksheet #1

Materials:

1) PowerPoint presentation
2) Worksheet
3) Crayons or colored pencils

Procedure:

1. The teacher starts the activity by reviewing the terms *similarity* and *difference* with the students (the teacher may mention the exploration task).
2. The teacher uses pictures or a PowerPoint presentation to show the student various pictures of organisms. These images may include plants, butterflies, birds, bees, etc.
3. The students are asked to group organisms according to their similarities (some characteristics they may have in common).
   Answers: Butterflies, bees and birds can fly because they have wings. Plants A and G cannot move from one place to another like the rest of the organisms, they have leaves and flowers. Organisms C, D, and F are butterflies. Organisms B, C, D, and F are insects because they have wings, antennae, but do not have feathers like the pigeon.
4. The teacher asks the students to indicate if organisms B, C, D, and F would be classified in the same group of insects.
   Answers: No, organisms C, D, and F are butterflies and organism B is a wasp.
5. The teacher asks the students if butterflies C, D, and F are similar or share some characteristics.
   Answers: Yes, they have wings, antennae, and legs, but the colors of the wings of butterflies C and D is different to butterfly F.
6. The teacher explains to the students that all organisms have specific characteristics that distinguish them from other organisms and that organisms that share characteristics are said to belong to the same **species**. A **species** is a group of organisms that can cross to produce fertile (that can also produce offspring, too) descendance (offspring).
7. Do organisms D and F belong to the same species?
   No. Although both are butterflies, they do not have the same shape and coloration on their wings.
8. And butterflies C and D, do they belong to the same species? Do you observe any differences among them?
   Yes, they belong to the same species.
   If students do not mention the black spot that the monarch has with letter C, the teacher may indicate that this spot is an easy way to identify a male monarch butterfly. Then we can say that butterfly F belongs to a different species tan butterflies C and D.
   Answer: Yes
9. And plants A and G, do they belong to the same species? Do you observe any similarities among them?
   Answer: Yes. Both plants belong to the same species (called *Asclepias curassavica*), their leaves and flowers have the same shape.
   How do both plants differentiate?
   Answer: They differentiate in that one produces red flowers and the other one produces yellow flowers.
10. Reflect with students about the differences between organisms of the same species: Organisms of the same species share traits that distinguish them as a species, but we have seen that among the same species some differences can be found. For example, in the coloration and shape of some parts of the organisms. When this happens, we say that there is morphological diversity. This means that there are differences or variety among the same

species, but that they share common traits that let those organisms reproduce and have offspring.

11. Once **Worksheet # 1** is discussed, the teacher reflects with the students. Today we learned that many species of organisms exist, whether they are plants or animals. Each **species** has organisms that share traits that distinguish them from other species. The teacher may show the images of various butterflies or Monarch Butterfly host plants (*PowerPoint*). This permits us to have abundant **biodiversity**. The word **biodiversity** means that we have a great variety of organisms on our planet. Each one of these organisms have some traits that distinguish them and that lets them live in a place or environment. It can also be explained that **bio** means life and **diversity** means variety.

CLOSURE

1. Carry out the activity *Making Faces*. See instructions on **Worksheet #2**.
2. To finalize the lesson, the teacher will ask the following question: What can we do to protect and help various species of organisms that live on our planet?
   Expected answers: Take care of them, feed them, sow plants, protect their homes, etc.

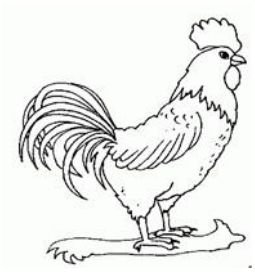
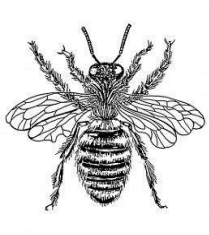
   Note: This question allows the students to show appreciation for biodiversity existing in our planet and at the same time it links with the following topic: adaptations (since organisms have survived during time, at any given moment, they have had to adapt to the loss of food, habitat, etc.)

Materials:

Crayons or colored pencils

In each row, color the organisms that share similar traits to belong in the same species.

1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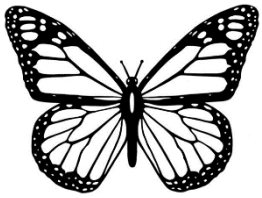



3




4


Answer:

1. **Why do you say that the organisms that you colored in each row belong to the same species?**

_____

_____

_____

_____

Materials:

Pencils and Crayons

Look at both drawings and answer:

1. How are both drawings similar?

Both are _____.

2. How are both drawings different?

This  is a _____.

This  is a _____.

