

Handout 1: Unit Overview

One of the most important tools that artists and designers use to give their characters a particular “look” or personality is proportion. For example, the relative sizes of a character’s head, torso, and leg and arm lengths are all designed to give an overall effect to a character’s appearance.

The relationships between the sizes of one body part and another can be expressed mathematically by using ratios.

Your work in this unit will revolve around the following questions:

- *How can body and facial proportions be expressed mathematically using fractions, ratios, and percentages?*
- *What kinds of information do facial and body proportions convey about a character?*
- *How can changes in facial and body proportions affect the audience’s perception of a character’s personality?*
- *How can artists design facial and body proportions to convey particular characteristics of a character?*

What You Will Do in This Unit

Examine the proportions of an ideal human body. Then, measure the body features of actual humans and animated characters, and calculate their body and facial proportions.

Look at the head-to-body and facial feature ratios of a variety of humans and animated characters. Analyze how differing ratios affect the perceptions of an animated character’s appearance and personality.

Experiment with changing body and facial feature ratios. Use scale factors to change ratios, and discuss how the changes affect a character’s appearance.

Design an animated character. Specify ratios for your character’s body and facial features that express your character’s personality, and then draw the character.

Unit Project

You will invent and design your own animated character, using what you’ve learned about calculating head-to-body and facial feature ratios, and about the effect that different proportions have on the way a character is perceived. You will describe your character, specify ratios to give your character the desired appearance, and then create your character, using your specified ratios.

Vocabulary Used in This Unit

Proportion: A statement of equality between two ratios, expressed in the form $\frac{a}{b} = \frac{c}{d}$. For example,

$$\frac{1}{3} = \frac{3}{9}.$$

Ratio: A numeric relationship between two things (in this unit, between linear measures). Ratios can be expressed in a variety of forms, including "a to b," "a:b," and $\frac{a}{b}$.

Scale factor: The ratio of the measures of corresponding parts of two similar figures.

Assessment Checklist: Character Design

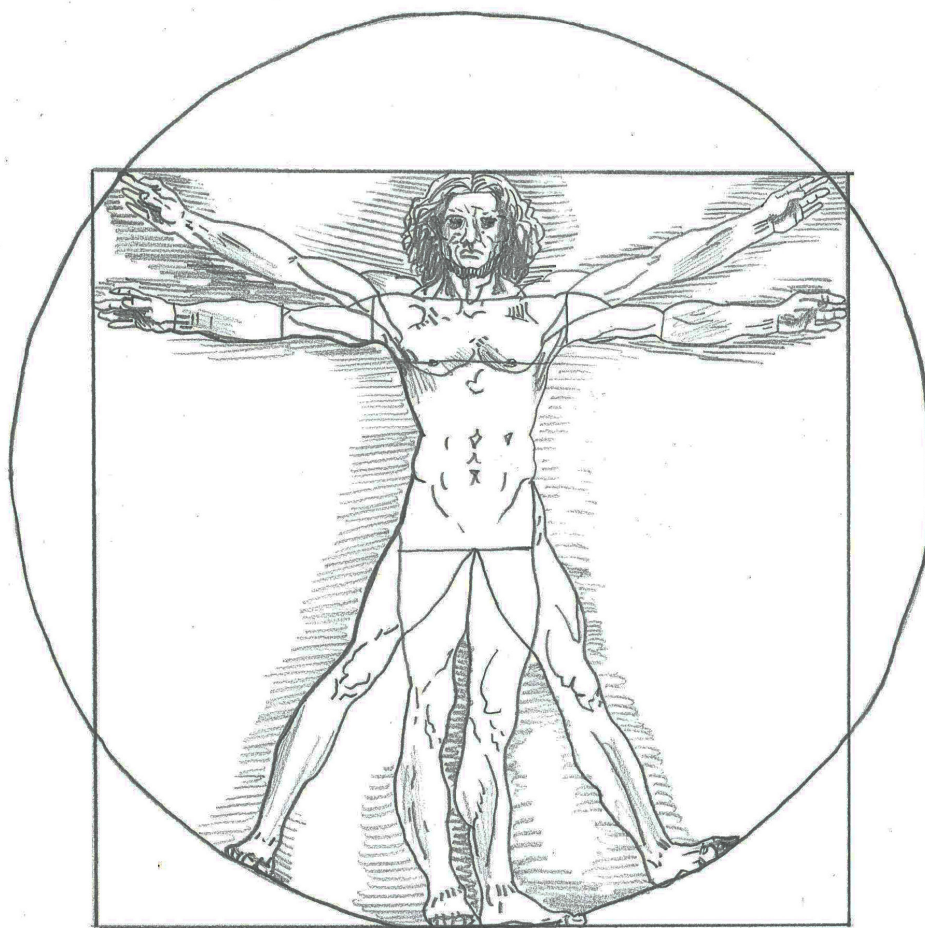
Use this assessment to help you design your character. Make sure to include all the requirements. Your teacher will use this assessment to evaluate your work.

Requirements	Percentage of Total Grade	Comments	
Character Design		Student Comments	Teacher Comments
Complete description of the character's qualities is provided.	10%		
Head : height ratio and facial proportions are specified.	10%		
Rationale convincingly explains why these proportions were chosen to express this character's characteristics.	10%		
Character has specified head : height proportion.	10%		
Character has specified eye, nose, and mouth position ratios.	30%		
Character has specified eye, nose, and mouth size ratios.	30%		
Total	100%		

Handout 2: Vitruvian Man Proportions

Artists who render the human form must have an understanding of human anatomy and proportion. Leonardo da Vinci's study of human anatomy and proportion informed his work as an engineer and architect, as well as his painting.

In 1490, Leonardo da Vinci drew and described the ideal body proportions of the human male as recorded by the Roman architect Vitruvius, who used proportional human figures in his architectural designs.



Silhouette of Leonardo da Vinci's drawing of Vitruvian man.

Da Vinci described the body ratios that Vitruvius used:

- A palm is the width of four fingers
- A cubit is the width of six palms
- A man's height is four cubits
- The distance from the top of the head to the bottom of the chin is one-eighth of a man's height

Use the information above to fill in the ratios on the table of Vitruvian Man proportions:

	1 finger	1 palm	1 head	1 cubit	1 height
Fingers					
Palms					
Heads					
Cubits					
Heights					

Handout 3: Calculating Vitruvian Man Measurements

Leonardo da Vinci does not give actual measurements for Vitruvian Man. So, what would be the measurements in inches and feet of someone who has Vitruvian proportions?

Find the measurements of five different-sized individuals whose bodies have the same proportions as Vitruvian Man. The table below gives one measurement for each individual.

Use the Vitruvian proportions from your work on Handout 2 to help you calculate the missing measurements for each individual.

	finger	palm	head	cubit	height
Individual A	$\frac{1}{2}$ "				
Individual B		$2\frac{1}{2}$ "			
Individual C			16"		
Individual D				21"	
Individual E					36"

Handout 4:

Human Head : Height Ratios

The three people in the image on this handout have different body proportions. Follow these steps to find the head : height ratio of each person:

- Line up the zero mark of a ruler with the top of the person's head (not including the hair).
- Look at the person's feet and decide which heel supports the person's body weight. (If the heel is not visible, make your best guess as to its location.)
- Line up the other end of the ruler with the heel supporting the body weight.
- Record the measurement in millimeters at the bottom of the person's chin to determine the measurement of the head.
- Record the measurement in millimeters at the person's heel to determine the person's height.
- Record the head : height ratio.
- Write the head : height ratio in the standard ratio form 1:x.



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Handout 5: Journal Assignment