3. Do these organisms belong to the same species? Explain.

_____

_____

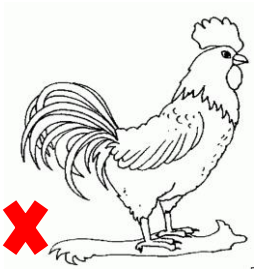
Materials:

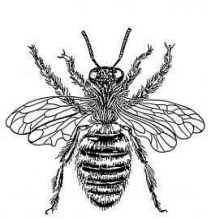
Crayons or colored pencils

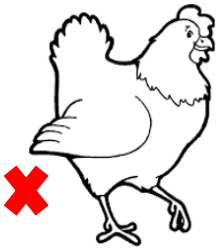
In each row, color the organisms that share similar traits to belong in the same species.

KEY

1







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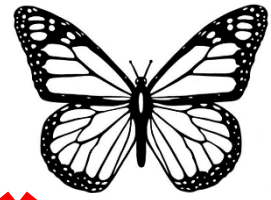


Female Monarch

Male Monarch

3

4

Answer:

1. **Why do you say that the organisms that you colored in each row belong to the same species?**

These organisms belong to the same species because they share traits that allow them to cross and have offspring, although some show morphological differences.

Note: In case there are students that cannot read or write, the teacher may read instructions or questions and the student may give the answers orally.

Lesson #1: How are we alike? How are we different? **Worksheet # 2**

Materials:

Pencils and Crayons

Look at both drawings and answer:

1. How are both drawings similar?

Both are butterflies: they have wings and antennae.

2. How are both drawings different?

This  is a female Monarch. It does not have dots in its wings.

This  is a male Monarch. It has black dots in its wings.

3. Do these organisms belong to the same species? Explain.

Yes. Although they have different spots in their wings, they share traits that allow them to cross and have offspring.

Closure: Making Faces **Worksheet # 2**

Materials:

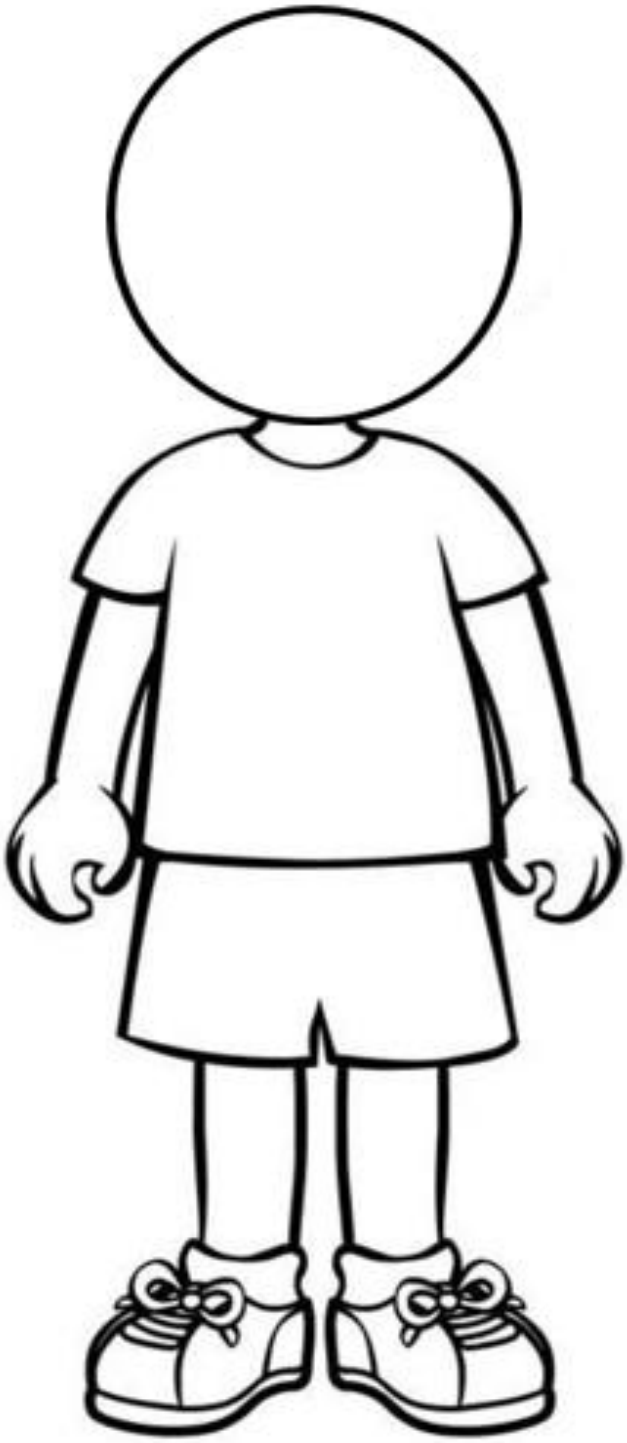
1. Crayons
2. Glue
3. Scissors

Procedure:

1. Indicate the students that during this activity they may draw the face of a girl or boy. Another option is that they could cut the drawings that appear in the worksheet to make the face.
2. Once the students finish their silhouette's face, the teacher will ask girls to show the faces to the rest of the group. Then, the same will be asked to boys.
3. Ask the students: Do the faces that you have prepared for the girl or boy silhouette have common traits?
   Expected answer: Yes, they have two eyes, hair, mouth, two ears, and a nose.
4. Then, are all faces equal?
   Expected answer: No.
5. How are the faces different?
   Expected answer: Some faces have eyes with different colors, their noses and eyes have different shapes, some have short hair, some have long hair, etc.
6. The teacher reflects with the students: We have mentioned that organisms of the same species share traits that distinguish them from other species. We have also learned that organisms of the same species may present differences in the color or shape of their body, in other words, that they show morphological differences.
7. The boys and girls whose faces you have prepared during the activity, do they belong to the same species? Expected answer: Yes, boys and girls belong to the same species, but we have traits that make us different.
8. Remember: organisms from each species have traits that distinguish them from other species. For this reason, the needs of each species also vary.

Name: _____

Complete the face of the boy. Draw or cut and paste the eyes, eyebrows, nose, mouth, ears, and hair. Color the clothes and shoes of the boy.

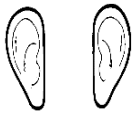


Cut the eyes, nose, mouth, hair, and ears to make the face of a boy.



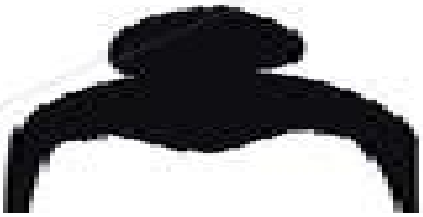






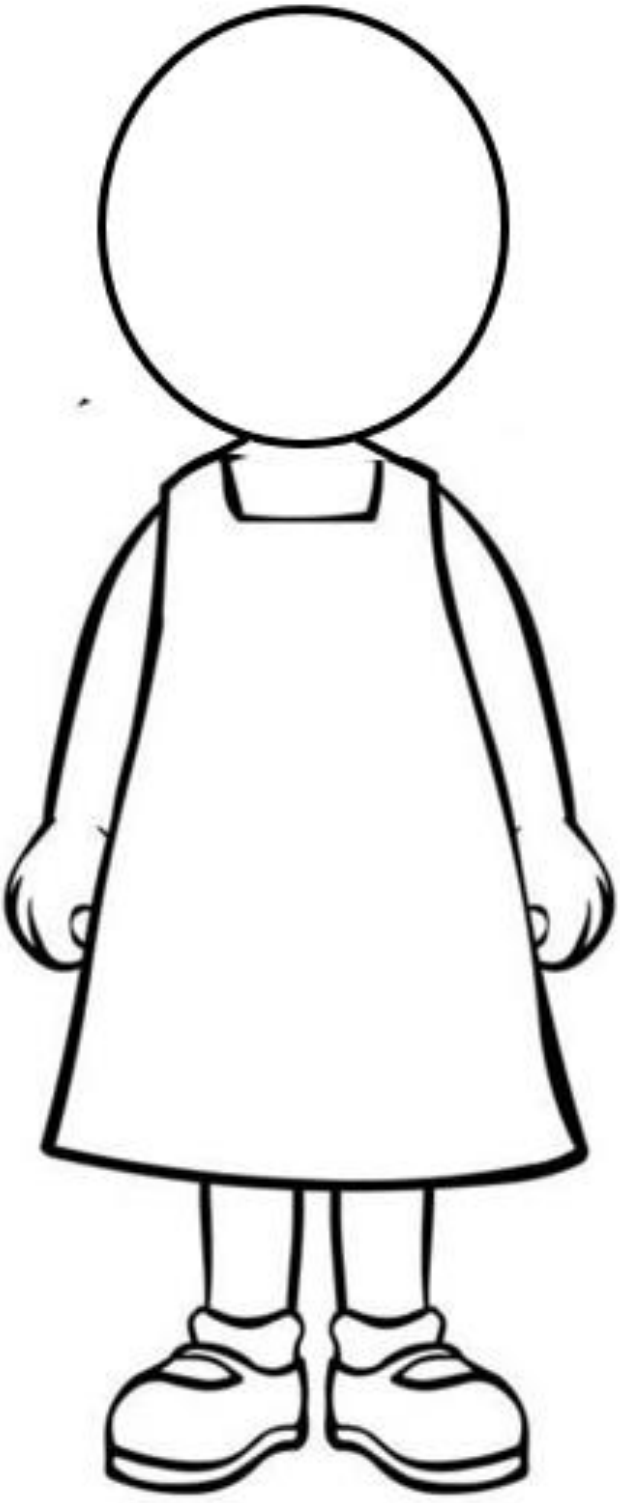


Closure: Making faces **Worksheet # 2**

Name: _____

Complete the face of the girl. Draw or cut and paste the eyes, eyebrows, nose, mouth, ears, and hair. Color the clothes and shoes of the girl.



Cut the eyes, nose, mouth, hair, and ears to make the face of a girl.