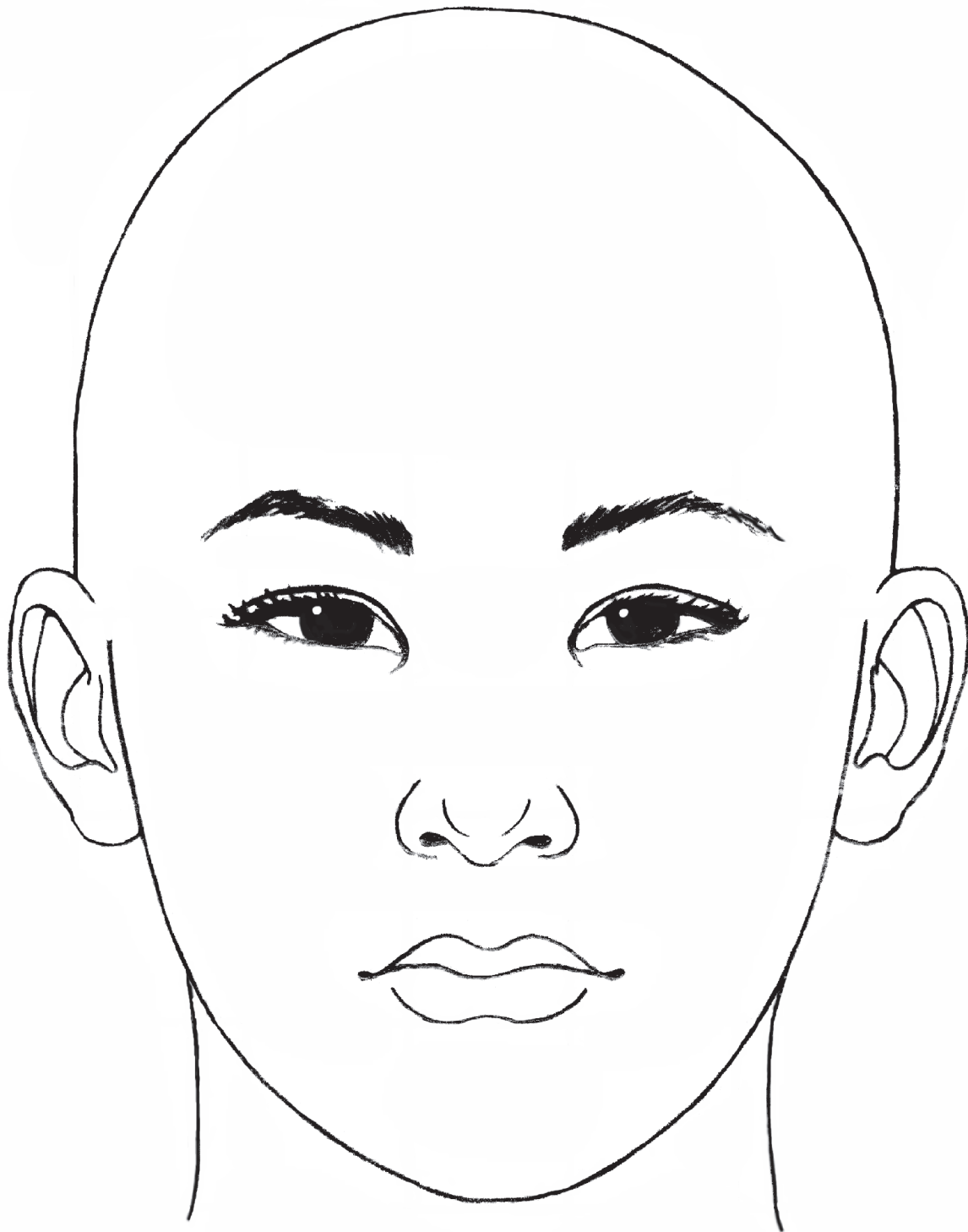
Complete the following journal assignment when you are instructed to do so by your teacher.

Journal 1

Follow these steps to calculate the head : height ratio of the person or character your teacher gave you:

- Measure the character's head height.
- Measure the character's height.
- Calculate the head : height ratio.
- Express the head : height ratio in the standard ratio form 1:x.

Handout 6: Human Face Drawing



Drawing courtesy of Brenda Hoddinott, <http://drawspace.com>

Handout 7: Facial Proportion Worksheet

Your teacher will assign you an image of a human or animated character. Measure the human's or animated character's facial features, and record your measurements in the table below. Make all measurements to the nearest millimeter.

When you have all the measurements, calculate the position ratio and width ratio for each facial feature. Express each ratio in the standard form 1:x, and record it in the table below.

Human's or character's name (if given): _____

Human's or character's head height: _____

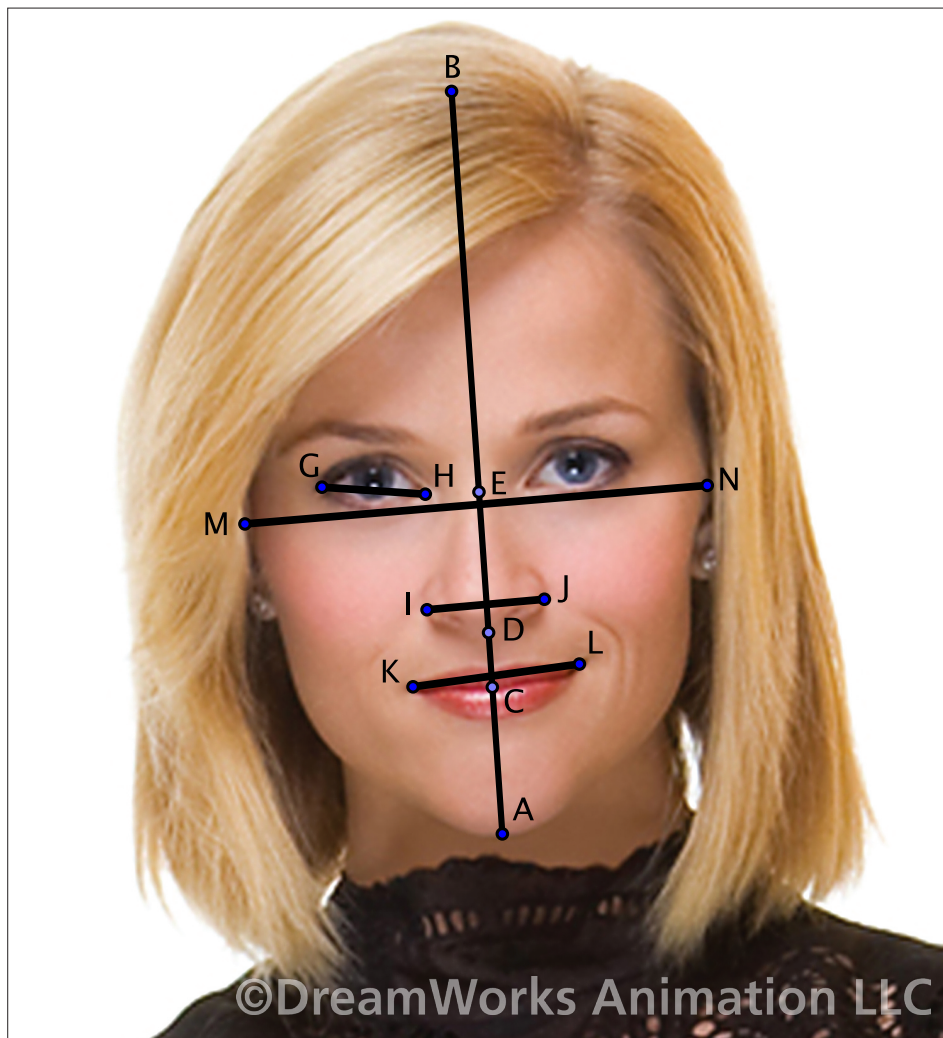
	Measurement (from chin to facial feature)	Position ratio (ratio of feature's distance from chin to head height)
Eye position		
Nose position		
Mouth position		

Human's or character's head width: _____

	Measurement (width of facial feature)	Width ratio (ratio of feature's width to head width)
Eye width		
Nose width		
Mouth width		

Handout 8: Sample Facial Proportion Ratios

You can use this handout for reference as you complete **Handout 7: Facial Proportion Worksheet**, measuring the facial features and calculating the position and width ratios for your assigned image.



eye position
 $AE / AB = 1:2.2$

nose position
 $AD / AB = 1:3.6$

mouth position
 $AC / AB = 1:5.2$

eye width
 $GH / MN = 1:4.4$

nose width
 $IJ / MN = 1:3.9$

mouth width
 $KL / MN = 1:2.7$

Reese Witherspoon, voice of Susan/Ginormica in *Monsters vs Aliens*.
Image courtesy of DreamWorks LLC.

Head height: 98 mm

	Measurement (from chin to facial feature)	Position ratio (ratio of feature's distance from chin to head height)
Eye position	45 mm	1:2.2
Nose position	27 mm	1:3.6
Mouth position	19 mm	1:5.2

Sample Calculation:

Eye Position: $\frac{45}{98} = \frac{1}{x}$

$$45x = 98$$

$$x = \frac{98}{45} \approx 2.2$$

Eye Position Ratio: 1:2.2Head width: 62 mm

	Measurement (width of facial feature)	Width ratio (ratio of feature's width to head width)
Eye width	14 mm	1:4.4
Nose width	16 mm	1:3.9
Mouth width	23 mm	1:2.7

Sample Calculations:

Eye Width: $\frac{14}{62} = \frac{1}{x}$

$$14x = 62$$

$$x = \frac{62}{14} \approx 4.4$$

Eye Width Ratio: 1:4.4

Handout 9: Facial Proportions Table

Fill in the table below with the data that you and your classmates found.

	Position Ratios			Width Ratios		
	Eye position	Nose position	Mouth position	Eye width	Nose width	Mouth width
Humans						
Woman						
Will Arnett						
Baby						
Animated Characters						
<i>Dr. Cockroach</i>						
<i>General Monger</i>						
<i>President Hathaway</i>						
<i>Missing Link</i>						
<i>Po</i>						
<i>Ginormica</i>						

Handout 10: Ratio Transformation Worksheet

Head Transformation

Transform the size of a character's head in relation to its body.

First, pick a character on whom you will transform the head : height ratio.

Next, change the character's head : height ratio. Use a specific ratio from 1:2 to 1:10 that you think will have an interesting effect on the character's appearance.

Character's name: _____

Character's height: _____

	Original measurement of head height	Original head : height ratio	New head : height ratio	Scale factor	New measurement of head height
Head height					

Facial Feature Size Transformation

Transform the size and position of the facial features of the figure on Handout 11 by changing the ratio of each facial feature. For each feature, use a new ratio that you think will have an interesting effect on the figure's appearance.

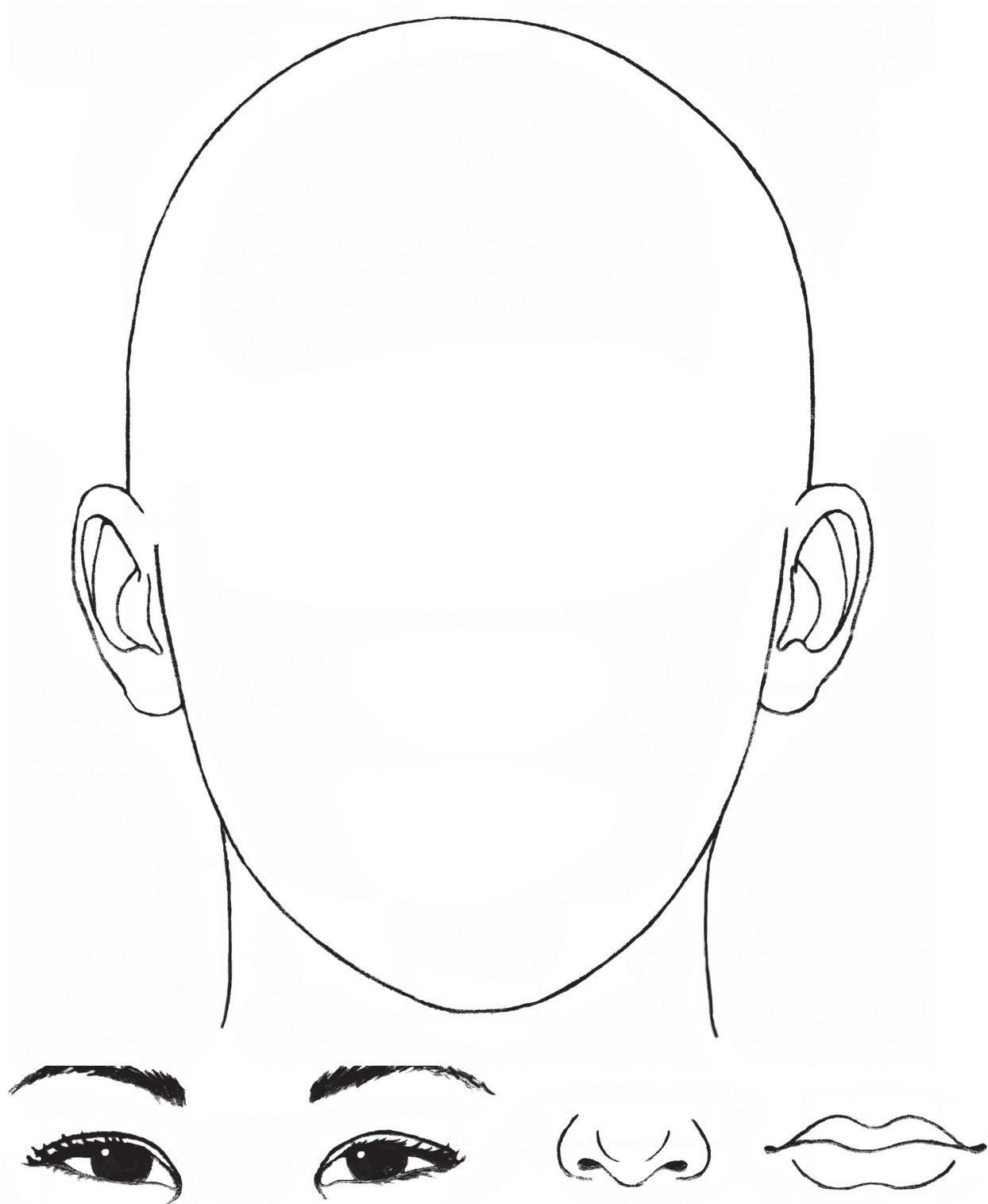
Figure's head width: _____

	Original measurement	Original ratio	New ratio	Scale factor	New measurement
Nose width					
Mouth width					
Eye width					

Figure's head length: _____

	Original measurement (from chin to facial feature)	Original ratio	New ratio	Scale factor	New measurement (from chin to facial feature)
Nose position					
Mouth position					
Eye position					

Handout 11: Face and Features



Drawing courtesy of Brenda Hoddinott, <http://drawspace.com>

Handout 12: Character Design Worksheet

Type of character (human, animal, superhero, etc.):

Approximate age (young, teen, adult, senior):

Gender:

Personality:

Other visual characteristics (such as jewelry or clothing):

Head : height ratio: _____

Facial proportions:

	Position ratio	Width ratio
Eyes		
Nose		
Mouth		

What these proportions will convey about this character:

Appendix A: Head : Height Proportion Images



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Ginormica from *Monsters vs. Aliens*. Image courtesy of DreamWorks LLC.



©DreamWorks Animation LLC

President Hathaway from *Monsters vs Aliens*. Image courtesy of DreamWorks LLC.



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General Monger from *Monsters vs Aliens*. Image courtesy of DreamWorks LLC.



Dr. Cockroach from *Monsters vs Aliens*. Image courtesy of DreamWorks LLC.



Insectosaurus from *Monsters vs. Aliens*. Image courtesy of DreamWorks LLC.



Gallaxhar from *Monsters vs. Aliens*. Image courtesy of DreamWorks LLC.



The Missing Link from *Monsters vs Aliens*. Image courtesy of DreamWorks LLC.



Po from *Kung Fu Panda*. Image courtesy of DreamWorks LLC.



Shifu from *Kung Fu Panda*. Image courtesy of DreamWorks LLC.



Tigress from *Kung Fu Panda*. Image courtesy of DreamWorks LLC.

Appendix C: Facial Proportion Images



Photo courtesy of Aurora Kurland



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Will Arnett, the voice of The Missing Link from *Monsters vs Aliens*. Image courtesy of DreamWorks LLC.



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Dr. Cockroach from *Monsters vs Aliens*. Image courtesy of DreamWorks LLC.



General Monger from *Monsters vs Aliens*. Image courtesy of DreamWorks LLC.



President Hathaway from *Monsters vs Aliens*. Image courtesy of DreamWorks LLC.



The Missing Link from *Monsters vs Aliens*. Image courtesy of DreamWorks LLC.



Po from *Kung Fu Panda*. Image courtesy of DreamWorks LLC.



Ginormica from *Monsters vs Aliens*. Image courtesy of DreamWorks LLC.